CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

FOR

DAWSON FOREST WRF SLUDGE DEWATERING UPGRADES

FOR

ETOWAH WATER & SEWER AUTHORITY
DAWSON COUNTY, GEORGIA



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WIEDEMAN AND SINGLETON, INC. CIVIL AND ENVIRONMENTAL ENGINEERS NORCROSS, GEORGIA



Bid Ready Set - February 26, 2020



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DOCUMENT 00 11 16

INVITATION TO BID

Project: DAWSON FOREST WRF SLUDGE DEWATERING UPGRADES

Owner: ETOWAH WATER & SEWER AUTHORITY, DAWSONVILLE, GEORGIA

Engineer: WIEDEMAN AND SINGLETON, INC.

3091 GOVERNORS LAKE DRIVE, SUITE 430

NORCROSS, GEORGIA 30071

SEPARATE SEALED BIDS for furnishing all materials and providing all labor, tools, and equipment will be received by the Owner at the Etowah Water & Sewer Authority Administration Office, 1162 Highway 53 East, Dawsonville, Georgia 30534, until 10:00 a.m., local time, on Tuesday, April 7th, 2020. The Bidder shall provide on the outside of a sealed envelope the Bidder's name and utility contractor license number. Any bid submitted which does not contain the above information will not be opened and will be returned to the bidder. The Bids will be publicly opened and read aloud at 10:10 a.m., local time, on said date in the Etowah Water & Sewer Authority Administrative Office Don D. Gordon Conference Room, 1162 Highway 53 East, Dawsonville, Georgia 30534. It is the responsibility of the person/firm submitting a Bid to ensure that it is received at the physical address of the Authority prior to the stated deadline. A date/time stamp located at the desk of Mrs. Sophia Dearwent, at the Administrative Office of the Authority will determine the time of receipt. Bids received after the deadline will not be considered under any circumstances and will be returned unopened after the Bid is made. Unsealed Bids, including facsimile Bids, will not be considered.

THE PROJECT consists of furnishing all materials and equipment and performing all labor necessary to construct a new Solids Dewatering Building at the Authority's Dawson Forest Water Reclamation Facility, and to install a new 2.2-meter belt press and related equipment and appurtenances as detailed in the specifications and as shown on the contract drawings.

THE WORK will be awarded in one Contract.

<u>PRE-QUALIFICATION OF BIDDERS</u> has been performed. <u>Only Bids submitted by properly prequalified Bidders will be opened.</u>

COURIER DELIVERY & POSTAL SERVICE DELIVERY

Etowah Water & Sewer Authority Administrative Office 1162 Highway 53 East Dawsonville, GA 30534

COPIES OF Contract Documents will be available electronically free of charge or they may be obtained, on or after, Wednesday, March 4th, 2020 at the Etowah Water & Sewer Authority Administrative Office, 1162 Highway 53 East, Dawsonville, Georgia 30534. The cost for said contract documents is \$100.00, non-refundable, per set. All checks should be made to Etowah Water & Sewer Authority. Street address, phone, fax number of your company and a FedEx account number must be provided to ensure prompt delivery.

<u>PRE-BID CONFERENCE</u> A Mandatory Pre-Bid Conference will be held for all Bidders on <u>Tuesday</u>, <u>March 24th, 2020</u> at 10:00 a.m. in the Etowah Water & Sewer Authority Administrative Office Don D.

INVITATION TO BID

Gordon Conference Room, 1162 Highway 53 East, Dawsonville, Georgia, 30534. Only bidders in attendance for the entire meeting will be allowed to bid the project.

<u>PRE-CONSTRUCTION CONFERENCE</u> A Pre-Construction Conference will be scheduled with the successful bidder prior to issuance of the Notice to Proceed.

<u>A BID BOND</u> in the amount of five percent (5%) of the total base bid shall accompany each bid submitted. The Bid Bond shall be prepared on the Bid Bond form attached to the Contract Documents or a Surety Company's Standard Bid Bond, duly executed by the Bidder as principal and having as surety thereon a surety company licensed to do business in the State of Georgia and listed in the latest issue of U.S. Treasury Circular 570.

<u>THE SUCCESSFUL</u> Bidder for this Contract will be required to furnish a satisfactory Performance Bond and Payment Bond each in the amount of 100 percent of the Bid.

THE OWNER reserves the right to reject any or all Bids, to waive informalities and to re-advertise.

<u>CLARIFICATIONS</u> Any explanation desired by Bidder regarding the meaning or interpretation of this Invitation to Bid shall be requested in writing by <u>Wednesday</u>, <u>April 1st</u>, <u>2020</u> at 10:00 a.m. All inquiries shall be directed to Tim Collins, Assistant General Manager, email: time@etowahwater.org. Any information given to a prospective Bidder concerning this Invitation to Bid shall be furnished to all known prospective Bidders as an amendment to this Invitation to Bid. Oral explanations or instructions given prior to award are not binding.

<u>ACKNOWLEDGEMENT OF AMENDMENTS</u> Receipt of any amendment to this Invitation to Bid shall be acknowledged, in writing, and shall be submitted with the Bid.

<u>TAXES</u> The CONTRACTOR shall pay all sales, consumer, use and other similar taxes required by the law of the place where the WORK is performed.

PUBLIC RECORDS Any information contained in this bid is subject to public disclosure.

Etowah Water & Sewer Authority is an equal opportunity owner/employer and will not discriminate against any Proposer because of race, creed, color, religion, sex, national origin, or ADA disability status.

All documents are an essential part of this Invitation to Bid. It is the Bidder's responsibility to verify that all documents are contained in the package received from the Authority. If any documents are missing, contact Sophia Dearwent @ 706.216.8474, email: sophiad@etowahwater.org.

PROJECT CONTACT: The project manager for this project is Tim Collins, phone: 706.968.6359 or email: timc@etowahwater.org, with Etowah Water & Sewer Authority.

ETOWAH WATER & SEWER AUTHORITY

Brooke Anderson, P.E General Manager

DOCUMENT 00 21 13

INSTRUCTIONS TO BIDDERS

CONTRACT DOCUMENTS

The Contract Documents include the Contract Agreement, Invitation to Bid, Bid Award, Bid Form, Instructions to Bidders, General Conditions, Supplementary Conditions, Special Conditions, (including all documentation accompanying the Bid and any post-bid documentation required by the Owner prior to the Notice of Award), Bonds, Specifications, Drawings, and addenda, together with written amendments, Change Orders, Field Orders and the Owner's written interpretations and clarifications issued on or after the date of the Contract Agreement. Shop Drawing submittals reviewed in accordance with the General Conditions, geotechnical investigations and soil reports and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site, are not Contract Documents.

The Contract Documents define and describe the Work.

PREPARATIONS AND EXECUTION OF BID

A. Each Bid shall:

- 1. Be prepared to represent that it is based solely upon the materials and equipment specified in the Contract Documents.
- 2. Be submitted on the Bid Form. All blank spaces for proposed prices, both words and figures, must be filled in, in ink. In case of discrepancy, the amount shown *in words* will govern.
- 3. Be received by Owner prior to the date and time of bid opening as stated in the Invitation to Bid. Any Bid received after that time shall not be opened and shall be returned to the Bidder.
- 4. Be submitted in a sealed envelope addressed to the Owner as shown below:

For hand carried Bids or Bids submitted via US Postal Service OR private couriers such as UPS or Federal Express:

Name of Bidder Address City, State Zip

Etowah Water & Sewer Authority
Engineering and Construction Department
1162 Highway 53 East
Dawsonville, Georgia 30534
Attention: Mrs. Sophia Dearwent

All license numbers applicable to project go here.

Name of Project

** No bids will be accepted via email or facsimile transmittal. **

- B. A detailed description of work to be performed is required to be available upon request.
- C. No change to the language of the bid documents is permissible.
- D. Bids not meeting all criteria for Bid submittal may be declared non-responsive, and subsequently returned to the Bidder.

- E. Only Bids submitted by properly pre-qualified bidders will be opened. A mandatory pre-bid conference will be held for all prospective Bidders on <u>Tuesday</u>, <u>March 24th</u>, <u>2020</u> at 10:00 a.m. in the Etowah Water & Sewer Authority Administration Building Don D. Gordon Conference Room at 1162 Highway 53 East, Dawsonville, Georgia. A Bid submitted by a Bidder that did not attend the entire Pre-Bid conference will not be opened.
- F. The Bidder in signing a Bid on the whole or any portion of the Project, shall conform to the following requirements:
 - 1. Bids that are not signed by individuals making them shall have attached thereto a power of attorney evidencing authority to sign the Bid in the name of the person for whom it is signed.
 - 2. Bids that are signed for a partnership shall be signed by all of the partners or by an attorney-in-fact. If a Bid is signed by an attorney-in-fact, there should be attached to the Bid a power of attorney executed by the partners evidencing authority to sign the Bid.
 - 3. Bids that are signed for a corporation shall have the correct corporate name thereof and the signature of the president or other authorized officer of the corporation manually written below the corporate name following the wording "By _______". Corporation seal shall also be affixed to the Bid.
- G. Complete, execute and submit the following documents, which are attached to these Contract Documents:
 - a. 00 41 13 Bid Form
 - b. 00 43 13 Bid Bond Form
 - c. 00 45 00.01 Drug-Free Workplace Certificate
 - d. 00 45 19 Non-Collusion Affidavit of Prime Bidder
 - e. 00 45 19.01 Non-Collusion Affidavit of Sub-Contractor
 - f. 00 45 20 Contractor's License Certification
 - g. 00 45 43 Corporate Certificate, if applicable
 - h. 00 45 46.16 Vendor Affidavit and Agreement (GA Security and Immigration Compliance Act)

These documents must be submitted in the sealed envelope as specified in paragraph A.4 above.

- H. Eligible Bidders are limited solely to companies who have a proven record of quality work in the fields specified for this Project. Further qualifications required are found in the Contract Documents.
- I. All submissions become property of the Owner and may be retained by the Owner.
- J. All costs associated with the submission preparation will be borne by the submitting company.

METHOD OF BIDDING

The unit or lump sum price for each of the items in the Bid includes its pro rata share of overhead and profit so that the sum of the products, obtained by multiplying the quantity shown for each item by the unit price, represents the total amount bid for a particular item. Any Bid not conforming to this requirement is subject to rejection. This includes Bids, which in the opinion of the Owner, are unbalanced. Conditional Bids will not be accepted. Should unit quantities be revised, no limit will be fixed for such increased or decreased quantities, nor extra compensation allowed.

ADDENDA AND INTERPRETATIONS

No interpretation of the meaning of the Drawings, Specifications or other pre-bid documents will be made to any Bidder orally. Every request for such interpretation should either be made in writing and addressed to Etowah Water & Sewer Authority, Attention: Tim Collins, Assistant General Manager, 1162 Highway

53 East, Dawsonville, GA 30534, or emailed to <u>time@etowahwater.org</u>., and, to be given consideration, must be received at least five (5) business days prior to the date fixed for opening Bids. Interpretations and supplemental instructions will be issued in the form of written Addenda to the Contract Documents and will be mailed to all prospective Bidders at the addresses furnished by the Bidders and recorded by the Owner as having received the bid documents prior to the date fixed for the opening of Bids. It is the responsibility of the Bidder to insure and verify the Owner receives any submitted request.

Failure of Bidders to receive or acknowledge any Addendum shall not relieve them of any obligations under the Bid. Addenda become part of the Contract Documents.

BID MODIFICATION AND WITHDRAWAL

Bids may be modified or withdrawn by an appropriate document duly executed, as defined in this Section and delivered to the Owner, any time prior to the Bid opening.

BID SECURITY

- A. Each Bid must be accompanied by a Certified Check, Bank Cashier's Check, or Bid Bond in the amount of five percent (5%) of the bid. Bid Bonds must be prepared on Section 00 43 13 Bid Bond Form included herein or a Surety Company's Standard Bid Bond Form, duly executed by the Bidder as Principal and having as surety thereon a Surety Company <u>authorized to transact business in the State of Georgia</u> and listed in the latest issue of U.S. Treasury Circular 570. Attorney-in-fact signing the Bid Bond must file with each bond a currently dated copy of their Power of Attorney.
- B. If the successful Bidder withdraws from the competition after opening of the Bids, or if the Bidder refuses to execute and deliver the Contract and Bonds required within ten (10) days after receipt of notice of the acceptance of Bid, the Owner may proceed to enforce the provisions of the Bid Bond.

RECEIPT AND OPENING OF BIDS

The Owner reserves the right to reject any and all Bids and to waive minor irregularities in Bids received, whenever such rejection or waiver is in the Owner's interest. The Owner also reserves the right to disregard all non-conforming, conditional, or unbalanced Bids or counterbids. Bids received after the time and date specified shall not be opened.

SUBCONTRACTS

The Bidder is specifically advised that any person, firm, or other party to whom it is proposed to award a subcontract under this Contract must be acceptable to the Owner.

CONDITIONS OF THE PROJECT

- A. Each Bidder shall be informed fully of the conditions relating to the construction of the Project and the employment of labor thereon. Failure to do so will not relieve a successful Bidder of the obligation to furnish all material and labor necessary to carry out the provisions of the Contract. Insofar as possible, the Bidder will employ means or methods to limit the interruption of or interference with the normal use and operation of the Owner's facilities.
- B. Before submitting his Bid, each Bidder shall:
 - 1. Examine the Bid Documents, Specifications and/or Drawings.
 - 2. Visit the site(s) where the work shall be performed to familiarize himself with the Work and local conditions that may in any manner affect the performance of the Work.

The Bidder shall notify the Owner of the date and time Bidder proposes to examine the location(s) of the Project. The Bidder shall confine examination to the specific areas designated for the proposed construction, including easements and public rights-of-way. If Owner's proceedings for obtaining the proposed construction site, including easements, have not been completed, the Bidder may enter the site only with the express consent of the property owner. The Bidder is solely responsible for damages caused by his examinations of the site.

- 3. Familiarize himself with federal, state, and local laws, ordinances, rules and regulations affecting the performance of the Work.
- 4. Carefully correlate his observations with the requirements of the Bid Documents, Specifications, and/or Drawings.
- C. The Bidder shall employ personnel to see that the Work is carried out in a professional manner and that all communications with the public are handled with courtesy and understanding at all times.
- D. Insofar as possible, the Bidder shall employ means and methods to limit interruption of or interference with the work of any other Contractor.
- E. Failure to comply with the foregoing conditions, including examination of the site(s), will not relieve the successful Bidder of an obligation to furnish all products and labor necessary to carry out the provisions of the Contract.

NOTICE OF SPECIAL CONDITIONS

If any special federal, state, county or city laws, municipal ordinances, and the rules and regulations of any authorities having jurisdiction over construction of the Project, enclosed, herein referred to, or applicable by law to the Project, conflict with requirements of the Contract Documents, then the most stringent requirement prevails.

OBLIGATION OF BIDDER

By submission of a Bid, each Bidder warrants that he has inspected the site(s) and has read and is thoroughly familiar with the Contract Documents (including all addenda). The failure or omission of any Bidder to examine any form, instrument, or document shall in no way relieve him from any obligation in respect to the Bid.

METHOD OF AWARD

- A. The Contract will be awarded to the Responsive and Responsible Bidder submitting the lowest Bid complying with the conditions of the Contract Documents. Award will be made on the basis of the prices given in the base Bid, and any alternates. The lowest Bid will be determined by the Owner and may include any combination of, or none of, the alternates in addition to the base Bid. Alternates may be awarded at the discretion of the Owner within ninety (90) days of the Notice to Proceed.
- B. The Owner reserves the right to reject any and all Bids and to waive any minor irregularities in Bids received whenever such rejection or waiver is in the Owner's interest. The Owner also reserves the right to disregard all non-conforming or conditional Bids or counterbids.
- C. A Responsive Bidder submits a Bid in the proper form without qualification or intent other than as called for in the Contract Documents, binds himself on behalf of the Bid to the Owner with the proper Bid Bond completed and attached, and properly completes all forms required to be completed and submitted at the time of the Bid. The Bidder furnishes all data required by these Contract Documents. Failure to do so may result in the Bid being declared non-responsive. No changes to the Contract Documents are permitted. Should the low Bidder insist on changes, that Bidder will be disqualified from being awarded the Contract.

- D. Acceptance of the Bidder's documentation and substantiation or Contract Award by the Owner does not relieve the Bidder of liability for non-performance as covered in the Contract Documents, nor will the Bidder be exempted from any other legal recourse the Owner may elect to pursue.
- E. A Responsible Bidder shall be one who properly submits all information as requested within the Contract Documents, specifically on the 'Statement of Bidder's Qualifications', and has been determined qualified by the Owner.

EMPLOYMENT OF LOCAL LABOR

Preference in employment on the Project shall, insofar as practical, be given to qualified local labor. If requested, the Bidder will provide the anticipated percentage of local labor they will use during construction of the Project in their response to this Bid.

OWNER'S OPTIONS TO PURCHASE MATERIALS

- A. By submitting a Bid, the Bidder agrees to allow the Owner to purchase certain materials for this Project at the price quoted to Bidder by its supplier. The Bidder further agrees to execute a Change Order at the time of execution of the Contract Agreement to adjust the appropriate unit prices or extended totals and total Contract amount. The amount of the Change Order will be based on deducting from the prices bid the sum of:
 - 1. The cost of the materials;
 - 2. Shipping costs based on freight-on-board (FOB) job site; and
 - 3. Sales tax in the amount of seven percent (7%) of the sum of the two preceding items.
- B. By virtue of a Bidder utilizing quotes from suppliers in the preparation of its Bid for this Project, the Bidder declares that he has reached an agreement with his potential suppliers to allow the Owner to purchase the materials for this Project from the suppliers in accordance with the terms and conditions included herein. It is further agreed to by the supplier, that the quantities for this Project are subject to increase or decrease, with no limit. The supplier also agrees that the quoted prices will be valid for the entire Contract Time as bid, plus ninety (90) days.
- C. The apparent low Bidder's supplier of the designated material shall each submit a sworn affidavit stating the cost of the material and the cost of shipping the material which was utilized in the Bidder's preparation of its Bid.
- D. In the event the Owner purchases materials for this Project the Bidder shall:
 - 1. Be responsible for scheduling Shop Drawings, the delivery of the materials to the Project site, as well as establishing the hours of delivery and method of delivery to the Project site, maintain communication with the material schedules, submit, with Construction Progress Schedule, a schedule for required deliveries of Owner furnished material.
 - 2. Pay all delivery waiting charges.
 - 3. Review and handle all Shop Drawings prepared by the supplier in accordance with Section 01 33 23 of these Specifications.
 - 4. Proceed without delay to unload materials upon delivery.
- E. Should any materials be damaged, lost, or fail under test, and in the opinion of the Engineer, such failure or damage is the result of improper handling, it shall be replaced in kind by the Bidder at no cost to the Owner.

- F. No additional payment shall be made for receiving, handling and distributing materials furnished by the Owner.
- G. No additional payment shall be made due to delays in delivery of materials furnished by the Owner.
- H. Fittings, solid sleeves and special pipe, which are not shown on the Drawings and which are installed for the convenience of the Bidder, shall not be paid for by the Owner.
- I. Upon receipt of materials from the manufacturer, the Bidder shall:
 - 1. Make an inspection of materials, checking and certifying the bill of lading, noting discrepancies and obtaining a proper memorandum signed by the Agent of the carrier for shortages in the shipment and damaged materials received.
 - 2. Be responsible for distribution of all materials as required to complete the Work.
 - 3. Be responsible for any loss or damage to materials furnished by the Owner.
- J. All bills of lading and any memorandum for shortage of or damage to material in the shipment shall be promptly submitted to the Engineer. Materials furnished to the Bidder shall be in the custody of the Bidder from the time of receipt until final acceptance of the completed Work.
- K. Materials as used herein can also mean and cover equipment that may be furnished by the Owner.

EXTRA WORK ITEMS IN THE PROPOSAL

The Bid Form (Section 00 41 13) may contain certain unit price items entitled "Extra Work, If Ordered by the Engineer/Owner". In each such item, the estimated quantity is based on the average amount of extra work encountered in a typical job. The stated quantities are not guaranteed but are included in the Bid Form in order to determine, in advance of construction, the actual low Bidder. No work included in such items will be authorized for payment without advance authorization by the Engineer/Owner. See Section 01 22 00 – Measurement and Payment for additional details.

PROCUREMENT DEFINITIONS

DOCUMENT 00 23 00

PROCUREMENT DEFINITIONS

DEFINITIONS

Where the following words or the pronouns used in their stead occur herein, they shall have the following meaning:

- A. "Bid" shall mean a balanced Bid in which each of the unit prices and total amount proposed for each of the listed items reasonably reflects the value of that item with regard to the entire job considering the prevailing cost of labor, material and equipment in the relevant market. A Bid is unbalanced when, in the opinion of the Owner, any unit prices or total amounts proposed on any of the listed items do not reasonably reflect such values.
- B. "Bidder" shall mean a Contractor who has been determined qualified by the Owner and who submits a Bid for the Work to the Owner.
- C. "Change Order" is a written instrument prepared by the Engineer and signed by the Owner, Contractor, and Engineer, stating their agreement upon all of the following:
 - 1. Change in the work;
 - 2. The amount of the adjustment, if any, in the contract sum; and;
 - 3. The extent of the adjustment, if any, in the Contract Time.
- D. "Completion Date" will be the date of final acceptance of the Project by the "Owner".
- E. "Contract Documents" define and describe the Work; and include the Contract Agreement, Invitation to Bid, Bid Award, Bid Form, Instructions to Bidders, General Conditions, Supplementary Conditions, Special Conditions, (including all documentation accompanying the Bid and any post-bid documentation required by the Owner prior to the Notice of Award), Bonds, Specifications, Drawings, and addenda, together with written amendments, Change Orders, Field Orders and the Owner's written interpretations and clarifications issued on or after the date of the Contract Agreement.
- F. "Contract Time" shall mean the number of consecutive calendar days as provided in the Contract Agreement for completion of the Project, to be computed from the date of the Notice to Proceed.
- G. "Contractor" shall mean the party of the second part to the Contract Agreement or the authorized and legal representative of such party who is authorized to transact business in the State of Georgia.
- H. "Design Engineer" shall mean Wiedeman and Singleton, Inc.
- I. "Engineer" shall mean a Construction Manager appointed by the "Owner" and shall be the entity responsible for administering the Contract under the direction of the "Owner".
- J. "Field Order": A written order issued by the Engineer which clarifies or explains the plans or specifications, or any portion or detail thereof, without changing the design, the Contract Price, the Time for Completion or the Contract Completion Date.
- K. "Furnished by the Owner" shall mean the Owner shall pre-purchase specific products and have them delivered to a place mutually agreed upon by the supplier, the Owner and the Contractor, at no cost to the Contractor.

PROCUREMENT DEFINITIONS

- L. "Liquidated Damages" shall mean the sum the Bidder agrees to pay for each consecutive calendar day beyond the Contract Time required to complete the Project. Liquidated Damages will end upon written notification from the Owner of final acceptance of the Project.
- M. "Owner" shall mean Etowah Water & Sewer Authority, a political subdivision of the state of Georgia and a public corporation, created by the Georgia Legislature, located in the County of Dawson of the State of Georgia, (hereinafter referred to as Owner), also known herein as the Authority, party of the first part to the Contract Agreement, or its authorized legal representatives.
- N. "Products" shall mean materials or equipment permanently incorporated into the Project.
- O. "Project" shall mean scope of Work as defined in the Invitation to Bid.
- P. "Provide", "Furnish", "Set" or similar terms when used in the Contract Documents shall be interpreted as furnish and install unless specifically indicated otherwise.
- Q. "Responsible Bidder" and "Responsive Bidder" shall mean a Bidder who properly submits a complete Bid in the proper form, and all information as required within the Contract Documents.
- R. "Satisfactorily completed", solely for the purposes of Official Code of Georgia Annotated O.C.G.A. paragraph 13-10-20(b), shall mean the completion of all Work, certifications and affidavits as required by the Owner.
- S. "Substantial completion of the Work", solely for the purposes of Official Code of Georgia Annotated O.C.G.A. paragraph 13-10-20(c), shall be defined as occurring on the date of the written notification from the Engineer that the Project is ready for final inspection.
- T. "Work" shall mean the entire completed construction required to be furnished under the Contract Documents.

COMPANY'S BUSINESS LICENSE OR AOI

DOCUMENT 00 40 00.16

COMPANY'S BUSINESS LICENSE OR ARTICLES OF INCORPORATION

PLEASE STAPLE TO THIS PAGE THE ABOVE TITLED APPLICABLE DOCUMENTS.

BID FORM

DOCUMENT 00 41 13

BID FORM

| TO: | ETOWAH WATER & SEWER AUTHORITY | |
|------|---|------|
| FROM | I:Bidder's Name | |
| FOR: | DAWSON FOREST WRF SLUDGE DEWATEING UPGRADES | |
| | Submitted | 2020 |

I. BID FORM AND BID SCHEDULE

- A. The undersigned, as Bidder, hereby declares that the only person or persons interested in the Bid as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this Bid Form or in the Contract to be entered into; that this Bid Form is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud.
- B. The undersigned Bidder, in compliance with your Invitation to Bid for the construction of this Project, having examined the Contract Documents and the site of proposed Work, and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of materials and labor, hereby proposes to construct the Project in accordance with the Contract Documents.
- C. The Bidder proposes and agrees, if this Bid is accepted, to contract with the Etowah Water & Sewer Authority in the form of Contract Agreement specified, to furnish all necessary products, machinery, tools, apparatus, means of transportation and labor necessary to complete the construction of the Work in full and complete accordance with the reasonably intended requirements of the Contract Documents to the full and entire satisfaction of the Etowah Water & Sewer Authority with a definite understanding that no money will be allowed for extra work except as set forth in the Contract Documents, for the following prices:

Sub total Section I the lump sum amount of:

BID FORM

<u>Section I - Construction of the Dawson Forest WRF Sludge Dewatering Upgrades:</u> For furnishing all materials and equipment, except for items listed in Sections II, III, IV, V, VI, and VII, and performing all labor necessary for construction of all work and appurtenances necessary for completion of work under this contract as shown on the Drawings and/or specified.

The Owner has pre-negotiated a Base Bid equipment price shown in this proposal under Section II, Item 1 – Belt Filter Press (46 76 21). The equipment and services to be provided by Charter Machine Company for this base bid price are detailed herein in Attachment A. The Contractor shall provide all additional equipment, appurtenances, labor, etc. required to install the Belt Filter Press and Appurtenances as a complete working system. The Contractor shall include these costs in his lump sum bid for Construction of the Dawson Forest WRF Sludge Dewatering Upgrades.

| Sub-total, Section 1, the lump sum amount of. | | |
|---|-------------|--|
| | DOLLARS (\$ | |

Section II – **Major Equipment**: For furnishing and installing the following major items of equipment. Use the lowest price for the base bid amount (see Instructions to Bidders for determination of the lowest acceptable bid).

EQUIPMENT

| No. | Description | Price | Base Bid |
|-----|---|---------------|---------------|
| 1. | Belt Filter Press (46 76 21) | | |
| | System Supplier: Charter Machine Company (Base Bid) | \$ 452,594.00 | \$ 452,594.00 |

Sub-Total, Section II, the amount of: <u>FOUR HUNDRED FIFTY-TWO THOUSAND FIVE HUNDRED</u> NINETY-FOUR DOLLARS (\$452,594.00)

<u>Section III</u> – <u>Rock Excavation</u>: This section is for Rock Excavation as specified (see Sections 31 00 00 – Earthwork and 31 23 16 – Trench Excavation and Fill).

| Item No | Approx. Quantity | Unit | Description | ι | Jnit Price | Total Price |
|------------|---------------------|------|-------------|----|------------|----------------|
| 1. | 200 | C.Y. | Mass Rock | \$ | 30.00 | \$ 6,000.00 |
| 2. | 60 | C.Y. | Trench Rock | \$ | 50.00 | \$ 3,000.00 |

Sub-Total, Section III, Items 1 through 2, the amount of: NINE THOUSAND DOLLARS (\$9,000.00)

BID FORM

<u>Section IV</u> – <u>Erosion Control:</u> For furnishing all materials and equipment under this section and performing all labor necessary for construction, and all other work and appurtenances necessary for completion of work under this contract as shown on the Drawings and/or specified for the following prices:

| Item | 1 1 | | | | |
|------|----------|-------|-------------------------|------------|-------------|
| No | Quantity | Unit | Description | Unit Price | Total Price |
| | | | | | |
| 1. | 275 | LF | Silt Fence (Sd1-S) | \$ | \$ |
| 2. | 15 | LF | Ditch Checks (Cd) | \$ | \$ |
| 3. | 0.35 | Acres | Temporary Grassing | \$ | \$ |
| 4. | 0.35 | Acres | Permanent Grassing | \$ | \$ |
| 5. | 1 | Ea. | Pumped Silt Control Bag | \$ | \$ |
| 6. | 1 | Ea. | Concrete Washdown | \$ | \$ |
| 7. | 1 | Ea. | Construction Exit (Co) | \$ | \$ |
| | | | | | |

Sub-Total, Section IV, Items 1 through 7, the amount of:

DOLLARS (\$

<u>Section V</u> – <u>Cash Allowances:</u> This section is for Cash Allowances as detailed on the drawings and as specified (see Section 01 21 13 – Cash Allowances).

| Item No. | Description | Base Bid Price |
|----------|--|----------------|
| 1. | Soils and Concrete Testing: to cover Owner verification of the soil conditions and poured in place concrete. | \$ 15,000.00 |
| 2. | <u>Construction Surveying</u> : to cover Owner verification of the Contractor's reference points, centerlines, and work performed. | \$ 2,000.00 |
| 3. | Blasting Monitoring : to cover blast monitoring and other blasting related operations of an Owner selected subcontractor. | \$ 2,000.00 |

Sub-Total, Section V, Items 1 through 3, the amount of: <u>NINETEEN THOUSAND DOLLARS</u> (\$ 19,000.00)

BID FORM

<u>Section VI – Demolition Work – Existing Dewatering Equipment and Appurtenances</u>: For furnishing all materials and performing all labor necessary to complete the demolition work to the existing dewatering equipment and appurtenances at the existing Dewatering Building under this contract as shown on the Drawings and/or specified.

| Sub-tot | tal, Section | VI, the l | lump sum amount of: | | | |
|---|---------------------|-----------|--|-----------------------------|---------------------|----|
| | | | | DOLLARS (\$ | 5 | _) |
| | | | ORK, IF ORDERED BY ENGINEE 1 Section I.) | \mathbf{R} : (To cover au | thorized changes in | |
| Item No | Approx. Quantity | Unit | Description | Unit Price | Total Price | |
| 1. | 200 | CY | Crushed Stone Stabilization (Including Excavation and Disposal of Unsuitable Material) | \$ 35.00 | \$ 7,000.00 | |
| 2. | 200 | SY | Geotextile Fabric (Mirafi 500X for Stabilization) | \$ 1.00 | \$ 200.00 | |
| Sub-Total, Section VII, Items 1 and 2, the total amount of: SEVEN THOUSAND TWO HUNDRED DOLLARS (\$7,200.00) | | | | | | |
| TOTAL BASE BID, SECTIONS I, II, III, IV, V, VI AND VII inclusive, the amount of: | | | | | | |

BID FORM

II. TERMS OF BID

- A. The Bidder further proposes and agrees hereby to commence work under this contract, with adequate force and equipment, on a date to be specified (Notice to Proceed) in a written order of the Engineer, and shall fully complete all work hereunder within 270 calendar days from the Notice to Proceed date.
- B. Bidder further agrees to pay as liquidated damages, the sum of \$500.00 for each consecutive calendar day thereafter required to complete all work as heretofore provided in the Instructions to Bidders.
- C. The Bidder declares an understanding that the quantities shown for unit price items are subject to either increase or decrease, and that should the quantities of any of the items of Work be increased, the Bidder proposes to do the additional Work at the unit prices stated herein; and should the quantities be decreased, the Bidder also under that payment will be made on the basis of actual quantities at the unit price bid and will make no claim for additional costs or anticipated profits for any decrease in quantities; and that actual quantities will be determined upon completion of Work, at which time adjustment will be made to the Contract amount by direct increase or decrease.
- D. In case of discrepancies between the figures shown in the unit prices and the totals, the unit prices shall apply and the totals shall be corrected to agree with the unit prices. In case of discrepancies between written amounts and figures, written amounts shall take precedence over figures and the sum of all Bid extensions (of unit prices) plus lump sum items shall take precedence over Subtotals and TOTAL BASE BID.
- E. The Bidder furthermore agrees that, in the case of a failure to execute the Contract Agreement and Bonds within ten days after receipt of conformed Contract Documents for execution, the attached Bid Bond accompanying this Bid and the monies payable thereon shall be paid into the funds of the Owner as liquidated damages for such failure.
- F. Attached hereto is a Bid Bond for the sum of <u>5 Percent (5%) of the Amount Bid</u> according to the conditions of "Instruction to Bidders" and provisions thereof.

III. ADDENDA

A.

| BIDDER ACKNOWLEDGES RECEIPT OF THE FOLLOWING ADDENDA. | | | | |
|---|-------|--|--|--|
| Addendum No. | Date: | | | |
| Addendum No. | Date: | | | |
| Addendum No. | Date: | | | |

Bidder acknowledges receipt of the Following Addenda:

BID FORM

IV. SIGNATURES

| BIDDER - PRINCIPAL | • | |
|---------------------------|----------------|--------|
| Ву: _ | | |
| | | |
| Address:_ | (Please Print) | |
| | Fax: | |
| | (Please Print) | |
| Title: | | (CEAL) |

Note: Attest for a corporation must be by the corporate secretary; for a partnership by another partner; for an individual by a notary.

Note: If the bidder is a corporation, the bid shall be signed by an officer of the corporation; if a partnership, it shall be signed by a partner; if signed by others, authority for the signature shall be attached.

BID BOND FORM

DOCUMENT 00 43 13

BID BOND FORM

STATE OF GEORGIA

COUNTY OF DAWSON

| KNOW ALL M | EN BY THESE PRESENTS, that we, as | |
|-------------------|--|----------|
| Principal, and _ | as Surety, are held and firm | ly |
| bound unto the l | towah Water & Sewer Authority in the sum of | |
| Dollars (\$ |) lawful money of the United States of America, for the payment | of |
| which sum well | and truly to be made, we bind ourselves, our heirs, personal representatives, successors are | nd |
| assigns, jointly | and severally, firmly by these presents. | |
| WHEREAS, the | Principal has submitted to the Owner a Bid for construction of the DAWSON FORES | <u>T</u> |
| WRF SLUDGI | DEWATERING UPGRADES. | |
| NOW THEREF | ORE, the conditions of this obligation are such that if the Bid be accepted, the Principal sha | .11, |
| within ten days | after receipt of conformed Contract Documents, execute a Contract in accordance with the | he |
| Bid upon the te | rms, conditions and prices set forth therein, and in the form and manner required by the | he |
| Contract Docur | ents and execute sufficient and satisfactory separate Performance and Payment Bone | ds |
| payable to the O | wner, each in an amount of 100 percent of the total Contract Price, in form satisfactory to the | he |
| Owner, then this | obligation shall be valid; otherwise, it shall be and remain in full force and effect in law; an | nd |
| the Surety shall | upon failure of the Principal to comply with any or all of the foregoing requirements with | in |
| the time specific | d above, immediately pay to the aforesaid Owner, upon demand, the amount hereof in good | od |
| and lawful mon | ey of the United States of America, not as a penalty, but as liquidated damages. | |
| This bond is giv | on pursuant to and in accordance with the provisions of <u>O.C.G.A.</u> Section 36-10-1 et seq. as | nd |
| all the provision | s of the law referring to this character of bond as set forth in said Sections or as may l | be |
| hereinafter enac | red and these are hereby made a part hereof to the same extent as if set out herein in full. | |
| IN WITNESS W | HEREOF, the said Principal has hereunder affixed its signature and seal, and said Surety h | as |
| hereunto caused | to be affixed its corporate signature and seal, by its duly authorized officers, on this | |
| day of | , 2020. | |
| | | |

BID BOND FORM

| CONTRACT | OR - PRINC | IPAL: | |
|---------------|------------|---|--------|
| | By: | | |
| | Name: | (Please Print) | |
| | | | |
| | | _Fax: | |
| ATTEST: | | | |
| | Name: | (Please Print) | |
| | | | (SEAL) |
| individual by | a notary. | n must be by the corporate secretary; for a parti | |
| | By: | | |
| | Name: | (Please Print) | |
| | Address: | | |
| | Phone: | | |
| ATTEST: | | | |
| | | (Please Print) | |
| | Title: | <u> </u> | (SEAL) |

Note: Surety companies executing bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of Georgia.

BID BOND FORM

| Resident agent in state in which Work is to be performed: | | | |
|---|--|--|--|
| Name: _ | | | |
| Address:_ | | | |
| Phone: | | | |

DRUG-FREE WORKPLACE CERTIFICATE

DOCUMENT 00 45 00.01

DRUG-FREE WORKPLACE CERTIFICATE

By signature on this certificate, the Contractor certifies that the provisions of O.C.G.A. Section 50-24-1 through 50-24-6 related to the "Drug-Free Workplace Act" have been complied with in full. The Contractor further certifies that:

- 1. A drug-free workplace will be provided for the Contractor's employees during the performance of the Contract; and
- 2. Each Contractor who hires a subcontractor to work in a drug-free workplace shall secure from that subcontractor the following written certification: "As part of the subcontracting agreement with (Contractor's name), (Subcontractor's name) certifies to the Contractor that a drug-free workplace will be provided for the subcontractor's employees during the performance of this Contract pursuant to O.C.G.A. Section 50-24-3(b)(7)".

By signature on this certificate, the Contractor further certifies that it will not engage in the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana during the performance of the Contract.

| CONTRACTOR: | |
|-------------|-------------------------|
| By: | |
| J | (name signed) |
| | |
| | (name printed or typed) |
| Title: | |
| Date: | |
| • | |

ETOWAH WATER & SEWER AUTHORITY NON-COLLUSION AFFIDAVIT OF PRIME BIDDER

DOCUMENT 00 45 19

NON-COLLUSION AFFIDAVIT OF PRIME BIDDER

| STATE OF GEORGIA | COUNTY OF DAWSON |
|--|---|
| | _, being first duly sworn, deposes and says that: |
| He or she is | _ |
| of | _, the Bidder that has submitted the attached Bid; |
| he or she is fully informed respecting the preparation as circumstances respecting such bid; | nd contents of the attached bid and of all pertinent |
| Such Bid is genuine and is not a collusive or sham Bid; | |
| Neither the said Bidder nor any of its officers, partner parties in interest, including this Affiant, has in any way or indirectly with any other Bidder, firm or person to sub Contract for which the attached bid has been submitted Contract, or has in any manner, directly or indirectly, so or conference with any other Bidder, firm or person to other Bidder, or to fix any overhead, profit or cost element of the secure through any collusion, conspiracy, connivate the Etowah Water and Sewer Authority, Dawsonville, Contract; and The price or prices quoted in the attached Bid are factors prices, connivated to the particle of the partic | y colluded, conspired, connived or agreed, directly brait a collusive or sham Bid in connection with the or to refrain from bidding in connection with such ought by agreement or collusion or communication fix the price or prices in the attached Bid or of any ment of the Bid price or the Bid price of any other of the Bid price or the Bid price of any other bidder, ance or unlawful agreement any advantage against Georgia or any person interested in the proposed fair and proper and not tainted by any collusion, rt of the Bidder or any of its agents, representatives, |
| By: | |
| (name signed) | |
| (name printed or typed |) |
| Title: | |
| Subscribed and Sworn to before me thisday of | , 2020 <u>.</u> |
| (Notary Public) My Commission | on expires: |
| END OF SE | (SEAL) CTION |

NON-COLLUSION AFFIDAVIT OF SUB-CONTRACTOR

DOCUMENT 00 45 19.01

NON-COLLUSION AFFIDAVIT OF SUB-CONTRACTOR

| STATE OF GEORGIA | COUNTY OF DAWSON |
|--|--|
| | , being first duly sworn, deposes and says that: |
| He or she is | |
| (Owner, Partner, Officer, Of | Representative or Agent) hereinafter referred to as the "Subcontractor"; |
| He or she is fully informed respecting the prepara pertinent circumstances respecting such Bid; | ation and contents of the Subcontractor's Bid and of all |
| Such Subcontractor's Bid is genuine and is not a coll- | usive or sham Bid; |
| parties in interest, including this Affiant, has in any indirectly with any other Bidder, firm or person to Contract or to refrain from submitting a Bid in conn or indirectly, sought by agreement or collusion or corperson to fix the price or prices in said Subcontract | s, partners, owners, agents, representatives, employees or way colluded, conspired, connived or agreed, directly or submit a collusive or sham Bid in connection with the section with such Contract, or has in any manner, directly mmunication or conference with any other Bidder, firm or tor's Bid or to secure through any collusion, conspiracy, ge against the Etowah Water and Sewer Authority, proposed Contract; and |
| | d are fair and proper and are not tainted by any collusion, ne part of the Bidder or any of its agents, representatives, his Affiant. |
| BIDDER: | |
| Ву: | (name signed) |
| | (name signed) |
| | (name printed or typed) |
| Title: | |
| Date: | |
| Subscribed and sworn to me thisday of | , 2020. |
| NOTARY PUBLIC: | |
| | (name signed) |
| | (name printed or typed) |
| Commission Expires: | |
| END O | F SECTION |

CONTRACTOR LICENSE CERTIFICATE

DOCUMENT 00 45 20

CONTRACTOR LICENSE CERTIFICATE

| Bidder/Contractor's Name: | |
|--|---|
| Contractor's License Number: | |
| Expiration Date of License: | |
| I certify that the above information is true and cor | rect and that the classification noted is applicable to the bid |
| for this Project. | |
| BIDDER: | |
| By: | |
| · · | (name signed) |
| - | (name printed or typed) |
| Title: | |
| Date: _ | |

CORPORATE CERTIFICATE

DOCUMENT 00 45 43

CORPORATE CERTIFICATE

| I, | , certify that I am the Secretary of the Corporation named as Bide | der in the |
|---------------------------------|---|-------------|
| foregoing Bid; that | , who signed said Bid on behalf of the Contractor | was then |
| of said Corporation; that said | Bid was duly signed for and on behalf of said Corporation by author | rity of its |
| Board of Directors, and is with | hin the scope of its corporate powers; that said Corporation is organiz | ed under |
| the laws of the State of | | |
| This day of | , 2020. | |
| Corporate Secretary: | | |
| , <u> </u> | (name signed) | |
| | (name printed or typed) | |
| | | (SEAL) |

VENDOR AFFIDAVIT AND AGREEMENT

DOCUMENT 00 45 46.16

VENDOR AFFIDAVIT AND AGREEMENT

STATE OF GEORGIA

COUNTY OF DAWSON

ETOWAH WATER & SEWER AUTHORITY

By executing this Affidavit and Agreement, the undersigned Vendor verifies its compliance with O.C.G.A. §13-10-91, stating affirmatively that the individual, firm or corporation which is contracting with Etowah Water & Sewer Authority has registered with and is participating in and will continue to participate in a federal work authorization program, in accordance with the applicable provisions and deadlines established in O.C.G.A §13-10-91.

The undersigned further agrees that, should it employ or contract with any sub-vendor and/or subcontractor, in connection with the physical performance of services pursuant to the contract/purchase order with Etowah Water & Sewer Authority, Vendor will secure from such sub-vendor similar verification of compliance with O.C.G.A. §13-10-91. Vendor further agrees to maintain records of such compliance and provide a copy of each such compliance and provide a copy within 5 business days to Etowah Water & Sewer Authority at the time the sub-vendor(s) is retained to perform and/or provide such services.

For further information or to obtain an E-Verify Identification Number please reference the E-Verify Home Page on the U.S. Citizenship and Immigration Services website at: http://www.uscis.gov.

| E-Verify Basic Pilot Program User Identification Number | Date of Authorization | |
|---|--|--|
| BY: Authorized Officer or Agent of Vendor (Signature) | Title of Authorized Officer or Agent of Vendor | |
| Printed Name of Authorized Officer or Agent of Vendor | | |
| Witness | | |
| Notary Public | | |
| My Commission Expires: | | |
| | | |

NOTICE TO VENDOR

This affidavit is subject to disclosure to members of the public under the Georgia Open Records Act.

SECTION 00 52 43 CONTRACT AGREEMENT

DOCUMENT 00 52 43

CONTRACT AGREEMENT

| This Contact Assumption I and a list that the second of th | | |
|--|--|--|
| This Contract Agreement made and entered into the day of, 20, by and between Etowah Water and Sewer Authority, a political subdivision of the state of Georgia and a public corporation, created by the Georgia Legislature, located in the County of Dawson of the State of Georgia, (hereinafter referred to as Owner) and (hereinafter referred to as Contractor). | | |
| WITNESSETH: | | |
| That the Contractor, for the consideration hereinafter fully set out, hereby agrees with the Owner as follows: | | |
| That the Contractor will furnish all products, tools, construction equipment, skill and labor of every description necessary to carry out and to complete in a good, firm, substantial workmanlike manner the construction of the Project known as: | | |
| DAWSON FOREST WRF SLUDGE DEWATERING UPGRADES | | |
| and will complete the Work in strict conformity with the Drawings and the Specifications, together with the foregoing Bid made by the Contractor, the Invitation for Bid, Instructions to Bidders, General, Supplementary, and Special Conditions, Performance and Payment Bonds, all Addenda, and any additional references specifically noted in the Table of Contents hereto incorporated form essential parts of this Contract Agreement, as if fully contained herein. | | |
| That the Contractor shall commence the Work to be performed under this Contract Agreement on a date to be specified in a written 'Notice to Proceed' and shall fully complete the Work, hereunder, within 270 consecutive calendar days, which includes the inclement weather days as described in Section 00 72 43, Article 31. Time is of the essence and is an essential element of this Contract, and the Contractor shall pay to the Owner, not as a penalty, but as liquidated damages, the sum of Five Hundred Dollars (\$500.00) for each calendar day that the Work is not completed within the time limit named herein. If the Contractor abandons the Contract before commencement of the Work or defaults in completion of all the Work after commencement thereof, the Contractor shall be liable for such liquidated damages. These fixed liquidated damages are not established as a penalty but are calculated and agreed upon in advance by the Owner and the Contractor due to the uncertainty and impossibility of making a determination as to the actual and consequential damages incurred by the Owner and the general public of Dawson County, Georgia as a result of the failure on the part of the Contractor to complete the Work on time. Such liquidated damages referred to herein are intended to be and are cumulative and shall be in addition to every other remedy now or hereafter enforceable at law, in equity, by statute, or under the Contract. The Owner hereby agrees to pay to the Contractor for the faithful performance of this Contract Agreement, subject to additions and deductions as provided in the Specifications and Bid, in lawful money of the United States of America, the sum of | | |
| (\$) which sum shall also pay for loss or damage arising out of | | |
| the nature of the Work aforesaid, or from the action of the elements, or from unforeseen obstructions or difficulties encountered in the prosecution of the Work, and for all expenses incurred by, or in consequence of the Work, its suspension or discontinuance and for well and faithfully completing the Work and the | | |

CONTRACT AGREEMENT

whole thereof, as herein provided, and for replacing defective work or products for periods of time after completion as specified under various warranty and guarantee sections of this Contract Documents.

The Owner shall make monthly partial payments to the Contractor in accordance with the provisions of the Contract Documents.

Final payment on account of this Contract Agreement shall be made within thirty (30) days after the completion by the Contractor of all Work covered by this Contract Agreement and the acceptance of such Work by the Owner, in accordance with the provisions of the Contract Documents.

It is further mutually agreed between the parties hereto that if, at any time after the execution of this Contract Agreement and the surety bonds hereto attached for its faithful performance, the Owner shall deem the surety or sureties upon such bond to be unsatisfactory, or if, for any reason, such bond ceases to be adequate to cover the performance of the Work, the Contractor shall, at no additional expense to the Owner, within five days after the receipt of notice from the Owner to do so, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Owner. In such event, no further payment to the Contractor shall be deemed to be due under this Contract Agreement until such new or additional security for the faithful performance of the Work shall be furnished in manner and form satisfactory to the Owner.

IN WITNESS WHEREOF, the parties hereto have executed this Contract Agreement under their respective seals on the day and date first above written in three counterparts each of which shall, without proof or accounting for the other counterparts, be deemed an original Contract.

CONTINUED ON NEXT PAGE

CONTRACT AGREEMENT

APPROVED TO FORM BEFORE EXECUTION:

| By: | | |
|--------------|---|--------|
| Linda Dunlay | vy, Attorney for the Owner | |
| OWNER: | ETOWAH WATER AND SEWER AUTHORITY DAWSONVILLE, GEORGIA | |
| | By: | |
| | Name: Brooke Anderson P.E., General Manager | (SEAL) |
| WITNESS: | By: | |
| | Name: Sophia Dearwent, Executive Assistant | |
| CONTRACTOR: | | |
| | By: | |
| | Name: (Please Print) | |
| | Title: | |
| ATTEST: | By: | |
| | Name:(Please Print) | (SEAL) |
| | Title: | |

Note: If the Contractor is a corporation, the Contract Agreement shall be signed by the president or vice president, attested by the secretary and the corporate seal affixed. If the Contractor is a partnership, the Contract Agreement shall be signed in the partnership name by one of the partners, with indication that he or she is a general partner.

PERFORMANCE BOND

DOCUMENT 00 61 13.13

PERFORMANCE BOND

| STATE OF GEORGIA | BOND NO |
|--|--|
| COUNTY OF DAWSON | |
| Know ALL MEN BY THESE PRESENTS, that v | ve, |
| as Principal, (hereinafter known as "Contractor" | |
| hereby acknowledge ourselves indebted and fin Authority (hereinafter called the "Owner"), for us | , as Surety, do rmly bound and held unto Etowah Water and Sewer e and benefit of those entitled thereto, in the sum |
| · · · · · · · · · · · · · · · · · · · | Dollars (\$) yment of which sum will and truly to be made, we bind cessors and assigns, jointly and severally, firmly by these |
| WHEREAS, said Contractor has entered into a co | ertain Contract Agreement with said Owner, dated |
| , 20, for the | e project known as: |

DAWSON FOREST WRF SLUDGE DEWATERING UPGRADES

(hereinafter called the "Contract"), which Contract Agreement and the Contract Documents for said Work shall be deemed a part hereof as fully if set out herein.

NOW, THEREFORE, if said Contractor shall fully and faithfully perform all the undertakings and obligations under the said Contract Agreement hereinbefore referred to and shall fully indemnify and save harmless the said Owner from all costs and damage whatsoever which it may suffer by reason of any failure on the part of said Contractor to do so, and shall fully reimburse and repay the said Owner any and all outlay and expense which it may incur in making good any such default, and shall correct all defects in products and workmanship appearing within one (1) year of the completion of all Work, then this obligation shall be null and void, otherwise, it shall remain in full force and effect.

And for value received it is hereby stipulated and agreed that no change, extension of time, alteration or addition to the terms of the said Contract Agreement, or in the Work to be performed thereunder, or the Specifications accompanying the same shall in any way affect the obligations under this Contract Agreement or Bond, and notice is hereby waived any such damage, extension or time, alteration or addition to the terms of the Contract Agreement or to the Work or to the Contract Documents.

This bond is given pursuant to and in accordance with provisions of <u>O.C.G.A.</u> Section 36-01-1 et. seq. and 36-82-100 et. seq. and all the provisions of the law referring to this character of Bond as set forth in said Sections or as may be hereinafter enacted, and these are hereby made a part hereof to the same extent as if set out herein in full.

| Surety | has hereunto caused to be af | aid Contractor has hereunder affixed its signature and fixed its corporate signature and seal, by it duly authori, 20, executed in three counterparts. | |
|--------|-------------------------------|--|---------|
| | day or | , 25, executed in times counterparts. | |
| CONT | RACTOR - PRINCIPAL: | | (SEAL) |
| BY: _ | | | , , |
| | | | |
| | | (Please Print) | |
| ΓΙΤLΕ | : | | |
| | ATTEST: | | |
| | NAME: | (Please Print) | |
| | TITLE: | | |
| Note: | another partner; for an indiv | | ship by |
| | | | |
| | | | |
| | | | |
| PHON | NE: | | |
| FAX: | | | |
| BY: _ | | | |
| | | | |
| | | (Please Print) | (SEAL) |
| TITLI | E: | | (SE/IE) |
| | | | |
| | 3: | | |
| | | (Please Print) | |
| TITLE | : | | |
| | | | |

PERFORMANCE BOND

Note: Surety companies executing Bond must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of Georgia.

PAYMENT BOND

DOCUMENT 00 61 13.16

PAYMENT BOND

| STATE OF GEORGIA | BOND NO | |
|--|------------|---------------|
| COUNTY OF DAWSON | | |
| Know ALL MEN BY THESE PRESENTS, that | we | |
| as Principal, (hereinafter known as "Contractor" |), and we, | |
| do hereby acknowledge ourselves indebted an Authority (hereinafter called the "Owner"), for u | * | |
| lawful money of the United States, for the parourselves, our heirs, personal representatives, surpresents. | • | nade, we bind |
| WHEREAS, said Contractor has entered into, 20, for the project kn | | Owner, dated |

DAWSON FOREST WRF SLUDGE DEWATERING UPGRADES

(hereinafter called the "Contract"), which Contract Agreement and the Contract Documents for said Work shall be deemed a part hereof as fully if set out herein.

NOW, THEREFORE, the condition of this obligation is such, that if said Contractor and all subcontractors to whom any portion of the Work provided for in said Contract Agreement is sublet and all assignees of said Contractor and of such subcontractors shall promptly make payments to all persons supplying them with labor, products, services, or supplies for or in the prosecution of the Work provided for in such Contract Agreement, or in any amendment or extension of or addition to said Contract Agreement, and for the payment of reasonable attorney's fees, incurred by the claimant in suits on this Bond, then the above obligation shall be void; otherwise, it shall remain in full force and effect.

HOWEVER, this Bond is subject to the following conditions and limitations:

(a) Any person, firm or corporation that has furnished labor, products, or supplies for or in the prosecution of the Work provided for in said Contract Agreement shall have a direct right of action against the Contractor and Surety on this Bond, which right of action shall be asserted in proceeding, instituted in the county in which the Work provided for in said Contract Agreement is to be performed.

Such right of action shall be asserted in proceedings instituted in the name of the claimant or claimants for its use and benefit against said Contractor and Surety or either party (but not later

PAYMENT BOND

| | than one (1) year after the final settlement of said Contract Agreement) in which action such claim or claims shall be adjudicated, and judgment rendered thereon. | | |
|--------|---|--|--|
| (b) | The Principal and Surety hereby designate and appoint the | | |
| | , as the agent of each party to receive and accept service of process or other pleading issued or filed in any proceeding instituted on this bond and hereby consent that such service shall be the same as personal service on the Contractor and/or Surety. | | |
| (c) | In no event shall the Surety be liable for a greater sum than the penalty of this Bond, or subject to any suit, action or proceedings thereon that is instituted later than one (1) year after the final settlement of said Contractor Agreement. | | |
| (d) | This Bond is given pursuant to and in accordance with provisions of <u>O.C.G.A.</u> Section 13-10-1 ET. Seq. and 36-82-100 ET. Seq. hereinafter, and all the provisions of law referring to this character of Bond as set forth in said Sections or as may be hereinafter enacted, and these are hereby made a part hereof to the same extend as if set out here in full. | | |
| Surety | ITNESS WHEREOF, the said Contractor has hereunder affixed its signature and seal, and said has hereunto caused to be affixed its corporate signature and seal, by it duly authorized officers, on day of | | |

CONTINUED ON NEXT PAGE

PAYMENT BOND

| CONTRACTOR - PRINCIPAL: | (SEAL) |
|---|---------|
| BY: | , |
| NAME: | |
| (Please Print) | |
| TITLE: | |
| ATTEST: | |
| NAME:(Please Print) | |
| TITLE: | |
| Note: Attestation for a corporation must be by the corporate secretary; for a partner another partner; for an individual by a notary. | ship by |
| SURETY: | |
| CONTACT: | |
| ADDRESS: | |
| PHONE: | |
| FAX: | |
| BY: | |
| NAME:(Please Print) | (07.11) |
| TITLE: | (SEAL) |
| WITNESS: | |
| NAME:(Please Print) | - |
| TITLE: | |

Note: Surety companies executing Bond must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of Georgia.

COMPANY'S INSURANCE CERTIFICATE

DOCUMENT 00 62 16

COMPANY'S INSURANCE CERTIFICATE

PLEASE STAPLE TO THIS PAGE THE ABOVE TITLED APPLICABLE DOCUMENTS.

ETOWAH WATER & SEWER AUTHORITY FINAL AFFIDAVIT, RELEASE, AND LIEN WAIVER

DOCUMENT 00 65 19.16

FINAL AFFIDAVIT, RELEASE, AND LIEN WAIVER

| TO: ETOWAH WATER & SEWER AUTHORITY | , DAWSONVILLE, GEORGIA |
|---|--|
| FROM:(C | |
| (0 | Contractor) |
| RE: Agreement between Etowah Water & Sewer A | uthority, Dawsonville, Georgia and |
| dat | ted for construction of the |
| DAWSON FOREST WRF SLU | UDGE DEWATERING UPGRADES |
| employed by subcontractors in Dawson County, Georgia , 20 , and the | nent and services, subcontractors, mechanics, and laborers or any of its have been paid and satisfied in full as of nat there are no outstanding obligations or claims of any & Sewer Authority, Dawsonville, Georgia on the above |
| | ute this document on Contractor's behalf and has personal |
| This day of | , 20 |
| RIDDER: | |
| | |
| Бу: | (name signed) |
| | (name printed or typed) |
| Title: | |
| Date: | |
| Subscribed and sworn to me this day of | ,20 . |
| NOTARY PUBLIC: | |
| | (name signed) |
| | (name printed or typed) |
| Commission Evniras | |
| Commission Expires. | |
| END O | F SECTION |

SECTION 00 72 43 GENERAL CONDITIONS

DOCUMENT 00 72 43

GENERAL CONDITIONS

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GENERAL: The provisions of these General Conditions are intended, but are not limited to, providing general conditions of agreement and provisions toward the awarding of the Contract, the obligations of the successful Bidder and requirements for execution and administration of the Contract. <u>IN ANY EVENT, PROVISIONS IN THIS SECTION ARE SUBJECT TO AND GOVERNED BY PROVISIONS IN THE SUPPLEMENTARY CONDITIONS, AS APPLICABLE.</u>

ARTICLE 1 - NOTICE OF AWARD OF CONTRACT

Within sixty (60) days after receipt of Bids, the Owner will notify the successful Bidder of the award of the Contract.

Should the Owner require additional time to award a Contract, the time may be extended by the mutual agreement between the Owner and the successful Bidder. If an award of Contract has not been made within ninety (90) days from the Bid date or within the extension mutually agreed upon, the Bidder may withdraw the Bid without further liability on the part of either party.

ARTICLE 2 - EXECUTION OF CONTRACT DOCUMENTS

The Owner and the Contractor shall execute at least three counterparts of the Contract Documents. The Owner, the Contractor, and the Engineer shall each receive an executed counterpart of the Contract Documents.

Within fifteen (15) days of notification of Award of Contract, the Owner will furnish the Contractor with conformed copies of Contract Documents for execution by the Contractor and the surety.

Within fifteen (15) days after receipt, the Contractor shall return all the Documents properly executed by the Contractor and the surety. Attached to each Document shall be an original power-of-attorney for the person executing the Bonds for the surety and certificates of insurance for the required insurance coverage.

Within thirty (30) days after receipt of the Conformed Documents executed by the Contractor and the surety with the Power-of-Attorney and certificates of insurance, the Owner will complete the execution of the Documents and make distribution of the completed Documents.

Should the Contractor and/or the surety fail to properly execute the Documents within the specified time, the Owner shall have the right to proceed on the Bid Bond accompanying the Bid.

If the Owner fails to execute the Documents within the time limit specified, the Contractor shall have the right to withdraw the Bid without penalty. In such event, the Owner shall have no liability to the Contractor under these Documents or otherwise.

Should either party require an extension of any of the time limits stated above, it shall be done only by mutual agreement in writing between both parties.

ARTICLE 3 - CONTRACT SECURITY

The Contractor shall furnish separate Performance and Payment Bonds each in a sum equal to the amount of the Contract Price, the Performance Bond conditioned upon the performance by the Contractor of all undertakings, covenants, terms, conditions and agreements of the Contract Documents, and the Payment Bond conditioned upon the prompt payment by the Contractor to all persons supplying labor and products in the prosecution of the Work provided by the Contract Documents. Such Bonds shall be executed by the Contractor and a corporate bonding company licensed to transact such business in the State of Georgia and

named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these Bonds shall be borne by the Contractor. If at any time a Surety on any such Bond is declared bankrupt or loses its right to do business in the State of Georgia or is removed from the list of Surety Companies accepted on Federal Bonds, the Contractor shall, within 10 days after notice from the Owner to do so, substitute an acceptable Bond (or Bonds) in such form and sum and signed by such other Surety as may be satisfactory to the Owner. The premium on such Bond (or Bonds) shall be paid by the Contractor. No further progress payments shall be deemed due, nor shall be made, until the new Surety furnishes an acceptable Bond to the Owner.

The person executing the Bond on behalf of the Surety shall file with the Bond a general power-of-attorney, unlimited as to amount and type of Bond covered by such power-of-attorney and certified to by an official of said Surety.

ARTICLE 4 - INDEMNIFICATION

The Contractor shall indemnify and hold harmless the Owner; Etowah Water & Sewer Authority, Dawsonville, Georgia; and their agents and employees from and against all claims, damages, losses and expenses including consultants' and attorneys' fees arising out of or resulting from the performance of the Work, provided that any such claims, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, including the loss of use resulting there from; and is caused in whole or in part by the Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

In any and all claims against the Owner or any of their agents or employees, by any employee of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any subcontractor under worker's compensation acts, disability benefit acts or other employee benefits acts.

This indemnification and hold harmless obligation shall extend to cover any and all claims not covered by the Owner's Protective Liability Insurance, the requirements of which are specified in Section 00 73 16 Insurance Requirements.

ARTICLE 5 - NOTICE TO PROCEED

The Notice to Proceed will be issued, following the pre-construction conference, within ten (10) days of the execution of the Contract Agreement by the Owner. The time may be extended by mutual agreement between the Owner and the Contractor. If the Notice to Proceed has not been issued within the sixty (60) day period following the Award of Contract date or within the period mutually agreed upon, the Contractor may terminate the Contract Agreement without further liability on the part of either party.

ARTICLE 6 - TERMINATION OF WORK FOR DEFAULT

- A. The Work may be terminated if:
 - 1. The Contractor is declared bankrupt or becomes insolvent.
 - 2. The Contractor makes a general assignment for the benefit of creditors.
 - 3. A trustee or receiver is appointed for the Contractor or for any of Contractor's property.

- 4. The Contractor files a petition to take advantage of any debtor's act, or to reorganize under bankruptcy or applicable laws.
- 5. The Contractor repeatedly fails to supply sufficient skilled workmen, materials or equipment.
- 6. The Contractor fails to make satisfactory progress toward timely completion of the Work.
- 7. The Contractor repeatedly fails to make prompt payments to subcontractors or material suppliers for labor, materials or equipment.
- 8. The Contractor disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction of the Work.
- 9. The Contractor fails to comply with directives of the Owner.
- 10. The Contractor otherwise violates any provision of the Contract Documents.
- B. In the event of a default by the Contractor, the Owner may, without prejudice to any other right or remedy and after giving the Contractor and surety a minimum of ten (10) days from delivery of a written notice, terminate the services of the Contractor and take possession of the Project and of all products thereon owned by the Contractor, and finish the Work by whatever method the Owner may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct and indirect costs of completing the Project, including compensation for additional professional services, such excess shall be paid to the Contractor. If such costs exceed such unpaid balance, the Contractor and/or surety shall pay the difference to the Owner. Such costs incurred by the Owner will be determined by the Owner and incorporated in a Change Order.
- C. Where the Contractor's services have been terminated by the Owner as set forth above, said termination will not affect any right of the Owner against the Contractor then existing or which may thereafter accrue. Any retention or payment of monies by the Owner due the Contractor will not release the Contractor from compliance with the Contract Documents.

ARTICLE 7 - TERMINATION FOR CONVENIENCE OF THE OWNER

If, for any reason other than those provided for under Article 7, the Owner elects to discontinue, in whole or in part, the Work under this Contract, the Owner may, after ten (10) days from delivery of a written notice to the Contractor, terminate, in whole or in part, the Contractor's performance of the Work under this Contract. The notice of termination shall specify the extent to which performance of the Work under the Contract is terminated.

In the event of such termination by the Owner, the Contractor shall be entitled to payment for the Work at the job site acceptably performed up to the time of the termination and reimbursement for such costs as are reasonably incurred by the Contractor due to the termination and not otherwise compensated.

The Contractor shall also be entitled to profit on the amounts payable to the Contractor, but such profit shall be limited to five (5) percent of such amounts.

The Contractor will not be entitled to any payment, including any anticipated profit, on Work not performed and will not be entitled to any compensation for other economic loss arising out of or resulting from such compensation or damages of any nature.

ARTICLE 8 - ASSIGNMENTS

The Contractor shall not assign the whole or any part of this Contract or any monies due or to become due hereunder without written consent of the Owner. In case the Contractor assigns all or any part of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to prior liens of all persons, firms, and corporations for services rendered or materials supplied for the performance of the Work called for under this Contract.

ARTICLE 9 - SUBCONTRACTING

- A. The Contractor shall not subcontract the complete Work, or any part thereof, and shall not award any work to any subcontractor without prior written approval of the Owner. Owner approval will not be given except upon the basis of written statements containing such information as the Owner may require. At the pre-construction conference, the Contractor shall submit all subcontractors that the Contractor plans to use on the Project. Any changes or additional subcontractors should be submitted at least 14 days prior to the needed approval.
- B. The Contractor shall utilize the services of specialty subcontractors on those parts of the Work which, under normal contracting practices, are best performed by specialty subcontractors, as required by the Owner in Owner's sole discretion, at no additional cost to the Owner. If the Contractor desires to perform specialty work, the Contractor shall submit a request to the Owner, accompanied by evidence that the Contractor's own organization has successfully performed the type of work in question, is presently competent to perform the type of work, and the performance of the work by specialty subcontractors will result in materially increased costs or inordinate delays.
- C. The Contractor shall be fully responsible to the Owner for the acts and omissions of the Contractor's subcontractors and of persons either directly or indirectly employed by the Contractor. The Contractor shall be fully responsible to the Owner for the acts and omissions of independent contractors or independent subcontractors of the Contractor and of persons indirectly employed by the Contractor as the Contractor is for the acts and omissions of persons directly employed by the Contractor.
- D. The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the Work to bind subcontractors to the Contractor by the terms of the General Conditions and other Contract Documents insofar as applicable to the work of subcontractors and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the Contract Documents.
- E. Nothing contained in this Contract shall create any contractual relation between any subcontractor and the Owner.
- F. The Contractor agrees that, should it employ or contract with any sub-vendor and/or subcontractor, in connection with the physical performance of services pursuant to the contract/purchase order with Etowah Water & Sewer Authority, Contractor will secure from such sub-vendor and/or subcontractor similar verification to Section 00 45 46.16 Vendor Affidavit and Agreement, included herein, of compliance with O.C.G.A. §13-10-91. Contractor further agrees to maintain records of such compliance and provide a copy of each such compliance within five business days to the Project Manager with Etowah Water & Sewer Authority at the time the sub-vendor and/or subcontractor is retained to perform and/or provide such services.

ARTICLE 10 - SEPARATE CONTRACTS

- A. The Owner reserves the right to let other contracts in connection with this Project. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their products and the execution of their work, and the Contractor and other contractors shall properly connect and coordinate their work with each other. If the proper execution or results of any part of the Contractor's work depends upon the work of any other contractor, the Contractor shall inspect and promptly report to the Owner any defects in such work that render it unsuitable for such proper execution and results.
- B. The Owner may perform additional work related to the Project with Owner's own forces. The Contractor shall afford the Owner reasonable opportunity for the introduction and storage of products and the execution of work, and shall properly connect and coordinate Contractor's work with work performed by Owner's own forces.
- C. If the performance of additional work by other contractors or the Owner is not noted in the Contract Documents prior to the execution of the Contract, written notice thereof will be given to the Contractor prior to starting any such additional work. If the Contractor believes that the performance of such additional work by the Owner or others involves the Contractor and Contractor incurs additional expense or entitles the Contractor to an extension of the Contract Time, the Contractor may make a claim therefore as provided in Article 28.

ARTICLE 11 - LAWS AND REGULATIONS

The Contractor's attention is directed to the fact that all applicable federal, state, county and city laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the Contract throughout, and they will be deemed to be included in the Contract as though written out in full herein. The Contractor shall keep fully informed of all laws, ordinances and regulations of the federal, state, county, city and municipal governments or authorities in any manner affecting those engaged or employed in the Work or the materials used in the Work or in any way affecting the conduct of the Work and of all orders and decrees of bodies or tribunals having any jurisdiction or authority over same. If any discrepancy or inconsistency should be discovered in these Contract Documents herein referred to, in relation to any such law, ordinance, regulation, order or decree, the Contractor shall herewith report the same, in writing, to the Owner. The Contractor shall at all times observe and comply with all such existing and future laws, ordinances and regulations, and shall protect and indemnify the Owner and their agents against the violation of any such law, ordinance, regulation, order or decree, whether by the Contractor or by the Contractor's employees.

ARTICLE 12 – TAXES

The Contractor shall pay all consumer, use, and other similar taxes required by the law of the place where the Work is performed. The Owner will be responsible for any sales or use tax due on products furnished by the Owner to the Contractor, if any, to be incorporated into the Work.

Should a local inspection license be required, this fee should be paid by Contractor. If any delinquent taxes or other monies are owed to the City of Dawsonville or Dawson County, said taxes or monies shall be paid prior to Award of Contract by the Authority. In the event the Authority determines such unsettled amounts still exist after Award of Contract has been issued, then the Authority reserves the right to withhold all amounts due the City of Dawsonville or Dawson County from the contractor's payment.

ARTICLE 13 - NOTICE AND SERVICE THEREOF

All notices, demands, requests, instructions, approvals, and claims shall be in writing.

- A. Any notice to or demand upon the Contractor will be sufficiently given if delivered at the office of the Contractor specified in the Bid (or at such other office as the Contractor may from time to time designate to the Owner in writing), or if delivered by the United States Mail in a sealed, postage-prepaid envelope, or delivered by facsimile transmission, followed by written confirmation, in each case addressed to such office.
- B. All papers required to be delivered to the Owner shall, unless otherwise specified in writing to the Contractor, be delivered to the Office of the Owner as specified in Section 00 21 13 Instructions to Bidders.
- C. Any notice to or demand upon the Owner shall be sufficiently given if delivered to the Office of said General Manager or if delivered by the United States Mail in a sealed, postage-prepaid envelope, or delivered by facsimile transmission, followed by written confirmation, in each case addressed to said General Manager or to such other representative of the Owner or to such other address as the Owner may subsequently specify in writing to the Contractor for such purposes.
- D. Any such notice or demand shall be deemed to have been given to the Owner or made as of the time of actual delivery to Owner.
- E. The Contractor shall file all "Notices of Commencement" required for this Project in accordance with O.C.G.A. 44-14-361.5 et.seq. and 36-82-104 et.seq., as applicable. The Contractor shall respond to all requests for copies of a "Notice of Commencement". Should the Owner receive such a request, this request will be forwarded to the Contractor for further handling. The name and address of the Owner and the name and general description of the Project shall be as stated in the Invitation to Bid.

ARTICLE 14 - PATENTS

- A. The Contractor shall hold and save the Owner and their agents harmless from liability of any kind, including cost and expenses, reasonable attorney's fees, for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the Work, including its use by the Owner.
- B. If the Contractor uses any design, process, device or materials covered by letters, trademarks, patent or copyright, the Contractor shall provide for such use by suitable agreement between the Owner and the holder of such patented or copyrighted design, device or material. The Contract prices shall include royalties or cost arising from the use of such design, device or materials, in any way involved in the Work. The Contractor and the Contractor's sureties shall indemnify and save harmless the Owner and their agents from claims for infringement by reason of the use of such patented or copyrighted design, process, device or materials or any trademark or copyright in connection with the Work agreed to be performed under this Contract, and shall indemnify the Owner and their agents for any cost, expense, damage and reasonable attorney's fees which it may be obliged to pay by reason of such infringement, at any time during the prosecution of the Work or after completion of the Work.

ARTICLE 15 - LAND AND RIGHTS-OF-WAY

The Owner will provide, as indicated in the Contract Documents and prior to the Notice to Proceed, the lands upon which the Work is to be done, rights-of-way for access thereto, and such other lands that are designated for the use of the Contractor. The Contractor shall confine work and all associated activities to

the easements and other areas designated for the Contractor's use. The Contractor shall comply with any limits on construction methods and practices that may be required by easement agreements.

If, due to some unforeseen reason, the necessary easements are not obtained, the Contractor shall receive an equitable extension of Contract Time and/or an equitable increase in the Contract Price to cover the Contractor's additional costs as a result thereof, provided the Owner is notified immediately of the claim. The Contractor's claim therefore shall be handled as provided for under Article 28.

Should additional temporary easements for ingress or egress be required by the Contractor for more suitable access to the Work, these easements shall be obtained by the Contractor, at no additional cost to the Owner.

Portions of the work to be done will require construction within rights-of-way of the Georgia Department of Transportation. This work is allowed under permit with the Georgia Department of Transportation. The Contractor shall comply with the Utility Accommodation Standards and Specifications of the Georgia Department of Transportation and in accordance with the requirements of the permit(s) the Owner has obtained.

ARTICLE 16 – USE OF PREMISES

The Contractor will confine his equipment, the storage of materials and equipment and the operations of his workmen to areas permitted by law, ordinances, permits, or designated by the Owner, and shall not unreasonably encumber the premises with materials or equipment.

The Contractor shall not load or permit any part of a structure to be loaded with weights that will endanger the structure, nor shall be subject any part of the work to stresses or pressures that will endanger it.

The Contractor shall repair the staging area(s) and road(s) incidental to the Work to its original condition.

The Owner will designate any area(s) secured by the Owner for the Contractor to use as staging area(s) for the project on the Project Drawings. The Contractor shall not use any other area other than those designated without prior written approval from the Owner. The Contractor shall be responsible for the security of his equipment and materials stored in the staging area. The Contractor shall provide portable restroom(s) for the use of his workers.

ARTICLE 17 - PRODUCTS

- A. Products shall be so stored in accordance with the manufacturer's recommendations to insure the preservation of their quality and fitness for the Work. Stored products to be incorporated in the Work shall be located so as to facilitate prompt inspection.
- B. Manufactured products shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.
- C. Products shall be furnished in accordance with shop drawings and/or samples submitted by the Contractor and approved by the Owner.
- D. Products to be incorporated into the Work shall not be purchased by the Contractor or the subcontractor subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

E. Product substitution following execution of Contract will be considered only due to unusual or extenuating circumstances. Procedures are specified in Section 01 25 13 "Substitution and Product Options".

ARTICLE 18 - SUPERVISION OF WORK

The Contractor shall supervise and direct the Work. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor shall employ and maintain on the work site a qualified supervisor or superintendent who shall have been designated in writing by the Contractor as the Contractor's representative at the site. The supervisor or superintendent shall have supervised past projects of equal size and scope and have excellent performance references from the owners from a minimum of three (3) projects within a period of five (5) years maximum. Contractor shall submit his appointed supervisor or superintendent and references for review by the Owner and Engineer within ten (10) days from bid date and prior to contract signing. The supervisor or superintendent shall be present on the site at all times as required to perform adequate supervision and coordination of the Work.

The supervisor shall have full authority to act on behalf of the Contractor and to execute the orders or directions of the Owner or Engineer without delay. The supervisor shall have full authority to promptly supply products, tools, plant equipment, and labor as may be required. The supervisor's authority shall be such that all communication given to the supervisor shall be as binding as if given to the Contractor.

The Contractor shall employ only competent and skilled personnel. The Contractor shall, upon demand from the Owner or Engineer, immediately remove any superintendent, supervisor, foreman, or workman whom the Owner may consider incompetent or undesirable.

ARTICLE 19 - INTERRUPTION OF FACILITY OPERATIONS

The Contractor shall provide the Owner with written notice at least five (5) days prior to any interruption in facility operations required by construction activity. The notice shall include the date and time of the scheduled interruption; the length of time the interruption will be in effect; the procedures to be followed in effecting the interruption; a complete identification of all those processes, equipment and operations to be affected; and all other information the Owner may require. The Contractor shall provide any equipment, piping, auxiliary power or other means necessary to sustain facility operations or function for interruptions which have not been identified by the Specifications, or when interruptions must exceed the time allowed by the Specifications.

The Contractor shall schedule the work such that the Contractor does not interrupt the operation of any existing facility, including water mains and sewers.

ARTICLE 20 - PROTECTION OF WORK, PROPERTY AND PERSONS

A. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to all employees on the Work and other persons who may be affected thereby, all the Work and all products to be incorporated therein, whether in storage on or off the site, the work of other prime contractors installed as part of the Project and including material acceptance for storage and which are properly stored in areas designated by the Contractor, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

- B. The Contractor shall comply with the Department of Labor Safety and Health Regulations for construction, promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL-91-54). The Contractor shall erect and maintain, as required by the conditions and progress of the Work, all necessary safeguards for safety and protection.
- C. The Contractor shall remedy all damage, injury or loss to any property, improvements or facilities caused, directly or indirectly, in whole or in part, by the Contractor or any of the Contractor's subcontractors or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable. The property, improvements or facilities shall be replaced or restored to a condition as good as when the Contractor entered upon the Work. Upon receiving a directive from the Engineer, the Contractor shall comply and complete any/all corrective work within a one (1) working week time period. In case of failure on the part of the Contractor to restore such property, or make good such damages or injury, the Owner may, after forty-eight (48) hours written notice, proceed to repair, rebuild, or otherwise restore such property, improvements or facilities as may be deemed necessary. The cost thereof will be deducted from any monies due or which may become due the Contractor under this Contract.
- D. In emergencies affecting the safety of persons or the Work or property at the site or adjacent thereto, the Contractor, without special instruction or authorization from the Owner, shall act to prevent threatened damage, injury or loss.
- E. Completed Work and stored products shall be suitably protected during unseasonable weather, to allow the Work to proceed in a timely fashion. Work planned, or in progress, should be performed to minimize impact of adverse weather.

ARTICLE 21 - PROTECTION, LOCATION AND RELOCATION OF UTILITIES

The Contractor shall notify owners of adjacent utilities when prosecution of the Work may affect them. The Contractor shall protect from damage all existing improvements or utilities at, or in proximity to, the site of the Work, and shall repair or restore any damage to such facilities resulting from failure to exercise reasonable care in the performance of the Work. If the Contractor fails or refuses to repair any such damage promptly, the Owner may have the Work performed and charge the cost thereof to the Contractor.

Prior to the construction or installation of any proposed facility or pipeline, the Contractor shall expose all existing utilities true to their vertical and horizontal location, within the vicinity of the Work. In order to avoid conflicts between existing and proposed facilities or utilities, the Contractor shall either relocate the existing or proposed utility on a temporary or permanent basis, or shall take whatever means necessary to protect the existing facilities or utilities during the installation of proposed utilities, as approved by the Owner. No separate payment will be made for the relocation of existing utilities or for any work associated with the protection of existing facilities or utilities.

ARTICLE 22 - PROTECTION OF THE ENVIRONMENT

- A. The Contractor shall be responsible for taking all measures required to minimize all types of pollution associated with the undertaking of the Work, and shall abide by the requirements of all governmental agencies having jurisdiction over the Work or Contractor's Project operations.
- B. Any area used or involved in the Project that is disturbed by the Contractor, shall be restored to original or better condition, even though such area is outside the limits of that specified for grading, grassing or landscaping.

C. All supervisors are required to have successfully completed the Worksite Erosion Control Supervisor Certification Training as approved by the Georgia Environmental Protection Division. This training shall be completed prior to or within thirty days of Notice of Award of the Contract. All certified supervisors shall have their training card or proof of certificate on their persons at all times.

ARTICLE 23 - SCHEDULES, REPORTS AND RECORDS

- A. The Contractor shall submit to the Owner progress schedules, payrolls, reports, estimates, records and other data as the Owner may request concerning work performed or to be performed as stipulated in the various sections of these Specifications.
- B. Immediately after execution of the Contract by the Owner, and before the first partial payment is made, the Contractor shall submit a schedule of values for the Work, including quantities and unit prices, aggregating the Contract Price, and showing the proposed dates of commencement and completion of each of the various subdivisions of work required under the Contract Documents and the anticipated amount of each monthly payment that will become due the Contractor in accordance with the Progress Schedule.
- C. An updated schedule and an updated Schedule of Submittals shall be presented with each partial payment request. Lack of an updated schedule and/or an updated Schedule of Submittals will delay processing of the pay request until receipt of the updated schedule and/or an updated Schedule of Submittals.
- D. If the schedule reflects a completion date prior to the completion date established by the Contract Agreement, this shall afford no basis to claim for delay should the Contractor not complete the Work prior to the projected completion date. Instead all "float" between the completion date in the Contractor's schedule and the completion date established in the Contract Agreement shall belong to and be exclusively available to the Owner. Should a change order be executed with a revised completion date, the progress schedule shall be revised to reflect the new completion date.
- E. The Contractor shall maintain on the Project site, a complete set of up-to-date Record Documents.
- F. Project Coordination Meetings: The Contractor shall participate in Project Coordination Meetings to be held on the site or at an agreed location monthly, or more often if conditions warrant, to establish the current state of completion and to revise the schedule as necessary. The Project Coordination Meeting will be conducted by the Owner and be in accordance with Section 01 31 00.
- G. Temporary Staging Area for Materials It is the responsibility of the Contractor to obtain permission from the property owner(s) to utilize private property for the temporary staging of materials and equipment. This agreement is solely between the contractor and the property owner. The Contractor will submit to the Owner a copy of the agreement stating the conditions of the permission and details of how the property will be restored after use.

ARTICLE 24 - DRAWINGS AND SPECIFICATIONS

The Drawings, Specifications, Contract Documents, and all supplemental documents are considered essential parts of the Contract, and requirements occurring in one are as binding as though occurring in all. They are intended to define, describe and provide for all Work necessary to complete the Project in an acceptable manner, ready for use, occupancy, or operation by the Owner.

The Owner will furnish the Contractor with one original and two (2) copies of the Contract Documents to include all drawings and attachments, one copy of which the Contractor shall have available at all times on the Project site. Any additional copies will be furnished at additional cost.

In cases where products or quantities are omitted from the Specifications, the description and quantities shown on the Drawings will govern.

Any materially differing site condition as between what is shown on the Drawings and Specifications and actually found on site shall be immediately reported to the Owner, in writing, prior to the commencement of Work at the site. Failure of the Contractor to notify the Owner, in writing, of the differing site condition prior to performance of Work at the site shall constitute a waiver of any claim for additional monies. Any Change Order necessitated by the differing site condition shall be processed as provided under Article 28.

Any ambiguities or need for clarification of the Drawings or Specifications shall be immediately reported in writing to the Owner. The Contractor is fully responsible for the coordination of work and trades related to modifications to the Contract Documents due to corrective actions during the shop drawings submissions. Shop drawings shall be consistent with the Contract Documents and the Contractor shall notify the Engineer of any deviation from the Contract Documents. Any such ambiguity or need for clarification will be handled by the Owner, in writing.

No clarification of the Drawings and Specifications hereunder by the Owner will entitle the Contractor to any additional monies unless a Change Order has been processed as provided by Article 28 hereof.

Any work done by the Contractor following a discovery of such differing site condition or ambiguity or need for clarification in the Contract Drawings and Specification, prior to a written report to the Owner, shall not entitle the Contractor to additional monies and shall be done at the Contractor's risk.

ARTICLE 25 – SURVEYS

The Owner will furnish a land survey to establish a base line, as required, for locating the principal component parts of the Work, as shown in the Contract Documents. A benchmark will be established adjacent to the Work. From this information, unless otherwise specified in the Contract Documents, the Contractor shall develop and make all detailed surveys needed for construction, such as alignment, slope stakes, batter boards, stakes for pile locations and other working points, lines, elevations and cut sheets.

ARTICLE 26 - TESTING, INSPECTION AND REJECTION OF WORK

- A. Testing of Materials: Unless otherwise specifically provided for in the Specifications, the inspection and testing of products to be incorporated in the Work at the site, if required, shall be made by bureaus, laboratories, or agencies approved by the Owner; the cost of such inspection and testing shall be paid by the Contractor. The Contractor shall furnish evidence, satisfactory to the Owner, that the products have passed the required tests prior to their incorporation into the Work. The Contractor shall promptly segregate and remove rejected products from the site of the Work.
- B. Inspection: The Contractor shall furnish the Owner with every reasonable facility for ascertaining whether or not the Work performed and products used are in accordance with the requirements and intent of the Specifications and Contract Documents. No Work shall be done or products used without suitable inspection by the Engineer. Failure to reject any defective Work or product shall not in any way prevent later rejection when such defect is discovered, or obligate the Owner to final acceptance.

- C. Authority and Duties of the Construction Inspector: The Construction Inspector appointed by the Owner will be authorized to inspect all Work done and all products furnished, including preparation, fabrication and manufacture of the products to be used, but the Construction Inspector will not be authorized to alter or waive any requirements of the Contract Documents. The Construction Inspector may reject products or suspend the Work until any question at issue can be referred to and decided by the Owner. The responsibility of the Contractor is not lessened by the presence of the Construction Inspector.
- D. Rejection of Work and Materials: All products furnished and all Work done that is not in accordance with the Drawings or Specifications or that is defective will be rejected. All rejected products or Work shall be removed immediately. If rejected products or Work is not removed within forty-eight (48) hours, the Owner will have the right and authority to stop the Work immediately and will have the right to arrange for the removal of said rejected products or Work at the cost and expense of the Contractor. All rejected products or Work shall be replaced with other products or Work that conforms to the Drawings and Specifications.
- E. Contractor's Responsibilities: Inspection of the Work will not relieve the Contractor of any obligations to fulfill the Contract and defective Work shall be made good regardless of whether such Work has been previously inspected by the Engineer and accepted or estimated for payment. The failure of the Owner to reject improper Work shall not be considered a waiver of any defect, which may be discovered later, or for Work actually defective.

ARTICLE 27 - CONTRACT TIME AND LIQUIDATED DAMAGES

The Contract Time and Liquidated Damages shall be defined in the Contract Agreement.

The Contractor shall proceed with the Work at a rate of progress, which will insure completion within the Contract Time. It is expressly understood and agreed by and between the Contractor and the Owner that the Contract Time for the Work described herein is proposed by the Contractor and is a reasonable time, taking into consideration the average climatic and economic conditions, and other factors prevailing in the locality of the Work.

If the Contractor shall fail to perform the Work required within the Contract Time, or extended Contract Time if authorized by Change Order, then the Contractor shall pay to the Owner the full amount of liquidated damages specified in the Contract Agreement for each calendar day that the Contractor shall be in default after the time stipulated in the Contract Agreement.

The Contractor shall not be charged with liquidated damages or any excess cost when the delay in performance of the Work is due to the following and the Contractor has promptly given written notice of such delay to the Owner:

- A. To any preference, priority or allocation order duly issued by the Owner.
- B. To unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God or of the public enemy, acts of the Owner, acts of another contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather.
- C. To any delays of subcontractors occasioned by any of the causes specified in paragraphs A and B.

ARTICLE 28 - CHANGES IN THE CONTRACT

A. Changes in the Work: The Owner may at any time, as the need arises, order changes within the scope of the Work without invalidating the Contract Agreement. If such changes increase or decrease the amount due under the Contract Documents, or in the time required for performance of the Work, an equitable adjustment will be authorized by Change Order.

The Owner, also, may at any time, by issuing a field order, make changes in the details of the Work. These changes by field order will not affect Contract Time or Contract Price. The Contractor shall proceed with the performance of any changes in the Work so ordered by the Owner, unless the Contractor believes that such field order entitles Contractor to a change in Contract Price or Contract Time or both, in which event Contractor shall give the Owner, within three business days, written notice thereof and, if required, an estimate of the direct cost of Work as outlined in (b) below, after the receipt of the ordered change, and the Contractor shall not execute such changes pending the receipt of an executed Change Order or further written instruction from the Owner.

Should the Contractor encounter, or the Owner discover, during the progress of the Work, subsurface or latent conditions at the site materially differing from those shown on the Drawings or indicated in the Specifications, or unknown conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in the Work of the character provided for in the Drawings and Specifications, the Owner shall immediately be notified in writing of such conditions before they are disturbed. The Owner will thereupon promptly investigate the conditions. If the Owner finds that conditions do so materially differ, or the conditions are of an unusual nature, and upon written request of the Contractor, an equitable adjustment will be authorized by Change Order.

If the Contractor does not immediately notify the Owner in writing of the belief that a field order, additional work by other contractors or the Owner, or subsurface, latent or unusual unknown conditions, entitles the Contractor to a Change Order, no consideration for time or money will be given the Contractor.

The Owner may elect to postpone the issuance of a Change Order until such time that a single Change Order of substantial importance can be issued incorporating several changes. In such cases, the Owner will indicate this intent for each change in the Contract in a written response to the Contractor's request for a change, following agreement by the Owner and Contractor on the change's scope, price and time.

- B. Changes in Contract Price: The Contract Price may be changed only by a Change Order. The value of any Work covered by a Change Order for increase or decrease in the Contract Price will be determined by one or more of the following methods, in the order of precedence listed below:
 - 1. By estimating the number of unit quantities of each part of the Work which is changed (either increased or decreased) and then multiplying the estimated number of such unit quantities by the price Bid (which price shall include the Contractor's overhead and profit) for a unit quantity thereof.
 - 2. The Owner will fix the total lump sum value of the change in the Work of the Contractor following the Contractor's submittal, within a reasonable time, of an estimate of the direct cost of the Work. The direct cost estimate will be added to, or deducted from, the Contract Price (which price will include the Contractor's overhead and profit as outlined below). If the Contractor does not submit a cost estimate of the Work in a reasonable time or if the Owner and Contractor do not reach agreement on the cost, the Owner may fix the total lump sum value at a reasonable amount. On

any lump sum change, which involves a net credit to the Owner, no allowance for overhead and profit will be figured.

3. By ordering the Contractor to proceed with the Work and to keep and present, in such form as the Owner may direct, a correct account of the cost of the change together with all vouchers therefore. The cost hereunder will only include an allowance for overhead and profit as outlined below.

For the Work performed in item (2) or (3) above, payment will be made for the documented actual direct cost of the following:

- a. Labor, including foremen, for those hours they are assigned and participating in the Work covered by the change order (actual direct payroll cost of wages). The Contractor shall furnish, if required by the Owner, certified payrolls to verify wages. All labor related costs will be included in a 30 percent markup of the cost of direct payroll wages. This refers to the Contractor's specific labor wages.
- b. Material delivered and used on the designated Work, including sales tax, if paid for by the Contractor and as verified by original invoices or otherwise verifiable to the Owner's acceptance.
- c. Rental, or ownership cost of equipment, including necessary transportation of equipment, having a purchase value in excess of \$300.00. Rental or ownership cost will be allowed for only those hours during which the equipment is required on the project site. Cost allowances will not exceed the rates defined as follows: the hourly rate, for equipment not used exclusively in the change to the scope of work, will be the monthly rate, as printed in the current Rental Blue Book for Construction Equipment published by Dataquest, divided by 176; the rate, for equipment used exclusively for those tasks identified in the change to the scope of work, will be the daily, weekly or monthly rate, used singularly or in combination, which will provide the lowest total cost. The rates will be modified by the Rate Adjustment Table factors to reflect a depreciation allowance indexed to the year a machine was originally manufactured and sold. The rates will be adjusted to account for regional differences in annual use hours, cost of labor, freight, taxes, etc. The amount by which basic rates will be increased or decreased is shown on the adjustment maps included in the "Blue Book".

The equipment use period will begin only at the time equipment is unloaded at the site of the changed work, will include each day that the equipment is required at the site of the changed work and will terminate at the end of the day on which the use of such equipment becomes unnecessary, plus reasonable transportation time.

The maximum time to be paid per day will not exceed eight hours unless the equipment is in operation for a longer time. The time that will be paid for per day, for equipment not used exclusively in the change to the scope of work, will be the hours that the equipment was actually in operation on the changed work.

In addition to the actual costs in items (a) through (c) above, there will be, for the Contractor actually performing the work, a fixed fee of 16% for bond, insurance, overhead and profit added to the cost of Items (a), (b) and (c), above.

If all or a portion of the Change Order is performed by a subcontractor, payment will be made for the documented actual direct cost as outlined in (a), (b) and (c), above. A fixed

fee of 16% for bond, insurance, overhead and profit will be added to the cost of (a), (b) and (c) of the subcontractor's work only.

A fixed fee of 10% will be added to the subcontractor's Work for the Contractor's administrative handling of portions of the Work that are performed by an approved subcontractor. No additional fixed fee will be allowed for the Contractor's or a subcontractor's administrative handling of Work performed by a subcontractor's subcontractor, unless by written permission from the Owner. All other costs not specifically listed above are considered to be included in the fixed fee.

- 4. The Contractor shall, when required by the Owner, furnish the Owner with an itemized breakdown of the quantities and prices used in computing the value of any change that might be ordered, in a printed format, and with sufficient detail as required by the Owner.
- C. Changes in Contract Time: The Contract Time may be changed only by a Change Order. Changes in the Work described in (a) and any other claim made by the Contractor for a change in the Contract Time will be evaluated by the Owner and if the conditions warrant, an appropriate adjustment of the Contract Time will be made.

The Owner, when making these evaluations will take into consideration the amount and scope of Work which has been changed and will evaluate if the change in Work has affected the critical path as currently accepted on the progress schedule such that it would delay the completion of the Project. If after these evaluations have been made and in the sole opinion of the Owner, the Contractor is due an extension of time, then the extension of time will be granted by a Change Order and the Owner will pay the associated cost due the Contractor for direct field costs, only as outlined under Changes in Contract Price (a) and (c), exclusive of Item (b), based on any delays to the overall Project. Extensions of time granted as a result of weather will not result in a change in Contract Price.

ARTICLE 29 – WARRANTIES

All warranties for the work under this contract shall be as specified in Section 01 77 00 Closeout Procedures of the Contract Documents. Submission of all warranties as specified shall have to be made by the Contractor to the Owner prior to submission of final pay request.

ARTICLE 30 - PAYMENT AND COMPLETION

A. Contract Price: The Contract Price is either a lump sum or the sum of the unit prices stated in the Contract Agreement, for each item multiplied by the actual quantities installed of each item, and is the total amount payable by the Owner to the Contractor for the performance of the Work set forth in the Contract Documents.

It is understood that the Contractor shall provide and pay for all products, labor (including labor performed after regular working hours, on Sundays, or on legal holidays), equipment, tools, water, light, power, sewer, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, place into operation, and deliver the Work.

It is further understood that the Contractor's proposed construction schedule is based on a normal forty (40) hour, five (5) day workweek, less recognized holidays. If the Contractor desires to work in excess of this limit, the Contractor shall submit a written request to the Owner a minimum of five days prior to the desired work date. The Contractor shall be responsible for any additional expenses incurred by

the Owner as a result of the extended work hours, including construction inspection overtime. The cost associated with construction inspector overtime will be deducted from the final Project change order.

The Owner will require that the Contractor increase his work effort to achieve a six (6) day, ten (10) hour per day work week upon the determination that the construction progress is two (2) weeks behind the original submitted construction schedule as required by the General Conditions. No changes in the Contract Price will be authorized due to this increased work effort. Completion time will not be extended for normally bad weather. The time for completion as stated in the Contract Documents includes due allowances for days on which work cannot be performed out-of doors. For the purpose of this contract, the Contractor agrees that he may expect to lose the approximate number of working days to weather in accordance with the following table:

| January | 14 | May | 6 | September | 6 |
|----------|----|--------|---|-----------|---|
| February | 14 | June | 3 | October | 3 |
| March | 10 | July | 4 | November | 5 |
| April | 7 | August | 2 | December | 9 |

If the total accumulated number of working days lost to the weather from the start of work until project completion date exceeds the total accumulated number to be expected for the same period from the table above, time for completion will be extended by the number of calendar days needed to include the excess number of working days lost. When applicable to the Work, no extension will be made for days of bad weather occurring after the building is enclosed. Furthermore, should a project fall behind the Contractor's original construction schedule, no extensions will be given for inclement weather days beyond the scheduled dry-in date plus any additional days due to the Contractor during such originally scheduled period. No changes in the Contract Price will be authorized because of adjustment of Contract Time due to weather.

- B. Breakdown of Cost: Before the first application for payment the Contractor shall submit to the Owner a breakdown of cost for the various portions of the Work, including quantities if required by the Owner, aggregating the total Contract Price prepared in such form as specified or as the Owner and the Contractor may agree upon and supported by such data to substantiate its correctness as the Owner may reasonably require. This schedule of values, when approved by the Owner, will be used only as a basis for the Contractor's application for payment; however, the payment schedule will correlate directly with the Overall Project Schedule (OPS) cost information, when applicable.
- C. Progress Payments: At the end of each calendar month, the Contractor shall submit to the Owner an itemized application for payment supported by such other substantiating data as the Owner may reasonably require covering Work completed through the end or the last working day of the month. Application for payment may include, at the Contractor's option, the cost of products not yet incorporated into the Work which have been delivered to the site or to other storage locations authorized and approved by the Owner. The Owner reserves the right to accept or reject pay requests for stored materials, and to limit payments to those stored materials which, in the Owner's judgment, are necessary for continuing satisfactory Project progress.
- D. Retention: The Owner will retain the following amounts from each properly certified estimate:
 - 1. Until the value of the Work completed, including stored materials, is at least fifty percent (50%) of the Contract amount, ten percent (10%) of the value of all Work satisfactorily completed, including stored materials.

- 2. When the value of the completed Work totals at least fifty percent (50%) of the Contract amount, the Owner will discontinue retaining amount in addition to those specified in paragraph 1 above, provided the Work is progressing satisfactorily, there are no Change Orders, and there is no specific cause for retaining a larger sum. The total amount retained will be at least five percent (5%) of the Contract Amount, adjusted for Change Orders, until the date of final payment.
- 3. The Owner may elect to reinstate retention of ten percent (10%) of the value of the Work completed if, at any time, the Contractor fails to make satisfactory progress or if there is other specific cause. Satisfactory progress is identified as conforming to the construction progress schedule as required in Article 23.
- 4. No form of collateral in lieu of cash will be acceptable as a retainer.
- 5. Amounts retained by the Contractor from payments due to suppliers and subcontractors (expressed as a percentage) shall not exceed that being retained by the Owner.
- E. Payments Withheld: The Owner may decline to approve an Application for Payment and may withhold certificate, in whole or in part, as may be necessary to protect from loss because of:
 - 1. Failure of the Contractor to make payments properly to subcontractors or for labor or products.
 - 2. Unsatisfactory prosecution of the Work by the Contractor either due to quality of the Work or if the Contractor is behind the currently approved construction schedule.
 - When the above reasons for nonpayment are corrected, then payment will be made for amounts withheld because of such reasons, not later than the next payment cycle.
- F. Completion and Final Acceptance shall be stipulated as follows:
 - 1. Upon completion of all work required, the Contractor shall request that the final inspection be performed. If the Owner finds the work of the Contractor complete and acceptable in accordance with the provisions of the Contract Documents the job will be accepted and final payment will be made.
 - 2. In the event that the final inspection reveals deficiencies in meeting the Contract requirements, the Contractor shall complete all remaining items of work, and make adjustments found to be necessary. Upon receipt of request from the Contractor that the work is complete and ready for reinspection, the Owner will make a final re-inspection.
 - 3. The Contractor will be notified, in writing, by the Owner of the final acceptance of the work. The date of final acceptance shall be the termination date for the Contractor's liability for the physical properties of the facilities and the beginning of the warranty period.
 - 4. Before final payment is made, the Contractor must certify, in writing, to the Owner that all payrolls, materials bills, and other indebtedness connected with the work have been paid.
 - 5. Final payment will not be made if there is disputed indebtedness or if there are liens against the Project or the Contractor.

- 6. The making of the final payment shall constitute a waiver of all claims by the Owner, other than those for faulty work covered by and appearing within the warranty period.
- 7. The acceptance of final payment shall constitute a waiver of all claims by the Contractor.

G. Prompt Payment Clause:

- 1. Owner and Contractor agree that all partial payments and final payments shall be subject to the Georgia Prompt Pay Act, as originally enacted and amended, and as set forth in O.C.G.A. 13-11-1 through 13-11-11, except as provided below to the extent authorized by law:
 - a. Interest Rate: For purposes of computing interest on late payments, the rate of interest shall be one-half percent per month or a pro-rata fraction thereof on the unpaid balance as may be due.

b. Payment Periods:

- (1) When the Contractor has performed in accordance with the provisions of these Contract Documents, the Owner shall pay the Contractor within 15 days of receipt by the Owner or the Owner's representative of any properly completed Application for Payment, based upon work completed or service provided pursuant to the terms of these Contract Documents.
- (2) When a subcontractor has performed in accordance with the provisions of its subcontract and the subcontract conditions precedent to payment have been satisfied, the Contractor shall pay to that subcontractor and each subcontractor shall pay to its subcontractor, within ten days of receipt by the Contractor or subcontractor of each periodic or final payment, the full amount received for such subcontractors work and materials based on work completed or service provided under the subcontract, less retainage expressed as a percentage, but such retainage shall not exceed that retainage being held by the Owner, provided that the subcontractor has provided or provides such satisfactory reasonable assurances of continued performance and financial responsibility to complete its work as the Contractor in its reasonable discretion may require, including but not limited to a payment and performance bonds.
- c. Interest on Late Payment: Except as otherwise provided in these Contract Documents and/or in O.C.G.A. 13-11-5, if a periodic or final payment to the Contractor is delayed by more than the time allotted in Paragraph b. of the Prompt Payment Clause or if a periodic or final payment to a subcontractor is delayed more than ten days after receipt of periodic or final payment by the Contractor or subcontractor, the Owner, Contractor, or subcontractor, as the case may be, shall pay interest to its Contractor, or subcontractor beginning on the day following the due dates as provided in Paragraph b. of this Prompt Payment Clause at the rate of interest as provided herein. Interest shall be computed per month or a pro-rata fraction thereof on the unpaid balance. There shall be no compounded interest. No interest is due unless the person or entity being charged interest receives "Notice" as provided in Paragraph d. of the Prompt Payment Clause. Acceptance of progress payments or final payment shall release all claims for interest on said payments.
- d. Notice of Late Payment and Request for Interest: Any person or entity asserting entitlement to interest on any periodic or final payment pursuant to the provisions of this Prompt Payment Clause shall provide "notice" to the person or entity being charged interest of the charging party's claim to interest on late payment. "Notice" shall be in writing, served by U.S. Certified

Mail - Return Receipt Requested at the time the properly completed Application for Payment is received by the Owner or Owner's representative, and shall set forth the following:

- (1) A short and concise statement that interest is due pursuant to the provisions of the Georgia Prompt Pay Act and this Prompt Payment Clause;
- (2) The principal amount of the periodic or final payment which is allegedly due to the charging party; and
- (3) The first day and date upon which the charging party alleges that said interest will begin to accrue, pursuant to the provisions of the Georgia Prompt Pay Act and this Prompt Payment Clause.

These "Notice" provisions are of the essence; therefore, failure to comply with any requirement as set forth in this Prompt Payment Clause precludes the right to interest on any alleged late payment to which said "Notice" would otherwise apply.

2. Integration with the Georgia Prompt Pay Act: Unless otherwise provided in these Contract Documents, the parties hereto agree that these provisions of this Prompt Payment Clause supersede and control all provisions of the Georgia Prompt Pay Act (O.C.G.A. 13-11-1 through 13-11-11 (1994), as originally enacted and as amended, and that any dispute arising between the parties hereto as to whether or not the provisions of this contract or the Georgia Prompt Pay Act control will be resolved in favor of these Contract Documents and its terms.

ARTICLE 31 - ARBITRATION AND JURISDICTION

Arbitration will not be allowed on this Project. This Agreement will be governed by, and construed in accordance with, the laws of the State of Georgia, without regard to its conflict of law's provisions. Contractor hereby submits to the jurisdiction of the Georgia Courts and will obtain and maintain an agent for service of process in the State of Georgia. Neither party will bring any action against the other party arising out of or relating to this Agreement in any forum or venue except the Superior Court of Dawson County, Georgia. Contractor irrevocably waives any present or future objections to such venue for any such legal action and irrevocably waives the right to bring any legal action in any other jurisdiction.

ARTICLE 32 – AUTHORITY OF THE ENGINEER AND DESIGN ENGINEER

The Engineer will act as the Owner's representative during the construction period. The Engineer will decide questions which may arise as to quality and acceptability of products furnished and Work performed. The Engineer will make visits to the site and determine if the Work is proceeding in accordance with the Contract Documents. The Engineer will judge as to the accuracy of quantities submitted by the Contractor in partial payment estimates and the acceptability of the Work which these quantities represent. The Design Engineer will interpret the intent of the Contract Documents in a fair and unbiased manner. The decision of the Design Engineer will be final and conclusive.

SUPPLEMENTAL CONDITIONS

DOCUMENT 00 73 00

SUPPLEMENTAL CONDITIONS

PART 1 GENERAL

1.1 SCOPE

A. The scope of this Section is to convey to the Contractor unique and unusual stipulations and requirements which have been established for this Project. Some of the stipulations and requirements are a result of negotiations with various entities and organizations which have an interest in this Project. Some requirements are based on technical aspects of the Project which are not otherwise conveyed to the Contractor. The provisions of this Section shall supersede the provisions of the Specifications but shall not supersede the Bidding Requirements, Contract Forms or Conditions of the Contract.

1.2 NPDES PERMIT

A. For the NPDES General Permit for Discharges Stormwater Associated with the Construction Activities, administered by the Georgia Environmental Protection Division, the Contractor will be designated as Primary Permittee. The Contractor shall be responsible for complying with the requirements of this Permit during the duration of the Project, including the filing of the Notice of Intent and Notice of Termination. The Cost for complying with the requirements of this Permit shall be paid from the NPDES Monitoring cash allowance.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

INSURANCE REQUIREMENTS

DOCUMENT 00 73 16

INSURANCE REQUIREMENTS

ARTICLE 1 - INSURANCE

The Contractor shall not commence any work under this Contract until all insurance, as stipulated herein, has been obtained and such insurance has been approved by the Owner, nor shall the Contractor allow any subcontractor to commence any work on subcontractor's contract until all similar insurance required of the subcontractor has been so obtained and approved by the Contractor.

- A. Worker's Compensation: The Contractor shall procure and shall maintain during the life of the Contract Agreement, Worker's Compensation Insurance for all of Contractor's employees to be engaged in work on the Project under this Contract, and in case any such Work is subcontracted, the Contractor shall require the subcontractor similarly to provide Worker's Compensation Insurance for all of the latter's employees to be engaged in such Work unless such employees are covered by the protection afforded by the Contractor's Worker's Compensation Insurance. Worker's Compensation Insurance shall be in accordance with Georgia Law and include Broad Form All States Endorsement and Voluntary Compensation. The contractor shall obtain a minimum of \$500,000 Employer's liability insurance and provide a waiver of subrogation in favor of the Owner.
- B. General Liability: The Contractor shall procure and shall maintain during the life of the Contract Agreement, such Comprehensive General Liability and Broad Form Property Damage Insurance as shall protect the Contractor and any subcontractor performing the Work covered by this Contract from claims for damages for bodily injury, including accidental death, as well as from claims for property damages, which may arise from operations under the Contract Agreement, whether such operations are by the Contractor or by any subcontractor or by anyone directly or indirectly employed by either of them. The amount of insurance shall not be less than the following:

| General Aggregate | \$2,000,000.00 |
|-----------------------------------|----------------|
| Products Comp/Ops Aggregate | \$2,000,000.00 |
| Personal and Advertising Injury | \$1,000,000.00 |
| Each Occurrence | \$1,000,000.00 |
| Fire Damage (Any one fire) | \$50,000.00 |
| Medical expenses (Any one person) | \$5,000.00 |

C. Automobile Liability: The Contractor shall procure and shall maintain during the life of the Contract Agreement, Comprehensive Automobile Liability Insurance. The insurance shall include coverage for owned, non-owned and hired vehicles. Amounts shall not be less than the following:

Combined Single Limits (CSL) \$1,000,000.00

D. Materials and Equipment Floater: The Contractor shall procure and shall maintain during the life of the Contract Agreement, Materials and Equipment Floater Insurance to protect the interests of the Owner, the Contractor, and subcontractors against loss by vandalism, malicious mischief, and all hazards included in a standard All Risk Endorsement. The amount of the insurance shall be in the names of the Owner and the Contractor.

INSURANCE REOUIREMENTS

E. Additional Excess or Umbrella Liability: The Contract shall procure and shall maintain during the life of the Contract Agreement, Excess or Umbrella Liability Insurance to overlay General Liability, Owner's and Contractor's Protective Liability, and Automobile Liability

| Occurrence | \$1,000,000.00 |
|------------|----------------|
| Aggregate | \$4,000,000.00 |

Certificates of Insurance: Certificates acceptable to the Owner shall be attached to each set of original signed Contract Documents when they are transmitted to the Owner for final execution and approval. The Owner, Etowah Water and Sewer Authority, Dawsonville, Georgia shall be Additional Insured on all coverages, except Worker's Compensation. The Certificates of Insurance, and any subsequent renewals, shall reference the Project. These certificates shall contain the statement that "Coverages afforded under the policies will not be canceled unless <u>AT LEAST THIRTY (30) days</u> prior to cancellation written notice has been given to the Owner."

- F. Indemnification: The work performed by Contractor shall be at the risk of the Contractor exclusively. Contractor hereby indemnifies and holds Owner, its parent and affiliates and their respective officers, directors, employees and agents, harmless from and against any and all claims, actions, losses, judgments, or expenses, including reasonable attorneys fees, arising from or in any way connected with the work performed, materials furnished, or services provided to Owner during the term of this Contract.
- G. The Contractor's insurance coverage shall be primary insurance as respects work and ongoing operations on this Project for the Owner, its directors, officers, and employees. Any insurance or self-insurance maintained by the Owner shall be excess of the Contractor's insurance. The Contractor, in its agreements with subcontractors, shall require subcontractors to obtain insurance meeting the minimum limits and incorporating the contractual requirements that are prescribed by these Contract Documents. The Contractor hereby waives and relinquishes any right of subrogation against Owner and its agents, representatives, employees, and affiliates they might possess for any policy of insurance provided under this Section or under any State or Federal Workers' Compensation or Employer's Liability Act.
- H. The insurance company used by the Contractor and any of its subcontractors must be licensed to do business by the Georgia Department of Insurance, and have an A.M. Best rating of "A" or higher except in the worker's compensation category.

SUMMARY OF WORK

SECTION 01 11 13

SUMMARY OF WORK

PART 1 GENERAL

1.1 SCOPE

- A. The Work to be performed under this Contract shall consist of furnishing all labor, materials, tools, equipment and incidentals, and performing all work required to construct the Dawson Forest WRF Sludge Dewatering Upgrades complete in place and ready to operate. The project consists of the work as detailed on the construction drawings and generally as follows:
 - Construct a new Solids Dewatering Building at the Authority's Dawson Forest Water Reclamation Facility, and to install a new 2.2-meter belt press and related equipment and appurtenances as detailed in the specifications and as shown on the contract drawings.
- B. All Work described above shall be performed as specified in the Contract Documents. The Dawson Forest Water Reclamation Facility (WRF) must stay in continuous operation during the life of this contract as detailed on the construction drawings.
- C. All federal, state, and local permits required for the construction of this Project will be obtained by the Owner prior to Notice to Proceed, except for the local building permits, which if required are the responsibility of the Contractor.
- D. All easements or rights-of-way required for this project will be obtained by the Owner prior to Notice to Proceed.

1.2 PROJECT LOCATION

A. The equipment and materials to be furnished will be installed at the locations shown on the Drawings.

1.3 QUANTITIES

A. The Owner reserves the right to alter the quantities of work to be performed or to extend or shorten the improvements at any time when and, as found necessary, and the Contractor shall perform the work as altered, increased, or decreased. Payment for such increased or decreased quantities will be made in accordance with the Instructions to Bidders. No allowance will be made for any change in anticipated profits nor shall such changes be considered as waiving or invalidating any conditions or provisions of the Contract and Bonds.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

CONSTRUCTION SEQUENCING

SECTION 01 12 16

CONSTRUCTION SEQUENCING

PART 1 GENERAL

1.1 SCOPE

A. Work under this Section includes construction sequencing required to minimize the inconvenience to the Owner and surrounding property owners during the construction period.

1.2 GENERAL

- A. The Contractor shall be solely responsible for all construction sequencing required by this Section.
- B. Coordinate all work of this Section with the Owner.
- C. The Contractor shall incorporate the requirements of this Section into the Construction Schedule required elsewhere in these Specifications.

1.3 SEQUENCE OF CONSTRUCTION

- A. All work, including piping and electrical installation, fencing, misc. concrete, clean up, and grassing shall be completed daily as construction activities progress.
- B. Disturbance at the site must be minimized and construction must be sequenced to allow the Dawson Forest Water Reclamation Facility (WRF) to stay in continuous operation during construction.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

WORK RESTRICTIONS

SECTION 01 14 00

WORK RESTRICTIONS

PART 1 GENERAL

1.1 OCCUPANT NOTIFICATION

A. The Contractor will be responsible for notifying the Owner of the location and time of any work to be done a minimum of 48 hours prior to any work being done.

1.2 WORKING HOURS

A. The Contractor shall schedule all work to be done Monday through Saturday during normal business hours unless otherwise approved by the Owner and timely notification given to the Engineer. No work shall be performed on Sundays without the specific approval of the Owner. The Contractor's work hours shall be restricted to daylight hours. Construction activity noise shall begin 30 minutes after sunrise, at the earliest, and shall be kept to a minimum and may continue until sunset.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION – Not Used

PROJECT UTILITY SOURCES

SECTION 01 18 00

PROJECT UTILITY SOURCES

PART 1 GENERAL

1.1 PROTECTION OF UTILITIES

A. The Contractor shall be responsible for notifying the Utilities Protection Center at 1-800-282-7411 or 811 prior to any work being done. The Contractor shall be responsible for field verifying and protecting all utilities within the construction limits.

1.2 UTILITY PROVIDERS

A. The following is a list of possible utility providers in the Project area:

| Electrical Providers | Georgia Power |
|-----------------------|--------------------------------|
| | Sawnee EMC |
| Gas Providers | Atlanta Gas Light |
| Water Providers | Etowah Water & Sewer Authority |
| | City of Dawsonville |
| Sewer Providers | Etowah Water & Sewer Authority |
| | City of Dawsonville |
| Telephone Provider | Windstream |
| Fiberoptics Providers | Windstream |
| | Quest Communications |
| | Verizon |
| Cable Providers | Windstream |
| | |
| | |

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

CASH ALLOWANCES

SECTION 01 21 13

CASH ALLOWANCES

PART 1 GENERAL

1.1 SCOPE

A. General

- 1. The Contractor shall include in the Bid Total all allowances stated in the Contract Documents. These allowances shall cover the net cost of the services provided by a firm selected by the Owner. The Contractor's handling costs, labor, overhead, profit, and other expenses contemplated for the original allowance shall be included in the items to which they pertain and not in allowances.
- 2. No payment will be made for nonproductive time on the part of testing personnel due to the Contractor's failure to properly coordinate testing activities with the work schedule or the Contractor's problems with maintaining equipment in good working condition. The Contractor shall make all necessary excavations and shall supply any samples of materials necessary for conducting compaction and density tests.
- 3. No payment shall be provided for services that fail to verify required results.
- B. Should the net cost be more or less than the specified amount of the allowance, the Contract will be adjusted accordingly by Change Order. The amount of Change Order will not recognize any changes in handling costs at the site, labor, overhead, profit, and other expenses caused by adjusting the allowance(s).

C. Documentation

- 1. Submit copies of the invoices with each periodic payment request from the firm providing the services.
- 2. Submit results of all services provided.

D. Schedule of Cash Allowances

- 1. Soils and Concrete Testing:
 - a. Allow the amount specified in the Bid for the services of a geotechnical engineering firm and testing laboratory to verify soil conditions, including trench excavation and backfill and similar issues, and for the testing of concrete cylinders for poured in place concrete, as directed by the Engineer.
 - b. This allowance is solely for use of the Owner for verification of the soil conditions and poured in placed concrete.

2. Construction Surveying

- a. Allow the amount specified in the Bid for construction surveying by an independent surveying firm, selected by the Owner, to perform horizontal and vertical alignment checks at the discretion of the Engineer.
- b. This allowance is solely for the use of the Owner for verification of the Contractor's reference points, centerlines, and work performed. The presence of this cash allowance in no way relieves the Contractor of the responsibility of installing reference points, center lines, and temporary benchmarks, or verifying that the work has been performed accurately.

CASH ALLOWANCES

3. Blasting Monitoring

- a. Allow the amount specified in the Bid for the services of an independent, qualified specialty subcontractor, selected by the Owner, to perform blast monitoring and other blasting related operations.
- b. This allowance is solely for the use of the Owner. The presence of this cash allowance in no way relieves the Contractor of any requirements set forth in these Contract Documents.

4. SCADA:

- a. Not included in contract.
- b. Owner will contract and pay Control Automation directly to complete required SCADA work. Contractor shall coordinate with Control Automation.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION – Not Used

SECTION 01 22 00

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SCOPE

- A. Measurement of an item of work will be by the unit indicated in the Bid (See Bid Form 00 41 43).
- B. The Bid lists each item of the Project for which payment will be made. Unless otherwise stated in individual sections of the Specifications or in the Bid, no separate payment will be made for any item of work, materials, parts, equipment, supplies, or related items required to perform and complete the work. The costs for all such items required shall be included in the price bid for item of which it is a part. No payment will be made for any items other than those listed in the Bid.
- C. Required items of work and incidentals necessary for the satisfactory completion of the work which are not specifically listed in the Bid, and which are not specified in this Section to be measured or to be included in one of the items listed in the Bid, shall be considered as incidental to the work. All costs thereof, including Contractor's overhead costs and profit, shall be considered as included in the lump sum or unit prices bid for the various Bid items. The Contractor shall prepare the Bid accordingly.
- D. Work includes furnishing all labor, equipment, tools, and materials, which are not furnished by the Owner and performing all operations required to complete the work satisfactorily, in place, as specified and as indicated on the Drawings.
- E. Payment will include all necessary and incidental related work not specified to be included in any other item of work listed in the Bid.
- F. Payment will be made by extending unit prices multiplied by quantities provided and then summing the extended prices to reflect actual work. Such price and payment shall constitute full compensation to the Contractor for furnishing all plant, labor, equipment, tools, and materials not furnished by the Owner and for performing all operations required to provide to the Owner the entire Project, complete in place, as specified and as indicated on the Drawings.
- G. Final payment quantities shall be determined by summing all the monthly payment request quantities as submitted by the Contractor and approved by the Owner. If there is any disagreement over the final payment quantities, the Contractor and Owner will review the completed Work in place based on the record drawing lengths, dimensions, quantities, etc. to determine final payment quantities. Said record drawings shall conform to Section 01 32 00 Construction Progress Documentation. The precision of final payment quantities shall match the precision shown for that item in the Bid.

1.2 MOBILIZATION

- A. No separate payment shall be made for mobilization.
- B. All costs for mobilization shall be included in the Lump Sum bid for Section I Construction of the Dawson Forest WRF Sludge Dewatering Upgrades.

1.3 TRAFFIC CONTROL

- A. No separate payment shall be made for traffic control.
- B. The costs of all traffic control shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.

1.4 CLEARING AND GRUBBING

- A. No separate payment shall be made for clearing and grubbing.
- B. The costs of all equipment, operators, materials, etc. to remove all vegetative material as specified on the Drawings or specified by the Design Engineer, shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.
- C. No separate payment shall be made for disposal.
- D. The costs of disposing of waste, hauling, trucks, etc. shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.

1.5 EARTHWORK

A. Earth Excavation

- 1. No separate payment shall be made for earth excavation.
- 2. The costs of such shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.
- 3. No separate or additional payment shall be made for any special or unique method, means, techniques or equipment necessary for the Contractor's compliance with these Specifications, regulatory requirements, permits, laws or regulations which govern this Project.
- 4. No separate payment will be made for providing sheeting, bracing, and timbering.
- 5. Additional Material: No separate payment will be made for additional earth or fill materials imported to the project site.
- 6. No separate payment will be made for removing excess materials from the project site.

B. Mass Rock Excavation

- 1. Mass rock excavation will be paid for separately at the unit price provided in the Bid Form.
- 2. Payment will be made for the measured quantity of rock excavated, at the sum of the unit price for Mass Rock Excavation.
- 3. Should the Contractor anticipate additional unit cost for mass rock excavation, the Contractor shall include such additional cost in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.

- 4. The maximum allowable volume of rock excavation for payment, unless otherwise authorized by the Engineer, shall be based on the measurement described below. No allowance shall be made for excavation beyond the required dimensions.
- 5. Horizontal measurements shall be to the actual dimension of the excavation, but not exceeding one foot beyond the outer surface of the structure or a minimum of two feet from a wall.
- 6. Depth measurement shall be made from the original top of the rock to the bottom of the structure or ditch as specified, or to the bottom of the rock, whichever has the higher elevation.

C. Dewatering

- 1. No separate payment will be made for cost of equipment, labor, and materials required for dewatering required to accomplish the work.
- 2. The costs of all such work shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.

D. Backfilling

- 1. No separate payment will be made for backfilling or excavation, hauling and placement of borrow material.
- 2. The cost of all such work and all cost incidentals thereto shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.

1.6 TRENCH EXCAVATION AND BACKFILL

A. No separate or additional payment shall be made for any special or unique method, means, techniques, or equipment necessary for the Contractor's compliance with these Specifications, regulatory requirements, permits, laws, or regulations which govern this Project.

B. Trench Excavation

- 1. No separate payment shall be made for trench excavation.
- 2. The costs of all such work shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades

C. Sheeting, Bracing and Shoring

- 1. No separate payment will be made for providing sheeting, bracing, and timbering which are specified, shown on the Drawings, or necessary due to Contractor's means of construction.
- 2. No payment will be made for sheeting removed or for sheeting left in place for the Contractor's convenience.
- 3. The costs of all such work shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.

D. Trench Rock Excavation

- 1. Trench rock excavation shall be paid for separately at the unit price provided in the Bid Form
- 2. Payment will be made for the measured quantity of rock excavated, at the sum of the unit price for Trench Rock Excavation.

- 3. Should the Contractor anticipate additional unit cost for trench rock excavation, the Contractor shall include such additional cost in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.
- 4. The maximum allowable volume of rock excavation for payment shall be based on a trench width equal to the outside diameter of the pipe barrel plus 18-inches, but not less than 24-inches, and depth of rock on the pipe centerline, from the top of the rock to the bottom of the rock or the specified bottom of the trench, whichever has the higher elevation.
- 5. The Engineer must be given reasonable notice to measure all rock.
- 6. No allowance shall be made for excavating to extra widths for construction of manholes or other appurtenances, for excavating to sloping sides, or for excavations made necessary by the physical limitations of the Contractor's equipment. Cost of such additional rock excavation shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.
- 7. No additional payment shall be made for ensuring all blasting operations are conducted in accordance with all existing ordinances, regulations, and these Specifications.
- 8. The Blast Monitoring cash allowance shall not be used to pay for the requirements of the Contractor set forth in Section 01 21 13.
- E. Dewatering Excavations: All cost of equipment, labor, and materials required for dewatering shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.

F. Crushed Stone Stabilization

- 1. No payment for crushed stone stabilization shall be authorized until after the trench has been dewatered. If the pipe is installed in an inadequately prepared trench bottom, the Owner shall notify the contractor in writing of the deficiency and will not authorize payment for that portion of that length of pipe which was improperly installed.
- 2. Payment for trench stabilization shall be made on the basis of the amount authorized and the unit price provided for Crushed Stone Stabilization in Section VI Extra Work, If Ordered by the Engineer/Owner of the Bid Form.
- 3. No additional payment will be made for material required for specific bedding.
- 4. Should the Contractor anticipate additional unit cost for crushed stone stabilization, the Contractor shall include such additional cost in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.

G. Geotextile Fabric

- 1. Payment for Geotextile Fabric shall be made on the basis of the amount authorized and the unit price provided for Geotextile Fabric in Section VI Extra Work, If Ordered by the Engineer/Owner of the Bid Form.
- 2. Should the Contractor anticipate additional unit cost for geotextile fabric, the Contractor shall include such additional cost in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.

H. Bedding and Haunching

1. No separate payment will be made for excavation of the trench to the depth below the pipe necessary to provide the specified bedding and to lay the sewer to grade.

- 2. No separate payment will be made for additional trench depth required to provide the specified bedding and haunching.
- 3. No separate payment will be made for material used to provide specified bedding.
- 4. No separate payment will be made for improved bedding required to compensate for over excavation of the trench.

I. Initial Backfill

- 1. No separate payment shall be made for initial backfill.
- 2. No separate payment shall be made for drying out of or adding moisture to the initial backfill material in order to meet the compaction requirements.
- 3. No separate payment shall be made for providing select material if the insitu material cannot meet the compaction requirements.

J. Final Backfilling

- 1. No additional payment will be made for additional material when excavated materials are used
- 2. No separate payment shall be made for drying out of or adding to the final backfill material in order to meet the compaction requirements.
- 3. No additional payment will be made for providing select material if the insitu material cannot meet the compaction requirements.

K. Additional Material:

- 1. No separate payment will be made for additional earth or fill materials imported to the project site.
- 2. No separate payment will be made for removing excess materials from the project site.

1.7 EROSION AND SEDIMENT CONTROL

- A. No separate payment shall be made for temporary or permanent erosion and sedimentation controls, except as noted below.
- B. No payment will be made for any portion of the Project for which temporary erosion and sedimentation controls are not properly maintained.
- C. Quantities for payment shall be based upon actual quantities constructed and authorized by the Engineer.

D. Sediment Barriers (Sd1-S and Sd1-M):

- 1. All costs for Type "S" silt fence, including installation, maintenance, repair, and removal shall be included in the unit price bid for Silt Fence (Sd1-S).
- 2. All costs for Mulch Filter Berm, including installation, maintenance, repair, and removal shall be included in the unit price bid for Mulch Filter Berm (Sd1-M).

E. Rip-Rap/Storm Drain Outlet Protection (Rp and St)

1. Rip-Rap (Rp) Ditches and Storm Drain Outlet Protection (St) shall be installed at the locations detailed on the drawings or ordered in the field by the Owner/Engineer. The cost of furnishing and installing all rip rap used in locations including storm drain

- protection outlets (St) and Rip-Rap ditches (Rp) shall be included in the unit price bid for those items.
- 2. All areas at creeks or ditches disturbed by the Contractor outside the construction area which require rip-rap shall be rip-rapped at no additional cost to the Owner.
- 3. Payment for Rip-Rap will be on a per ton basis.

F. Grassing/Disturbed Area Stabilization (Ds1, Ds2, & Ds3):

- 1. The unit price in the bid for "Grassing" shall be for one-time cleanup of the project and the application grassing materials, whether permanent, temporary, or both. Any other costs for labor, material and equipment for cleanup and grassing of the disturbed area shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.
- 2. No additional payment shall be made where the Contractor must reseed due to: inadequate watering and maintenance; loss of seeds caused by site erosion, e.g., wind and rain; inadequate germination of the seeds; inadequate coverage/density; providing permanent species at the appropriate season after temporary grassing has been performed.
- 3. Temporary Grassing: No additional payment will be made for providing a temporary species of grass where the seasonal limitations do not allow for the proper germination of a permanent species of grass. Any additional cost anticipated for sowing a temporary species shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades.
- 4. Measurement for payment for Grassing shall be along the centerline of the pipeline, through fittings, valves, and manholes. The length of pipe constructed under pavement, through casings and free bores, and the length of pipe associated with water and sewer services shall not be included in quantities for payment for Grassing.
- 5. Grassing shall be done on a daily basis in conjunction with construction operations.
- 6. No payment will be made for grassing performed which is not the same species of that which was disturbed, unless otherwise shown or the Drawings or directed by Engineer.

G. Slope Stabilization (Ss):

1. All costs for slope stabilization, including installation, maintenance, and repair, used in locations including ditch bottoms and on slopes for stabilization, shall be as shown on the Drawings or specified or directed by the Owner and shall be included in the unit price bid for Slope Stabilization (Ss).

H. Construction Exit (Co):

1. The cost of each construction exit shall be included in the unit price bid for each Construction Exit (Co), and shall be located as shown on the Drawings or directed by the Owner/Engineer in the field.

1.8 SANITARY SEWERS, MANHOLES, AND ACCESSORIES

A. Existing Utilities and Obstructions

- 1. No separate payment will be made for any delay or extra cost encountered by the Contractor due to searching for, protection, avoidance or relocation of existing utilities, mains or services shown or not shown on the Drawings.
- 2. Horizontal Conflict: No separate payment shall be made for changing the horizontal alignment of the sanitary sewer line or force main to avoid a horizontal conflict.

- 3. Vertical Conflict: No separate payment shall be made for lowering the sanitary sewer line or force main alignment to avoid a vertical conflict.
- B. Construction along Highways, Streets and Roadways: No separate payment shall be made for traffic control or maintaining highways, streets, roadways, and driveways.

C. Location and Grade

- 1. No separate payment shall be made for any surveying performed by the Contractor to establish or confirm the location of reference points, rights-of-way, or easements, or location and grade of the sanitary sewer line or force main.
- 2. The "Construction Surveying" cash allowance is solely for the use of the Owner for verification of the Contractor's reference points, centerline and work performed. The presence of this cash allowance in no way relieves the Contractor of the responsibility of installing reference points, centerline, temporary benchmarks or verifying that the work has been performed accurately.

D. Laying and Jointing Pipe and Accessories

- 1. Gravity Sewer:
 - a. No separate or additional payment shall be made for gravity sewers.
 - b. All costs shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades, and shall include all piping, lining, construction, and all related items required to construct the pipe at the required depth and alignment as specified on the Drawings and Contract Documents.

2. Force Mains:

- a. No separate or additional payment shall be made for force mains.
- b. All costs shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades, and shall include all piping, fittings, valves, construction, and all related items required to construct the pipe at the required depth and alignment as specified on the Drawings and Contract Documents.
- c. No separate payment shall be made for maintaining the top of pipe a minimum of four feet below the nearest edge of pavement for sanitary sewer mains when installing sanitary sewer lines within state, county, or city rights-of-way.
- 3. No separate payment will be made for replacement of defective materials.
- 4. No separate payment shall be made for tracer wire.
- 5. No separate payment will be made for cutting and beveling pipe.
- 6. No additional payment will be made for maintaining flow while placing the new sewer in service.

E. Sanitary Sewer Manholes

- 1. No separate or additional payment shall be made for manholes.
- 2. All costs shall be included in the Lump Sum bid for Section I Dawson Forest WRF Sludge Dewatering Upgrades, and shall include all precast bases, risers, transitions, rubber boots, inverts, frames and covers, pipe connections, labor, and all materials and equipment as required to construct the manholes as detailed on the Drawings and Contract Documents.

F. Sanitary Sewer System Testing

1. No separate or additional payment shall be made for sanitary sewer system testing.

ETOWAH WATER & SEWER AUTHORITY

MEASUREMENT AND PAYMENT

2. All costs shall be included in the Lump Sum bid for Section I – Dawson Forest WRF Sludge Dewatering Upgrades.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

SUBSTITUTIONS AND PRODUCT OPTIONS

SECTION 01 25 13

SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section outlines the Contractor's requirements for substitutions and product options.

1.2 PRODUCTS LIST

A. General

- 1. Within 30 days after the date of Contract, submit to the Owner a complete list of all products that are proposed for installation, unless otherwise indicated elsewhere in the Contract Documents.
- 2. Tabulate the list by each Specification Section.
- B. For products specified under reference standards, include with the listing of each product the following:
 - 1. Name and address of manufacturer,
 - 2. Trade name.
 - 3. Model or catalog designation, and
 - 4. Manufacturer's data including performance and test data, and reference standards.

1.3 CONTRACTOR'S OPTIONS

- A. For products specified only by reference standards, select any product meeting the standards by any manufacturer unless otherwise required elsewhere in the Contract Documents.
- B. Whenever the Engineer's design is based on a specific product of a particular manufacturer, that manufacturer will be shown on the Drawings and/or listed first in the list of approved manufacturers in the Specifications. Substitutions will be considered only if the term "equal to" precedes the names of approved Manufacturers in the Specification. The Contractor, after receiving the Notice to Proceed, shall submit shop drawings on the substitute product for the Owner's review. Any Bidder intending to furnish products other than the first listed manufacturer, or furnish substitute items, shall:
 - 1. Verify that the item being furnished will fit in the space allowed, perform the same functions, and have the same capabilities as the item specified.
 - 2. Include in its Bid the cost of all accessory items which may be required by the other listed substitute product.
 - 3. Include the cost of any architectural, structural, mechanical, piping, electrical, or other modifications required.
 - 4. Include the cost of required additional work by the Engineer, if any, to accommodate the product substitution.
- C. Approval from the Owner is dependent on determination that the product offered is "equal to" in function, performance, quality of manufacture, ease of maintenance, reliability, service life,

SUBSTITUTIONS AND PRODUCT OPTIONS

and other criteria to that on which the design is based and will require no major modifications to structures, electrical systems, control systems, or piping systems.

D. Whenever a product specification includes minimum experience requirements which the manufacturer selected by the Contractor cannot meet, the manufacturer shall furnish the Owner with a cash deposit, or bond acceptable to the Owner in an amount equal to the cost of the product, which shall remain in effect until the experience requirement has been met.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. In all cases every attempt will be made to comply with the specified materials called for in the Specifications. In the event that the specified materials are not available, the Contractor will contact the Owner for instructions.
- B. Any product substitutions made with no cost change are required to be "equal to" the approved manufacturers listed in the Specification for the product. Product substitutions of lesser or greater cost must have substantiation of the cost and quality in the form of quotes from suppliers and submittals delivered to the Owner. All substitutions will require written approval by the Owner before the product is procured. Any changes in cost will be incorporated into a Change Order.
- C. It is the Contractor's responsibility to notify the Owner in advance before the need for any product substitutions impacts the schedule.

1.5 OWNER'S RESPONSIBILITIES

- A. Approval from the Owner is dependent on determination that the product offered is essentially equal in function, performance, quality of manufacture, ease of maintenance, reliability, service life and other criteria to that on which the design is based and will require no major modifications to structures, electrical systems, control systems, or piping systems.
- B. The Owner reserves the right to take up to five (5) working days to decide on approving substitutions after appropriate documentation has been received.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

UNIT PRICES

SECTION 01 26 00

UNIT PRICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

1.3 DEFINITION

A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if the estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, overhead, profit, and applicable taxes.
- B. Measurement and Payment: Refer to Bid form and individual Specification Sections for work that requires establishment of unit prices and for methods of measurement and payment. In the event of a conflict between the Bid form and the individual Specification Sections, the Bid form shall control.
- C. The Owner reserves the right to reject the Contractor's measurement of work-in-place that involves use of established unit prices, and to have this work measured, at the Owner's expense, by an independent surveyor to be selected by the Owner.
- D. Schedule: See Bid Form.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION – Not Used

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.1 GENERAL

- A. Work under this Section includes administrative requirements and procedures and all scheduling and administering of pre-construction and Project Coordination Meetings as herein specified and necessary for the proper and complete performance of this Work.
- B. Scheduling and Administration by Engineer:
 - 1. Prepare agenda;
 - 2. Make physical arrangements for the meetings;
 - 3. Preside at meetings;
 - 4. Record minutes and include significant proceedings and decisions;
 - 5. Distribute copies of the minutes to participants.

1.2 ADMINISTRATIVE ITEMS

- A. The Contractor will be given four (4) copies of the Drawings and Specifications upon execution of the Contract. At least one shall be kept marked to current, as-built status and readily available at the job site during the course of the work. This set of marked drawings shall be turned over to the Engineer after construction is complete. Additional copies of the Drawings and Specifications, if requested, will be provided at the cost to reproduce copies of said documents which shall be borne by the Contractor.
- B. Other work on the site may be accomplished by other Contractors as needed by the Owner. The Contractor shall cooperate with other Contractors. The Contractor shall be aware of such work, which has been completed by other forces and which may be on site and shall ensure that these improvements are not disturbed. If, through acts of negligence on the part of the Contractor, any other contractor or any subcontractor shall suffer loss or damage on the work, the Contractor agrees to settle with such other contractor or subcontractor. If such other contractor or subcontractor shall assert any claim against the Owner on account of any damage alleged to have been sustained, the Owner shall notify the Contractor, who shall indemnify and save harmless the Owner against any such claim. Further, the Contractor shall be responsible for ensuring the security of their property stored on site and shall assume full responsibility for coordinating, staging and performing construction activities with additional contractors working on site.
- C. Inspectors shall be authorized to inspect all work done and all materials furnished, including preparation, fabrication, and manufacture of the materials to be used. The Inspector shall not be authorized to alter or waive requirements of the Drawings and/or Specifications. He shall call the attention of the Contractor to failures of the work and/or materials to conform to the Drawings and Specifications. He may reject materials or suspend work until questions at issue can be decided by the Engineer. The presence of the Inspector shall in no way lessen the responsibility of the Contractor.

- The Contractor shall furnish the Engineer with every reasonable facility for ascertaining whether or not the work performed and materials used are in accordance with the requirements and intent of the Specifications and Drawings. No work shall be done, or materials used, without suitable inspection by the Owner or his representative. Failure by the Engineer to reject defective work and materials shall neither prevent later rejection when those defects are discovered, nor obligate the Owner to accept defective work. The representatives of all state, local, and federal regulatory agencies will have access to the work whenever it is in preparation or progress, and the Contractor shall provide proper facilities for such access and inspection. Where special safety equipment is required for inspection the inspector shall be furnished this equipment by the Contractor. All materials furnished, or work done which is not in accordance with the Specifications and Drawings will be rejected. Such materials or work which has been rejected shall be immediately removed. Work shall then be done, and materials furnished in accordance with the Specifications and Drawings. If the Contractor fails to remove the work and materials within forty-eight hours after having been ordered to do so, the Owner shall have the authority to immediately stop all of the Contractor's work. The Owner shall also have the authority to supply personnel and materials, at the cost and expense of the Contractor, in order to remove that work and/or those materials which are found not to be in accordance with the Specifications and/or Drawings.
- E. The inspection of the work shall not relieve the Contractor of any of his obligations to fulfill the Contract. Defective work shall be corrected even though the work and materials have been previously inspected by the Engineer and accepted or estimated for payment. Previous failure by the Engineer to condemn improper materials and/or workmanship shall not be considered a waiver of defects, nor will this previous failure to condemn improper materials prevent the Owner at any time subsequently from recovering damages for work actually defective. All work shall be guaranteed against defects in workmanship and materials for a period of one year from completion of the project as a whole.
- F. Should any portion of the Drawings and Specifications be obscure or in dispute, they shall be referred to the Engineer, and he shall decide as to the true meaning and intent. He shall also have the right to correct errors and omissions at any time when those corrections are necessary for the proper fulfillment of the Drawings and Specifications.
- G. Should any disagreement or difference arise as to the estimate, quantities, or classifications, or as to the meaning of the Drawings and/or Specifications, on any point concerning the character, acceptability, and nature of the several kinds of work and materials and construction thereof, the decisions of the Engineer shall be final, conclusive, and binding upon all parties to the Contract.
- H. During unseasonable weather, when the Engineer directs, all work must stop and all work must be suitably protected. Notwithstanding the Engineer's direction, the Contractor retains responsibility to protect the work from damage due to weather, including (but not limited to) flooding. The Contractor should not rely upon the Engineer and may, at any time, decide to stop work and protect and preserve his works.
- I. The Owner will furnish all land and rights-of-way necessary for the carrying out of this contract and the completion of the work herein contemplated and will use due diligence in acquiring said land and rights-of-way as speedily as possible. But it is possible that all lands and rights-of-way may not be obtained as herein contemplated before construction begins, in

which event the Contractor shall begin his work upon such land and rights-of-way as the Owner may have previously acquired. The Owner will provide no right-of-way on adjacent properties not affected by the project. The Contractor shall take every precaution to inconvenience as little as possible the owners or tenants of adjacent property. Public highways shall not be obstructed in such a way as to cut off traffic. The Contractor shall, at his own expense, repair any damage or injury to either private or public property during progress of the work.

- J. The Contractor shall only employ competent and skilled personnel on this contracted work. The Contractor shall at all times have a Superintendent who is satisfactory to the Engineer and who is capable of acting as the Contractor's agent on this work. This Superintendent shall receive instructions from the Engineer or his authorized representative. The Superintendent shall have full authority to execute the orders and directions of the Engineer without delay, and to promptly supply materials, tools, plant equipment, and labor as may be required. The Contractor shall upon demand by the Engineer, immediately remove that Superintendent, Foreman, and/or Workman whom the Engineer may consider to be incompetent or undesirable, or both.
- K. The Contractor shall comply with all applicable laws, ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the work specified herein. Permits and licenses necessary for construction of the work shall be secured and paid for by the Contractor. Any failure to maintain erosion control is the sole responsibility of the Contractor. Any fines levied due to inadequate or improper erosion control measures shall be the sole responsibility of the Contractor.
- L. Necessary sanitary facilities for the use of personnel on the work shall be erected and maintained by the Contractor in such manner and at such points as shall be approved by the Engineer. Facilities shall be maintained in a sanitary condition, and in strict accordance with local regulations. No unsanitary act shall be committed outside sanitary facilities.
- M. Should the Contractor so desire, he may build storage facilities for housing tools, machinery, and supplies. Those facilities will be permitted only at approved places. Their surroundings shall be maintained at all times in a sanitary and satisfactory manner. On or before completion of the work, those facilities shall be removed at the expense of the Contractor.
- N. No office space is required for the Owner or Engineer on this project.
- O. Refer to Instructions to Bidders for requirements for water supply for construction operations.
- P. The Contractor shall make his own arrangements for water supply and electrical power supply for his construction operations.
- Q. Streets, roads, and drives used by the Contractor for access to and from the jobsite shall be protected from damage. Project related damages shall be repaired immediately, and the area shall be left in good condition at the end of the construction period.
- R. The Contractor shall furnish and install all necessary temporary works for the protection of the contracted work including lights at night, barricades, and warning signs.

- S. The performance of work under this Contract shall comply with safety regulations prescribed by the Owner, those of the National Occupational Safety and Health Act of 1970, and the requirements of the State of Georgia. Each Bidder is responsible for compliance with the character and extent of these regulations. The Contractor is required to have a written construction safety plan, and, if requested, provide a copy of said plan to the Owner.
- T. The Contractor shall coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PRECONSTRUCTION CONFERENCE

- A. The Engineer shall schedule the preconstruction conference prior to the issuance of the Notice to Proceed.
- B. Representatives of the following parties are to be in attendance at the meeting:
 - Owner,
 - 2. Engineer and Engineering Inspector,
 - 3. Contractor and Superintendent,
 - 4. Major subcontractors, and
 - 5. Representatives of governmental or regulatory agencies, when appropriate.
- C. The agenda for the preconstruction conference shall consist of the following, as a minimum:
 - 1. Distribute and discuss a list of major subcontractors and a tentative construction schedule;
 - 2. Critical work sequencing;
 - 3. Designation of responsible personnel and emergency telephone numbers;
 - 4. Processing of Change Orders and Time Extensions;
 - 5. Easements and Permits;
 - 6. Adequacy of distribution of Contract Documents;
 - 7. Schedule and submittal of shop drawings, product data and samples;
 - 8. Pay request format, submittal cutoff date, pay date and retainage;
 - 9. Procedures for maintaining record documents;
 - 10. Use of premises, including office and storage areas and Owner's requirements;
 - 11. Major equipment deliveries and priorities;
 - 12. Safety and first aid procedures;
 - 13. Security procedures;
 - 14. Housekeeping procedures; and
 - 15. Working hours.

3.2 PROJECT COORDINATION MEETINGS

- A. Schedule regular monthly meetings as directed by the Owner.
- B. Hold called meetings as the progress of the Work dictates.

- C. The meetings shall be held at the location indicated in the notice.
- D. Representatives of the following parties are to be in attendance at the meetings:
 - 1. Owner;
 - 2. Contractor and superintendent;
 - 3. Major subcontractors as pertinent to the agenda;
 - 4. Owner's representative as appropriate; and
 - 5. Representatives of governmental or other regulatory agencies, as appropriate.
- E. The minimum agenda for progress meetings shall consist of the following:
 - 1. Review and approve minutes of previous meetings;
 - 2. Review work progress since last meeting;
 - 3. Note field observations, problems, and decision;
 - 4. Identify problems which impede planned progress;
 - 5. Review off-site fabrication problems;
 - 6. Review Contractor's corrective measures and procedures to regain plan schedule;
 - 7. Review Contractor's documentation regarding rainout/inclement weather days and proposed revision to the construction schedule as outlined in the General Conditions;
 - 8. Review submittal schedule; expedite as required to maintain schedule;
 - 9. Maintenance of quality and work standards;
 - 10. Review changes proposed by Owner for their effect on the Construction Schedule and Completion Date; and
 - 11. Complete other current business.

SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.1 SCOPE

- A. <u>Construction Schedules</u> This section includes preparing, furnishing, distributing, and periodic updating of the construction schedules as herein specified. The purpose of the schedule is to demonstrate that the Contractor can complete the overall Project within the Contract Time and meet all required interim milestones.
- B. <u>Record Drawings</u> The Work under this Section includes, but is not necessarily limited to, the compiling, maintaining, recording, and submitting of project record documents as herein specified.
- C. <u>Construction Photographs</u> The Work under this Section includes, but is not necessarily limited to, the requirements for the subject matter, presentation, maintaining, and submitting of project photographs as herein specified.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 CONSTRUCTION SCHEDULES

A. Submittals:

- 1. Overall Project Schedule (OPS)
 - a. Submit the schedule prior to or at the Pre-Construction Conference.
 - b. The Engineer will review the schedule and return it within 10 days after receipt.
 - c. If required, resubmit within 10 days after receipt of Engineer's comments.
- 2. Near Term Schedule (NTS)
 - a. Submit the first Near Term Schedule within 10 days of the Notice to Proceed.
 - b. The Engineer will review the schedule and return it within 10 days after receipt.
 - c. Submit an update of the OPS and NTS with each progress payment request.
 - d. Submit the number of copies required by the Contractor, plus two copies to be retained by the Engineer.
- B. Approval: Approval of the Contractor's detailed construction program and revisions thereto shall in no way relieve the Contractor of any of the Contractor's duties and obligations under the Contract. Approval is limited to the format of the schedule and does not in any way indicate approval of, or concurrence with, the Contractor's means, methods, and ability to carry out the Work.
- C. Overall Project Schedule (OPS)

1. The Contractor shall submit to the Engineer for approval a detailed Overall Project Schedule of the Contractor's proposed operations for the duration of the Project. The OPS shall be in the form of a Gantt/bar chart.

2. Gantt/Bar Chart Schedule

- a. Each activity with duration of five or more days shall be identified by a separate bar. Activities with duration of more than 20 days shall be sub-divided into separate activities.
- b. The schedule shall include activities for shop drawing preparation and review, fabrication, delivery, and installation of major or critical path materials and equipment items.
- c. The schedule shall show the proposed start and completion date for each activity. A separate listing of activity start and stop dates and working day requirements shall be provided unless the information is shown in text form on the Gantt/bar chart.
- d. The schedule shall identify the Notice to Proceed date, the Contract Completion date, major milestone dates, and a critical path.
- e. The schedule shall be printed on a maximum 11 x 17-inch size paper. If the OPS needs to be shown on multiple sheets, a simplified, one page, summary bar chart showing the entire Project shall be provided.
- f. The schedule shall have a horizontal time scale based on calendar days and shall identify the Monday of each week.
- g. The schedule shall show the precedence relationship for each activity.

3. Near Term Schedule (NTS)

- a. The Contractor shall develop and refine a detailed Near Term Schedule showing the day-to-day activities with committed completion dates that must be performed during the upcoming 30-day period. The detailed schedule shall represent the Contractor's best approach to the Work that must be accomplished to maintain progress consistent with the Overall Project Schedule.
- b. The Near Term Schedule shall be in the form of Gantt/bar chart and shall include a written narrative description of all activities to be performed and describe corrective action to be taken for items that are behind schedule.

4. Updating

- a. Show all changes occurring since previous submission of the updated schedule.
- b. Indicate progress of each activity and show actual completion dates.
- c. The Contractor shall be prepared to provide a narrative report at the Project Coordination Meetings. The report shall include the following:
 - 1) A description of the overall Project status and comparison to the OPS.
 - 2) Identify activities that are behind schedule and describe corrective action to be taken
 - 3) A description of changes or revisions to the Project and their effect on the OPS.
 - 4) A description of the Near Term Schedule of the activities to be completed during the next 30 days. The report shall include a description of all activities requiring participation by the Engineer and/or Owner.

3.2 RECORD DOCUMENTS

A. Scope

- 1. Record documents include, but are not limited to:
 - a. Drawings;
 - b. Specifications;

- c. Change orders and other modifications to the Contract;
- d. Field orders or written instructions, including Requests for Information (RFI) and Clarification Memorandums;
- e. Reviewed shop drawings, product data, and samples;
- f. Test records.
- 2. The Contractor shall maintain on the Project site throughout the Contract Time an up to date set of Record Drawings.

B. Maintenance of Documents and Samples

1. Storage

- a. Store documents and samples in the Contractor's field office, apart from documents used for construction. If a field office is not required for the project, then the project superintendent shall maintain a record set in his possession.
- b. Provide files and racks for storage of documents.
- c. Provide locked cabinet or secure storage space for storage of samples.
- 2. File documents and samples in accordance with format of these Specifications.
- 3. Maintenance
 - a. Maintain documents in a clean, dry, legible condition, and in good order.
 - b. Do not use record documents for construction purposes.
 - c. Maintain at the site for the Owner one copy of all record documents.
- 4. Make documents and samples available at all times for inspection by Owner.
- 5. Failure to maintain the Record Documents in a satisfactory manner may be cause for withholding of a certificate for payment.

C. Quality Assurance

- 1. Unless noted otherwise, Record Drawings shall provide dimensions, distances, and coordinates to the nearest 0.1-foot.
- 2. Unless noted otherwise, Record Drawings shall provide elevations to the nearest 0.01-foot for all pertinent items constructed by the Contractor.

D. Recording

- 1. Label each document "PROJECT RECORD" in neat, large printed letters.
- 2. Recording
 - a. Record information concurrently with construction progress.
 - b. Do not conceal any Work until required information is recorded.

E. Record Drawings

- 1. Record Drawings shall be submitted consisting of a red-lined set of construction drawings detailing all changes that occurred during construction. At least three measurements from all permanent structures to each water valve.
- 2. Legibly mark drawings to record actual construction, including:
 - a. All Construction
 - 1) Change of dimension and detail.
 - 2) Changes made by Requests for Information (RFI), field order, clarification memorandums or by change order.
 - 3) Details not on original Drawings.
 - b. Site Improvements, Including Underground Utilities

- 1) Horizontal and vertical locations of all exposed and underground utilities and appurtenances, both new facilities construction and those utilities encountered, referenced to permanent surface improvements.
- 2) Location of and dimensions of roadways and parking areas, providing dimensions to back of curb when present.
- 3) The locations shall be referenced to at least two easily identifiable, permanent landmarks (e.g., power poles, valve markers, etc.) or benchmarks.
- 4) The Record Drawings shall include the horizontal angle and distance between manhole covers.

F. Specifications

Legibly mark each section to record:

- 1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
- 2. Changes made by Requests for Information (RFI), field order, clarification memorandums, or by change order.

G. Submittals

- 1. At contract closeout, deliver Record Documents to the Owner.
- 2. Accompany submittal with transmittal letter, in duplicate, containing:
 - a. Date.
 - b. Project title and number.
 - c. Contractor's name and address.
 - d. Title and number of each record document.
 - e. Signature of Contractor or Contractor's authorized representative.

3.3 CONSTRUCTION PHOTOGRAPHS

A. General

- 1. Prior to the beginning of any work, the Contractor shall take project photographs of the work area to record existing conditions.
- 2. All conditions that might later be subject to disagreement shall be shown in sufficient detail to provide a basis for decisions.
- 3. Photographs shall be taken by the Contractor to record the general progress of the Project. Photographs will be representative of the primary work being performed at that time.
- 4. The photographs shall include the date and time of the recording. All photographs shall be labeled on a table connected to the bottom of the photo to indicate date and description of work shown.
- 5. Photographs shall be submitted in plastic sleeves pre-punched for a 3-ring binder.
- 6. The Contractor may choose to provide the Owner with digital project photographs, provided these photos are still shot, submitted with reference date and description of work. These digital photographs shall be submitted on a CD.

B. Submittals

1. The construction photographs shall be submitted to the Owner within 30 calendar days after the date of receipt by the Contractor of Notice to Proceed. One print of each photograph shall be submitted.

- C. Buried, Submerged, and Hidden Construction
 - 1. Items that will not be readily visible after construction is completed or after the facilities are placed into operation shall be photographed prior to backfilling, placing of concrete, submergence, etc. This includes, but shall not be limited to:
 - a. Pipe or conduit under slabs or inside of walls;
 - b. Buried or submerged valves, pipes and equipment;
 - c. Restrain for valves, pipes, and equipment;
 - d. Concrete encasement, thrust blocking, vaults, and manholes;
 - e. Connections and tie-ins for water and sewer lines;
 - f. Connections, taps, and tie-ins for water and sewer services;
 - g. Utility lines, culverts, and other obstructions encountered during the construction activities.

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, & SAMPLES

PART 1 GENERAL

1.1 SCOPE

- A. The work under this Section includes submittal to the Owner of shop drawings, product data, and samples required by the various sections of these Specifications.
- B. Submittal Contents: The submittal contents required are specified in each section.
- C. Submittals are categorized as follows:
 - 1. Shop Drawings
 - a. Shop Drawings shall include technical data, drawings, diagrams, procedure and methodology, performance curves, schedules, templates, patterns, test reports, calculations, instructions, measurements, and similar information as applicable to the specific item for which the shop drawing is prepared.
 - 2. Product Data
 - a. Product data including standard printed information on materials, products, and systems, not specially prepared for this Project, other than the designation of selections from among available choices printed therein.
 - 3. Samples
 - a. Samples including both fabricated and un-fabricated physical examples of materials, products, and units of work, both as complete units and as smaller portions of units of work, either for limited visual inspection or, where indicated, for more detailed testing and analysis.
 - 4. Miscellaneous submittals related directly to the Work (non-administrative) include warranties, maintenance agreements, workmanship bonds, project photographs, survey data and reports, physical work records, statements of applicability, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, operation and maintenance materials, overrun stock, security/protection/safety keys and similar information, devices and materials applicable to the Work but not processed as shop drawings, product data, or samples.
- D. Electronic Submittals: Although not specifically stated herein, the Owner will consider electronic submittals in whole or in part if Owner and Contractor can reach mutual agreement to electronic submittal procedures.

PART 2 PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. The Contractor shall submit <u>via email electronic PDF copies</u> of shop drawings to the Engineer for review and comment for ALL material and work permanently entered into the Project.

- B. The Contractor shall not purchase nor install any material which has not been submitted, reviewed, and accepted by the Engineer.
- C. The Contractor shall transmit each submittal with transmittal letter. The Contractor shall submit a standard transmittal form or use the Owner's standard form.
- D. The Contractor shall sequentially number the transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- E. The Contractor shall identify Project, Contractor, subcontractor, and supplier; pertinent drawing and detail number; and specification section number, appropriate to submittal.
- F. The Contractor shall electronically stamp and sign each individual submittal certifying that review, approval, verification of products required, field dimensions, details, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents prior to submitting the shop drawing to the Engineer.
- G. The Contractor shall clearly identify any and all variations and deviations from the Contract Documents. This includes any product or system limitations which may be detrimental to the successful performance of completed Work.
- H. Any deviations proposed by the Contractor and accepted by the Engineer shall conform to these specifications and any extra costs for the deviations shall be the responsibility of the Contractor.
- I. The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by the Engineer's review/acceptance of the shop drawing, product data, or samples unless the Contractor has specifically informed the Engineer in writing of such deviation/ exception at the time of submission and the Engineer has given written acceptance to the specific deviation/exception.
- J. The Contractor shall not be relieved from responsibility of errors or omissions in the shop drawings by the Engineer's review thereof.
- K. The Contractor shall allow space on submittals for Contractor and Engineer review stamps.
- L. Review by the Engineer of the Contractor's shop drawings shall not relieve the Contractor of responsibility for accuracy of dimensions and details. The Contractor shall be responsible for agreement and conformity of working drawings with the Contract Drawings and Specifications.
- M. To avoid confusion regarding the authorship of review comments, the Contractor shall mark the submittal with blue ink, the Owner shall mark with green ink and the Engineer shall mark with red ink.
- N. When revised for resubmission, identify changes made since previous submission. If the submittal is resubmitted, it shall be a complete submittal including all previously submitted data and all revised information; otherwise the submittal shall be rejected.

- O. The Contractor shall direct specific attention, in writing or on resubmitted shop drawings, product data or samples, to revisions other than those requested by the Engineer on previous submittals.
- P. The Contractor shall not be relieved of financial responsibility to correct deviations and revisions not specifically addressed in the shop drawing and accepted by the Engineer.
- Q. The Contractor shall distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
 - The contract price shall include the cost of furnishing all submittals and working drawings, and the Contractor shall be allowed no extra compensation for furnishing those drawings.
- R. Submittal sheets or drawings showing more than the particular item under consideration shall have all but the pertinent description of the item, for which review is requested, crossed out.
- S. Make all shop drawings accurate to a scale large enough to show all pertinent features of the item.
- T. Details shall be identified by reference to sheet and detail, specification section, schedule, or room numbers shown on the Contract Drawings.
- U. The Contract Drawings shall not be traced or reproduced by any method for use as or in lieu of detailed shop drawings. Identify materials and products in the work shown. Indicate compliance with standards and special coordination requirements.
- V. Do not allow shop drawing copies without appropriate final "Action" markings by the Engineer to be used in connection with the Work.

2.2 PRODUCT DATA

- A. Submitted literature showing more than the particular item under consideration shall have all but the pertinent information, for which review is requested, crossed out. Collect required data into one submittal for each unit of work or system and mark each copy to show which choices and options are applicable to the Project.
- B. Include manufacturer's standard printed recommendations for application and use.

2.3 SAMPLES

- A. Samples shall illustrate materials, equipment, or workmanship and establish standards by which completed work is judged.
- B. Unless otherwise specifically directed by the Engineer, all samples shall be of the precise article proposed to be furnished.
- C. Submit all samples in the quantity that are required to be returned plus one sample that will be retained by the Engineer.

- D. Include "range" samples, not less than three units, where unavoidable variations must be expected, and describe or identify variations between units of each set.
- E. Provide full set of optional samples where the Owner's selection is required.
- F. Samples are submitted for review and confirmation of color, pattern, texture, and "kind" by the Engineer.

2.4 COLORS

- A. Unless the precise color and pattern is specifically described in the Contract Documents, and a choice of color or pattern is available, submit accurate color and pattern charts to the Engineer for review and selection.
- B. Unless all available colors and patterns have identical costs and identical wearing capabilities, and are identically suited to the installation, completely describe the relative costs and capabilities of each.

PART 3 EXECUTION

3.1 SUBMITTALS

A. The Owner may back charge the Contractor for costs associated with having to review a particular shop drawing, product data, or sample more than two times to receive a "No Exceptions Taken" mark.

B. Grouping of Submittals

- 1. Unless otherwise specifically permitted by the Owner, make all submittals in groups containing all items that are interdependent.
- 2. No review will be given to partial submittals of shop drawings for items that interconnect and/or are interdependent. It is the Contractor's responsibility to assemble the shop drawings for all such interconnecting or interdependent items.

C. Schedule of Submittals

1. Within 30 days of Notice to Proceed and prior to any shop drawing submittal, the Contractor shall submit a schedule showing the estimated date of submittal and the desired approval date for each shop drawing anticipated. A reasonable period shall be scheduled for review and comments. Time lost due to unacceptable submittals shall be the Contractor's responsibility and some time allowance for re-submittal shall be provided. The schedule shall provide for submittal of items that relate to one another to be submitted concurrently.

3.2 TIMING OF SUBMITTALS

A. Make all submittals in advance of scheduled dates for installation to provide all required time for reviews, for securing necessary approvals, for possible revision and re-submittal, and for placing orders and securing delivery.

- B. Allow sufficient time for the Engineer's review following the receipt of the submittal. Allow a minimum of 30 days for initial processing of each submittal. Allow longer periods where processing must be delayed for coordination with subsequent submittals. The Engineer will advise the Contractor promptly when it is determined that a submittal being processed must be delayed for coordination.
- C. Allow a minimum of two weeks for reprocessing each submittal revision.
- D. Submittals on the critical path, as identified in the Overall Project Schedule, shall be identified as such, and shall include the following notation: "Critical Path Item, Please Expedite". The notation shall appear on both the transmittal sheet and on the first page of the Submittal. The review of submittals noted to be on the critical path will be expedited. Failure of the Contractor to properly identify and note critical path submittals shall not be cause for claims of damage or delay. In addition, failure of the Contractor to provide adequate time for review of the critical path submittals shall not be cause for claims of damage or delay.

3.3 ROUTING OF SUBMITTALS

- A. Submittals and routine correspondence shall be routed as follows:
 - 1. Supplier to Contractor (through representative if applicable)
 - 2. Contractor to Engineer
 - 3. Engineer to Owner
 - 4. Owner to Engineer
 - 5. Engineer to Contractor
 - 6. Contractor to Supplier
- B. Address for Submittals:

Etowah Water & Sewer Authority
Engineering and Construction Department
1162 Highway 53 East
Dawsonville, Georgia 30534
timc@etowahwater.org
Attention: Tim Collins

3.4 REVIEWED SHOP DRAWINGS

- A. Submittals reviewed by the Engineer will be returned with one of the following marks:
 - 1. "No Exceptions Taken" means a submittal is acceptable.
 - 2. "Make Corrections Noted" means a submittal requires minor corrections. The Contractor may order, fabricate, and ship the items included in the submittals, provided the indicated corrections are made. Re-submittal and approval with a "No Exceptions Taken" mark is required prior to installation.
 - 3. "Amend and Resubmit" means a submittal must be revised and re-submitted with required changes.
 - 4. "Rejected See Remarks" means a product is not acceptable. Upon return of a submittal so marked, the Contractor shall repeat the initial review procedure utilizing acceptable products.

- B. No work or products shall be installed without a drawing or submittal bearing the "No Exceptions Taken" notation. The Contractor shall maintain at the job site a complete set of shop drawings, latest revision, bearing the Engineer's stamp.
- C. Use of the "No Exceptions Taken" notation on shop drawings or other submittals is general and shall not relieve the Contractor of the responsibility of furnishing products of the proper dimension, size, quality, quantity, materials, and all performance characteristics, to efficiently perform the requirements and intent of the Contract Documents. The Engineer's review shall not relieve the Contractor of responsibility for errors of any kind on the shop drawings. Review is intended only to assure conformance with the design concept of the Project and compliance with the information given in the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site. The Contractor is also responsible for information that pertains solely to the fabrication processes or to the technique of construction and for the coordination of the work of all trades.
- D. Substitutions: In the event the Contractor obtains the Owner's approval for the use of products other than those which are listed first in the Contract Documents, the Contractor shall, at the Contractor's own expense and using methods approved by the Owner, make any changes to structures, piping, and electrical work that may be necessary to accommodate these products.

JOB SITE SECURITY

SECTION 01 35 53

JOB SITE SECURITY

PART 1 GENERAL

1.1 BARRICADES, LIGHTS, AND SIGNALS

- A. The Contractor shall furnish and erect such barricades, fences, lights, and danger signals and shall provide such other precautionary measures for the protection of persons or property and of the Work as necessary. Barricades shall be painted in a color that will be visible at night. From sunset to sunrise, the Contractor shall furnish and maintain at least one light at each barricade and sufficient numbers of barricades shall be erected to keep vehicles from being driven on or into any Work under construction.
- B. The Contractor will be held responsible for all damage to the Work due to failure of barricades, signs, and lights and whenever evidence is found of such damage, the Contractor shall immediately remove the damaged portion and replace it at Contractor's cost and expense. The Contractor's responsibility for the maintenance of barricades, signs, and lights shall not cease until the Project has been accepted by the Owner.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

QUALITY REQUIREMENTS

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the requirements regarding quality assurance and control of installation.

B. Related Sections:

- 1. Project Manual General Conditions
- 2. Section 01 33 23 Shop Drawings, Product Data and Samples
- 3. Section 01 41 00 Regulatory Requirements

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. The source of supply of all materials and equipment shall be submitted to the Engineer for review before orders are placed. Suppliers of reinforcing steel, fabricated metal work, and metal castings may be required to submit guarantees of conformity with the Drawings and Specifications. Representative preliminary samples of the character and quality prescribed shall be submitted by the Contractor or producer for examination and tested in accordance with the methods specified.
- B. Only materials conforming to the requirements of the specifications shall be used in the work. All materials proposed to be used may be inspected or tested during their preparation and use. If, after inspecting and testing and/or trial, it is found that initial sources of supply do not furnish an acceptable product in conformity with the Specifications, the Contractor shall furnish material from other sources. No materials, which after approval have become unfit for use, shall be used in the work or remain on the job-site
- C. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- D. Tests shall be arranged by the Contractor as directed by the Engineer. The cost of all specified inspection and testing of materials shall be paid by the Contractor whether called for in this section or other sections. Companies to be hired by the Contractor for testing shall first be submitted for approval by the Owner and Engineer.
- E. Comply with manufacturers' instructions, including each step-in sequence.

1.3 TESTING AND INSPECTION SERVICES

A. The Contractor shall retain the services of an independent commercial testing laboratory. The independent firm will perform tests, inspections and other services specified and detailed on the drawings.

1.4 REFERENCES

- A. Unless otherwise specified, material tests shall be made in accordance with the standards of the American Society for Testing Materials (ASTM), and by a commercial testing laboratory approved by the Engineer; reports of tests shall promptly be furnished to the Engineer.
- B. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
- C. Obtain copies of standards where required by the Specifications.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 MATERIALS TESTING REQUIREMENTS

A. Cement:

- 1. Less than carload lots: The brand of a mill in successful operation for at least one year.
- 2. One car to five cars: Certificate of mill test to be furnished by producers of laboratory tests made as per (3) or (4).
- 3. Five cars and up: Independent laboratory tests as per ASTM C -150.
- 4. Bin Tests: As for (3) with test bin sealed.
- B. Fly Ash: Independent laboratory tests as per ASTM C 618.
- C. Slag Cement: Independent laboratory tests as per ASTM C 989.
- D. Sand: For use in Cement Concrete.
 - 1. 10 tons to 100 tons:

Field tests only.

- a. Color for organic matter
- b. Decantation test for silt
- c. Sieve Analysis
- 2. For each additional 100 tons: Independent laboratory test to indicate conformity with ASTM C 33.
- E. Stone and Gravel: For use in Cement Concrete:
 - 1. 10 tons 200 tons: Similar to Sand 1
 - 2. For each additional 200 tons: Similar to Sand 0

F. Concrete:

1. Preliminary Tests: Cylinder Compression Tests of concrete made of cement and aggregate proposed to be used in the work in accordance with ASTM C-39. Preliminary tests shall include at least four cylinders; two to be broken at 7 days and two at 28 days.

OUALITY REOUIREMENTS

2. Job Tests: Job tests shall include at least four cylinders for each test; two to be properly stored at the site; and two for laboratory control, one each to be broken at 7 days and one each at 28 days. Testing frequency shall be as outlined in these Specifications.

G. Brick:

- 1. 1 to 5 thousand: Visual inspection for shape, color, soundness, freedom from cracks, balls of clay or particles of lime.
- 2. 5,000 to 50 Thousand: For each additional 50 thousand or part thereof. Absorption test and either compression or flexure tests in accordance with ASTM C 67 by an independent laboratory.

H. Concrete Masonry Units:

- 1. 1 to 5 thousand: Visual inspection for soundness, freedom from cracks and chips, or other defects
- 2. For each additional 10 thousand or part thereof: In accordance with ASTM C 140.

I. Structural Steel:

- 1. Any quantity: Field inspection for rust, shape, and dimensions.
- 2. 25 to 200 tons: Independent shop inspection and certified copies of mill tests.
- 3. For Bridges and Buildings: See ASTM A 36.

J. Concrete Reinforcing Steel:

- 1. Certified copies of Mill Test for all heat runs.
- 2. Up to 50 thousand pounds: Field inspection for rust, shape, and dimensions.
- 3. 50 thousand pounds and up:

Independent laboratory inspection as follows:

| a. Billet Steel - ASTM A 615 |
|-------------------------------------|
| b. Roll Steel - ASTM A 616 |
| c. Cold-Drawn Steel Wire -ASTM A 82 |
| d Wire Fabric - ASTM A 185 |

K. Ductile Iron Pipe Gravity Sewer Pipe:

1. Section 33 31 00 – Sanitary Sewerage Piping, Ductile Iron Gravity Sewer Pipe: See testing and certification requirements.

L. PVC Pipe:

- 1. Field Inspection: For dimensions, inspect each piece for damage. Check quantities against the shipping list. Set aside any damaged items.
- 2. Laboratory Tests: Certified test reports by manufacturer.

ETOWAH WATER & SEWER AUTHORITY

QUALITY REQUIREMENTS

- M. Precast Concrete Manhole:
 - 1. Section 33 05 61 Manholes and Structures: See testing and certification requirements.
- N. Cast Iron Castings:
 - 1. Field Inspection: For dimensions, coatings, holes, hammer test.
 - 2. Laboratory Tests: Certified test reports by foundry.

SECTION 01 41 00

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

- A. Permits and Responsibilities: The Contractor shall, without additional expense to the Owner, be responsible for obtaining all necessary licenses and permits, including building permits, and for complying with any applicable federal, state, county and municipal laws, codes and regulations, in connection with the prosecution of the Work.
- B. The Contractor shall take proper safety and health precautions to protect the Work, the workers, the public and the property of others.
- C. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the Work, except for any completed unit of construction thereof that may heretofore have been accepted.

1.2 DESCRIPTION

- A. Whenever reference is made to conforming to the standards of any technical society, organization, body, code or standard, it shall be construed to mean the latest standard, code, specification or tentative specification adopted and published at the time of advertisement for Bids. This shall include the furnishing of materials, testing of materials, fabrication and installation practices. In those cases where the Contractor's quality standards establish more stringent quality requirements, the more stringent requirement shall prevail. Such standards are made a part hereof to the extent that is indicated or intended.
- B. The inclusion of an organization under one category does not preclude that organization's standards from applying to another category.
- C. In addition, all work shall comply with the applicable requirements of local codes, utilities and other authorities having jurisdiction.
- D. All material and equipment, for which a UL Standard, an AGA or NSF approval or an ASME, AASHTO, ASCE, ANSI, or ASTM requirement is established, shall be so approved and labeled or stamped. The label or stamp shall be conspicuous and not covered, painted, or otherwise obscured from visual inspection. All materials and equipment shall be new and unused.
- E. The standards that apply to this Project are not necessarily restricted to those organizations that are listed in Section 01 42 00.
- F. Unless otherwise stated in this document, all materials and workmanship within road rights-of-way shall be in accordance with the Georgia Department of Transportation's *Standard Specifications Construction of Transportation Systems*, latest edition.

ETOWAH WATER & SEWER AUTHORITY

REGULATORY REQUIREMENTS

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

REFERENCES

SECTION 01 42 00

REFERENCES

PART 1 ABBREVIATIONS AND ACRONYMS

1.1 STANDARD ORGANIZATIONS

A. Piping and Valves

| ACPA | American Concrete Pipe Association |
|------|---------------------------------------|
| ANSI | American National Standards Institute |

API American Petroleum Institute

ASME American Society of Mechanical Engineers

AWWA American Water Works Association

CISPI Cast Iron Soil Pipe Institute

DIPRA Ductile Iron Pipe Research Association

FCI Fluid Controls Institute

MSS Manufacturers Standardization Society

NCPI National Clay Pipe Institute
NSF National Sanitation Foundation

PPI Plastic Pipe Institute
Uni-Bell PVC Pipe Association

B. Materials

AASHTO American Association of State Highway and Transportation Officials

ANSI American National Standards Institute
ASTM American Society for Testing and Materials

C. Painting and Surface Preparation

NACE National Association of Corrosion Engineers

SSPC Steel Structures Painting Council

D. Electrical and Instrumentation

AEIC Association of Edison Illuminating Companies
AIEE American Institute of Electrical Engineers

EIA Electronic Industries Association ICEA Insulated Cable Engineers Association

IEEE Institute of Electrical and Electronic Engineers

IES Illuminating Engineering Society IPC Institute of Printed Circuits

IPCEA Insulated Power Cable Engineers Association

ISA Instrument Society of Americawee

NEC National Electric Code

NEMA National Electrical Manufacturers Association

NFPA National Fire Protection Association

ETOWAH WATER & SEWER AUTHORITY

REFERENCES

TIA Telecommunications Industries Association

UL Underwriter's Laboratories

VRCI Variable Resistive Components Institute

E. Aluminum

AA Aluminum Association

AAMA American Architectural Manufacturers Association

F. Steel and Concrete

ACI American Concrete Institute

AISC American Institute of Steel Construction, Inc.

AISI American Iron and Steel Institute
CRSI Concrete Reinforcing Steel Institute
NRMA National Ready-Mix Association
PCA Portland Cement Association
PCI Pre-stressed Concrete Institute

G. Welding

ASME American Society of Mechanical Engineers

AWS American Welding Society

H. Government and Technical Organizations

AIA American Institute of Architects
APHA American Public Health Association
APWA American Public Works Association
ASA American Standards Association

ASAE American Society of Agricultural Engineers

ASCE American Society of Civil Engineers
ASQC American Society of Quality Control
ASSE American Society of Sanitary Engineers

CFR Code of Federal Regulations

CSI Construction Specifications Institute
EDA Economic Development Administration
EPA Environmental Protection Agency
FAA Federal Aviation Administration
FCC Federal Communications Commission

FmHA Farmers Home Administration

FS Federal Specifications

IAI International Association of Identification
ISEA Industrial Safety Equipment Association
ISO International Organization for Standardization

ITE Institute of Traffic Engineers

NBFU National Board of Fire Underwriters
(NFPA) National Fluid Power Association
NBS National Bureau of Standards

NISO National Information Standards Organization

REFERENCES

OSHA Occupational Safety and Health Administration

SI Salt Institute

SPI The Society of the Plastics Industry, Inc.
USDC United States Department of Commerce

WEF Water Environment Federation

I. General Building Construction

AHA American Hardboard Association

AHAM Association of Home Appliance Manufacturers
AITC American Institute of Timber Construction

APA American Parquet Association, Inc.
APA American Plywood Association

BHMA Builders Hardware Manufacturers Association

BIFMA Business & Institutional Furniture Manufacturers Association

DHI Door and Hardware Institute

FM Factory Mutual Fire Insurance Company
HPMA Hardwood Plywood Manufacturers Association

HTI Hand Tools Institute

IME Institute of Makers of Explosives

ISANTA International Staple, Nail and Tool Association

ISDSI Insulated Steel Door Systems Institute
IWS Insect Screening Weavers Association
MBMA Metal Building Manufacturers Association

NAAMM National Association of Architectural Metal Manufacturers

NAGDM National Association of Garage Door Manufacturers NCCLS National Committee for Clinical Laboratory Standards

NFPA National Fire Protection Association
NFSA National Fertilizer Solutions Association
NKCA National Kitchen Cabinet Association

NWMA National Woodwork Manufacturers Association NWWDA National Wood Window and Door Association

RMA Rubber Manufacturers Association SBC SBCCI Standard Building Code

SDI Steel Door Institute

SIA Scaffold Industry Association
SMA Screen Manufacturers Association
SPRI Single-Ply Roofing Institute
TCA Tile Council of America

J. Roadways

AREA American Railway Engineering Association

DOT Department of Transportation

SSRBC Standard Specifications for Road and Bridge Construction,

GDOT Georgia Department of Transportation

K. Plumbing

REFERENCES

AGA American Gas Association

NSF National Sanitation Foundation

PDI Plumbing Drainage Institute

SPC SBCCI Standard Plumbing Code

L. Refrigeration, Heating, and Air Conditioning

AMCA Air Movement and Control Association

ARI American Refrigeration Institute

ASHRAE American Society of Heating, Refrigeration, and Air Conditioning

Engineers

ASME American Society of Mechanical Engineers

CGA Compressed Gas Association
CTI Cooling Tower Institute
HEI Heat Exchange Institute

IIAR International Institute of Ammonia Refrigeration

NB National Board of Boilers and Pressure Vessel Inspectors

PFMA Power Fan Manufacturers Association SAE Society of Automotive Engineers

SMACNA Sheet Metal and Air Conditioning Contractors National Association

SMC Standard Mechanical Code

TEMA Tubular Exchanger Manufacturers Association

M. Equipment

AFBMA Anti-Friction Bearing Manufacturers Association, Inc.

AGMA American Gear Manufacturers Association

ALI Automotive Lift Institute

CEMA Conveyor Equipment Manufacturers

CMAA Crane Manufacturers Association of America
DEMA Diesel Engine Manufacturers Association
MMA Monorail Manufacturers Association
OPEI Outdoor Power Equipment Institute, Inc.

PTI Power Tool Institute, Inc.
RIA Robotic Industries Association

SAMA Scientific Apparatus Makers Association

1.2 SYMBOLS

A. Symbols and material legends shall be as scheduled on the Contract Drawings.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

DEFINITIONS

SECTION 01 42 16

DEFINITIONS

1.1 SUMMARY

- A. Document Includes:
 - 1. Abbreviations.
 - 2. Acronyms.
 - 3. Definitions.

1.2 DEFINITIONS

- **ACI:** American Concrete Institute.
- **ANSI:** American National Standards Institute.
- **ASTM:** American Society for Testing and Materials.
- **AWWA:** American Water Works Association.
- Balanced Bid; shall mean a Bid in which each of the unit prices and total amount bid for each of the listed items reasonably reflects the value of that item with regard to the entire job considering the prevailing cost of labor, material and equipment in the relevant market. A Bid is unbalanced when, in the opinion of the Owner, any unit prices or total amounts bid on any of the listed items do not reasonably reflect such values.
- Contract Time: shall mean the amount of consecutive calendar days as provided in the Contract Agreement for completion of the Project, to be computed from the date of the Notice to Proceed.
- Contractor: shall mean the party of the second part to the Contract Agreement or the authorized and legal representatives of such party.
- **CRSI:** Concrete Reinforcing Steel Institute.
- **Deficiency:** shall refer to any component or part of a project that is stored, installed, operating, and/or occupied that does not comply with the requirements of the Contract Documents between the time of project acceptance and the end of the Warranty Period.
- **Design Consultant:** shall mean Wiedeman and Singleton, Inc. of Norcross, Georgia, acting for the Owner, or their duly authorized representative.
- **Design Engineer:** The engineer under whose direction the plans and specifications were prepared. Design Engineer shall be a Georgia Licensed Professional Engineer. The Design Engineer may also be the Design Consultant.
- **Developer:** Any person, firm, corporation, association or partnership or any agent thereof who undertakes or proposes to undertake the development of land so as to constitute a residential

subdivision, apartment complex, condominium or commercial/industrial/ institutional establishment.

- DFT: Dry Film Thickness.
- Diameter: Nominal inside diameter of pipe excluding bituminous or epoxy bonded coating thickness.
- **DIP:** Ductile iron pipe.
- **Easement:** Non-profitable interest in land owned by another that entitles its holder to a specific limited use.
- Engineer: shall mean the Construction Manager, and shall be the entity responsible for administering the construction under the direction of the Owner. The Construction Manager may also be the Owner.
- **Final Completion:** shall be achieved when the Contract has been completed as a whole, the final deficiency list or work list has been completed, and the **Operation Test Period** has been successfully completed.
- Force Main: Piping, valves and other components of a single pressurized line used to convey raw
 water, potable water or sewage. A force main conveying potable water may have a limited number
 of service connections.
- FMR: Factory Mutual Research.
- Furnish: shall mean to supply and deliver to the jobsite, unload, inspect for damage.
- Furnished by the Owner: shall mean that the Owner shall pre-purchase specific products and have them delivered to a place mutually agreed upon by the supplier, the Owner and the Contractor, at no cost to the Contractor.
- Georgia EPD: State of Georgia, Department of Natural Resources, Environmental Protection Division.
- **GFI:** Ground Fault Interrupt.
- **GPM or (gpm):** Gallons per minute.
- Gravity Sewer: Piping and other components used to convey sanitary sewage in a non-pressurized system.
- **Inclement Weather:** is any weather event that delays or prevents the Contractor's work progress.
- Install: shall mean to unpack, assemble, erect, apply, place, finish, cure, protect, clean, and make ready for use.
 - Where the product is specifically identified as being furnished by the Owner under these Specifications, "Install" shall mean to take delivery of products pre-purchased by the

Owner and shipped to the Owner at a place mutually agreed upon by the supplier, the Owner, and the Contractor, off-load and transport to the job site, store as necessary and install according to the Drawings and Specifications.

- Lateral: Pipe extending from a sewer main to a street right-of-way or easement for the purpose of servicing a property (lot). The lateral shall be six (6") inches in diameter, shall not contain a manhole and shall be less than 250 feet in length.
- Lift Station: All pumps, valves, wet wells, controls and other components used to pump sanitary sewage into a force main.
- Liquidated Damages: shall mean the sum of \$500.00, which the Bidder agrees to pay for each consecutive calendar day beyond the Contract Time or Contract Completion Date, required to complete the Project as a whole. Liquidated Damages will end upon written notification from the Owner of final acceptance of the Project.
- **NEC:** National Electrical Code, latest edition.
- NEMA: National Electrical Manufacturers' Association.
- No. 57 Stone: Class I embedment or backfill material consisting of manufactured aggregates (crushed stone) in accordance with ASTM D 2321-89 (Reapproved 1995) and ASTM D 2487-00. Percent passing sieve sizes are as follows: 100% passes 1-1/2", < or 10% passes No. 4 and < 5% passes No. 200.
- **Notice to Proceed (NTP):** shall mean a written communication issued by the Engineer to the Contractor authorizing it to proceed with the work, establishing the date of commencement and completion of the work, and providing other direction to the contractor.
- Operation Test Period: shall mean the 30 day period beginning on the date of the substantial completion, after equipment has been started and tested by the manufacturer and supplier and in opinion of the Design Engineer can be operated by the Owner.
 - O During this period the Owner shall operate and test the equipment, through the normal expected operational cycle of the equipment.
 - The Owner will not accept any equipment until the Operational Test period is successfully completed.
 - During this period the equipment shall operate as specified and detailed on the Plans, and Specifications.
 - The equipment shall operate without any deficiencies, failures and/or faults, which in the opinion of the Owner do not meet the requirements of the specifications.
 - If such deficiencies, failures and/or faults are noted, the Operation Test Period shall end, and the deficiencies shall be corrected by the Contractor at no cost the Owner.
 - The Operation Test Period shall be restarted after the deficiencies are corrected, and the Owner agrees to restart the test period.
 - The Operational Test Period shall not be completed or considered successful until the full 30 days have passed and in the opinion of the Owner the equipment meets the requirements of the Plans and Specifications.

- When there are multiple equipments on a Project, the Operational Test Period for the Projected shall not be completed or considered successful until ALL equipment have completed their individual Operational Test Periods.
- Owner: shall mean the ETOWAH WATER AND SEWER AUTHORITY, party of the first part to the Contract Agreement (or the entity responsible for maintaining and operating the system as the case may be), or its authorized and legal representatives.
- Pavement: Any asphalt, concrete, gravel or dirt surface including curbs and sidewalks used by vehicles and/or pedestrians.
- PCF or (pcf): Pounds per cubic foot.
- Plans: shall refer to project drawings, Shop Drawings, specifications, and any other project documents.
- Products: shall mean new materials, machinery, components, equipment, fixtures and systems permanently incorporated into the Project, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.
- Project: shall mean the entire completed construction required to be furnished under the Contract Documents. This includes all of the services specified, indicated, shown or contemplated by the Contract Documents, and furnishing by the contractor of all materials, equipment, labor, methods, processes, construction and manufacturing materials and equipment, tools, plans, supplies, power, water, transportation and other things necessary to complete such services in accordance with the Contract Documents to insure a functional and complete contract.
- Provide: shall mean to furnish and install.
- PSI or (psi): Pounds per square inch.
- **PVC:** Polyvinyl chloride.
- Rock: Solid material being greater than one (1) cubic yard in size which by actual demonstration cannot, in the opinion of the Engineer, be reasonably excavated with a minimum 135 horsepower backhoe, in good condition and equipped with manufacturer's standard boom and rock points or similar approved equipment; and which must be systematically drilled and blasted or broken by power-operated hammer, hydraulic rock breaker or expansive compounds.
- Rock Excavation: Removal of solid material, as the above specifies, and does not necessarily correspond to "rock" as implied by the names of geologic formations.
- Sanitary Sewer System: Multiple pipes, manholes and other components that convey sewage and to which storm water, surface water and ground water are not intentionally admitted.
- Satisfactorily Completed; solely for the purposes of Official Code of Georgia Annotated (O.C.G.A). paragraph 13-10-20(b), shall mean the completion of all work, certifications and affidavits as required.

- SCADA: Supervisory Control and Data Acquisition system.
- **Service Connection:** Fitting(s) connecting a service line or lateral from a property (lot) to a water main or sewer main.
- Service Line: Pressurized pipe extending from a water main to a water meter or pressurized pipe extending from a water main to a fire hydrant.
- **Sewage:** The combination of water-carried wastes from residential housing, institutional facilities, and commercial and industrial complexes together with such groundwater, surface water, and storm water as may inadvertently be present.
- **Sewer:** A pipe or conduit that conveys sewage.
- **Sewer Main:** Sewer to which one or more laterals are connected.
- Sewer Outfall: Sewer to which one or more sewer mains are connected.
- **Sewer Trunk:** Sewer to which one or more sewer mains or sewer outfalls are connected and discharges into a wastewater facility.
- Specifications: Shall refer to the project specifications as prepared by the Design Engineer.
- "Shop Drawing", "Submittal" and "Working Drawing" shall mean the same. The shop drawing shall consist of those specially prepared detailed drawings, diagrams, schedules, procedure and methodology, performance curves, equipment fabrication and installation, masonry layout, bending diagrams for reinforcing steel, piping lay out, electrical lay out, mechanical lay out, templates, patterns, test reports, calculations, instructions, measurements, cut sheets, data sheets and other information which may be required for prosecution of the work, but which are not included in the Contract Drawings.
- Submittal shall mean the same as Shop Drawing.
- Substantial Completion of the Work: solely for the purposes of Official Code of Georgia Annotated (O.C.G.A.) paragraph 13-10-20(c), shall be defined as occurring on the date of the written notification from the Engineer that the Project is ready for initiation of the operating test period for the total project.
- Suitable Soil: Soil that conforms to and as recommended by ASTM D 2321-89 (Reapproved 1995) and ASTM D 2487-00 and that is free of organic and/or deleterious material, expansive clay and rock fragments no larger than three (3") inches.
- **UL:** Underwriters Laboratory.
- Utility Contractor: Georgia Licensed Utility Contractor in accordance with the Official Code of Georgia, Chapter 43.
- Water Distribution System: Pressurized pipes, valves and other components that convey potable water.

DEFINITIONS

- Water Main: Pressurized pipe used to convey potable water from a force main to a service line.
- Work shall mean the same as Project.
- Working Drawing shall mean the same as Shop Drawing.
- **WPCP:** Water Pollution Control Plant.
- **WPP:** Water Production Plant.
- WRF: Water Reclamation Facility.
- **WWTP:** Wastewater Treatment Plant.

END OF DOCUMENT

OUALITY CONTROL

SECTION 01 45 00

QUALITY CONTROL

PART 1 TESTING LABORATORY SERVICES

1.1 SCOPE

- A. This Section includes testing which the Owner may require, beyond that testing required of the manufacturer, to determine if materials provided for the Project meet the requirements of these Specifications.
- B. This work also includes all testing required by the Owner to verify work performed by the Contractor is in accordance with the requirements of these Specifications, i.e., concrete strength and slump testing, soil compaction, etc.
- C. This work does not include materials testing required in various sections of these Specifications to be performed by the manufacturer, e.g., testing of pipe.
- D. The testing laboratory or laboratories will be selected by the Owner. The testing laboratory or laboratories will work for the Owner.

1.2 PAYMENT FOR TESTING SERVICES

- A. The cost of testing services required by the Contract to be provided by the Contractor shall be paid for by the Owner through the Cash Allowance, i.e., concrete testing and soil compaction.
- B. The cost of additional testing services not specifically required in the Specifications, but requested by the Owner, shall be paid for by the Owner through the Cash Allowance.
- C. The cost of material testing described in various sections of these Specifications or as required in referenced standards to be provided by a material manufacturer, shall be included in the price bid for that item and shall not be paid for by the Owner.
- D. The cost of retesting any item that fails to meet the requirements of these Specifications shall be paid for by the Contractor. Retesting shall be performed by the testing laboratory working for the Owner.

1.3 LABORATORY DUTIES

- A. Cooperate with the Owner and Contractor.
- B. Provide qualified personnel promptly on notice.
- C. Perform specified inspections, sampling, and testing of materials.
 - 1. Comply with specified standards, ASTM, other recognized authorities, and as specified.
 - 2. Ascertain compliance with requirements of the Contract Documents.

OUALITY CONTROL

- D. Promptly notify the Owner and Contractor of irregularity or deficiency of work which is observed during performance of services.
- E. Promptly submit three (3) copies (two copies to the Owner and one copy to the Contractor) of report of inspections and tests in addition to those additional copies required by the Contractor with the following information included:
 - 1. Date issued
 - 2. Project title and number
 - 3. Testing laboratory name and address
 - 4. Name and signature of inspector
 - 5. Date of inspection or sampling
 - 6. Record of temperature and weather
 - 7. Date of test
 - 8. Identification of product and Specification section
 - 9. Location of Project
 - 10. Type of inspection or test
 - 11. Results of test
 - 12. Observations regarding compliance with the Contract Documents
- F. Perform additional services as required.
- G. The laboratory is not authorized to release, revoke, alter or enlarge on requirements of the Contract Documents, or approve or accept any portion of the Work.

1.4 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with laboratory personnel; provide access to Work and/or manufacturer's requirements.
- B. Provide to the laboratory, representative samples, in required quantities, of materials to be tested.
- C. Furnish copies of mill test reports.
- D. Furnish required labor and facilities to:
 - 1. Provide access to Work to be tested:
 - 2. Obtain and handle samples at the site;
 - 3. Facilitate inspections and tests;
 - 4. Build or furnish a holding box for concrete cylinders or other samples as required by the laboratory.
- E. Notify the laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedule of tests.
- F. Laboratory Tests: Where such inspection and testing are to be conducted by an independent laboratory agency, the sample(s) shall be selected by such laboratory or agency or the Owner, and shipped to the laboratory by the Contractor at Contractor's expense.
- G. Copies of all correspondence between the Contractor and testing agencies shall be provided to the Owner

OUALITY CONTROL

1.5 QUALITY ASSURANCE

A. Testing shall be in accordance with all pertinent codes and regulations and with procedures and requirements of the American Society for Testing and Materials (ASTM).

1.6 PRODUCT HANDLING

A. Promptly process and distribute all required copies of test reports and related instructions to insure all necessary retesting or replacement of materials with the least possible delay in the progress of the Work.

1.7 FURNISHING MATERIALS

A. The Contractor shall be responsible for furnishing all materials necessary for testing.

1.8 CODE COMPLIANCE TESTING

A. Inspections and tests required by codes or ordinances or by a plan approval authority, and made by a legally constituted authority, shall be the responsibility of, and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

1.9 CONTRACTOR'S CONVENIENCE TESTING

A. Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

1.10 SCHEDULES FOR TESTING

A. Establishing Schedule

- The Contractor shall, by advance discussion with the testing laboratory selected by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings, and make all arrangements for the testing laboratory to be on site to provide the required testing.
- 2. Provide all required time within the construction schedule.
- B. When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the testing laboratory as required.
- C. When the testing laboratory is ready to test according to the determined schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra costs for testing attributable to the delay will be back-charged to the Contractor and shall not be borne by the Owner.

1.11 TAKING SPECIMENS

A. Unless otherwise provided in the Contract Documents, all specimens and samples for tests will be taken by the testing laboratory of the Owner.

QUALITY CONTROL

1.12 TRANSPORTING SAMPLES

A. The contractor shall be responsible for transporting all samples, except those taken by testing laboratory personnel, to the testing laboratory.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION – Not Used

TEMPORARY FACILITIES

SECTION 01 50 00

TEMPORARY FACILITIES

PART 1 GENERAL

1.1 SCOPE

- A. Temporary facilities required for this work include but are not necessarily limited to:
 - 1. Temporary utilities such as water and electricity.
 - 2. First aid facilities.
 - 3. Sanitary facilities.
 - 4. Potable water.
 - 5. Temporary enclosures and construction facilities.

1.2 GENERAL

- A. First aid facilities, sanitary facilities, and potable water shall be available on the Project site on the first day that any activities are conducted on site. The other facilities shall be provided as the schedule of the Project warrants.
- B. Maintenance: Use all means necessary to maintain temporary facilities in proper and safe condition throughout progress of the Work, In the event of loss or damage, immediately make all repairs and replacements necessary, at no additional cost to the Owner.
- C. Removal: Remove all such temporary facilities and controls as rapidly as progress of the Work will permit.

1.3 TEMPORARY UTILITIES

A. General:

- 1. Provide and pay all costs for all water, electricity and other utilities required for the performance of the Work.
- 2. Pay all costs for temporary utilities until Project completion.
- 3. Costs for temporary utilities shall include all power, water and the like necessary for testing equipment as required by the Contract Documents.
- B. Temporary Water: Provide all necessary temporary piping, and upon completion of the Work, remove all such temporary piping. Provide and remove water meters.

C. Temporary Electricity:

- 1. Provide all necessary wiring for the Contractor's use.
- 2. Furnish, locate, and install area distribution boxes such that the individual trades may use, their own construction type extension cords to obtain adequate power, and artificial lighting at all points where required by inspectors and for safety.

TEMPORARY FACILITIES

1.4 FIRST AID FACILITIES

A. The Contractor shall provide a suitable first aid station, equipped with all facilities and medical supplies necessary to administer emergency first aid treatment. The Contractor shall have standing arrangements for the removal and hospital treatment of any injured person. All first aid facilities and emergency ambulance service shall be made available by the Contractor to the Owner and the Engineer's personnel.

1.5 SANITARY FACILITIES

A. Prior to starting the Work, the Contractor shall furnish, for use of Contractor's personnel on the job, all necessary toilet facilities which shall be secluded from public observation. These facilities shall be either chemical toilets or shall be connected to the Owner's sanitary sewer system. All facilities, regardless of type, shall be kept in a clean and sanitary condition and shall comply with the requirements and regulations of the area in which the Work is performed. Adequacy of these facilities will be subject to the Engineer's review and maintenance of same must be satisfactory to the Engineer at all times.

1.6 POTABLE WATER

A. The Contractor shall be responsible for furnishing a supply of potable drinking water for employees, subcontractors, inspectors, engineers, and the Owner who are associated with the Work.

1.7 ENCLOSURES AND CONSTRUCITON FACILITIES

A. Furnish, install, and maintain for the duration of construction, all required scaffolds, tarpaulins, canopies, steps, bridges, platforms and other temporary construction necessary for proper completion of the Work in compliance with all pertinent safety and other regulations.

1.8 PARKING FACILITIES

A. Parking facilities for the Contractor's and Contractor's subcontractors' personnel shall be the Contractor's responsibility. The storage and work facilities provided by the Owner will not be used for parking by the Contractor's or subcontractor's personnel.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION - Not Used

VEHICULAR ACCESS AND PARKING

SECTION 01 55 00

VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.1 CONSTRUCTION ACCESS

A. Construction machinery and equipment will be via the existing access roads and needs to take extreme care not to damage property, existing utilities, or roadways.

1.2 STORAGE OF EQUIPMENT

A. All equipment, vehicles, and materials must be stored in the designated storage or staging area or in areas acceptable to the Engineer. Material shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism, and theft.

1.3 TRAFFIC CONTROL

- A. The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, and other traffic control devices; shall provide qualified flagmen where necessary to direct traffic; and shall take all necessary precautions for the protection of the work and safety of the public.
- B. Construction traffic control devices and their installation shall be in accordance with the current Federal Highway Administration "Manual of Uniform Traffic Control Devices for Streets and Highways."
- C. Placement and removal of construction traffic control devices shall be coordinated with the Owner, and the authority having jurisdiction, and/or the Department of Transportation a minimum of 48 hours in advance. Placement of construction traffic control devices shall be scheduled ahead of associated construction activities. Construction time within a street right-of-way shall be conducted to minimize the length of time traffic is disrupted. Construction traffic control devices shall be removed immediately following their useful purpose. Traffic control devices used intermittently, such as but not limited to "Flagmen Ahead," shall be removed and replaced as needed. Existing permanent traffic control devices within the construction work zone shall be protected from damage due to construction operations. The contractor at his expense shall replace any permanent traffic control device damaged during construction due to negligence of the contractor.
- D. Construction traffic control devices shall be maintained in good repair, clean and visible to affected traffic for daytime and nighttime operations. Traffic control devices affected by the construction work zone shall be inspected daily.
- E. No highway, road, or street shall be closed to traffic without authorization from the proper authority. It shall be the contractor's responsibility to determine the exact requirements of the authority having jurisdiction over the right-of-way and no extra compensation will be allowed the contractor for meeting such requirements.

VEHICULAR ACCESS AND PARKING

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

PRODUCT STORAGE AND HANDLING

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING

PART 1 GENERAL

1.1 SCOPE

A. The work under this Section includes, but is not necessarily limited to, the furnishing of all labor, tools and materials necessary to properly store and protect all materials, equipment, products and the like, as necessary for the proper and complete performance of the Work.

1.2 STORAGE AND PROTECTION

A. Storage

- 1. Maintain ample way for foot traffic at all times, except as otherwise approved by the Owner
- 2. All property damaged by reason of storing of material shall be properly replaced at no additional cost to the Owner.
- 3. Packaged materials shall be delivered in original unopened containers and so stored until ready for use.
- 4. All materials shall meet the requirements of these Specifications at the time that they are used in the Work.
- 5. Store products in accordance with manufacturer's instructions.

B. Protection

- 1. Use all means necessary to protect the materials, equipment and products of every section before, during and after installation and to protect the installed work and materials of all other trades.
- 2. All materials shall be delivered, stored and handled to prevent the inclusion of foreign materials and damage by water, breakage, vandalism or other causes.
- 3. Substantially constructed weather-tight storage sheds, with raised floors, shall be provided and maintained as may be required to adequately protect those materials and products stored on the site which may require protection from damage by the elements.
- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary for the approval of the Owner and at no additional cost to the Owner.
- D. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel and sheet construction products shall be stored with one end elevated to facilitate drainage.
- E. Unless otherwise permitted in writing by the Owner, building products and materials such as cement, grout, plaster, gypsum board, particle board, resilient flooring, acoustical tile, paneling, finish lumber, insulation, wiring, etc., shall be stored indoors in a dry location. Building products such as rough lumber, plywood, concrete block and structural tile may be stored outdoors under a properly secured waterproof covering.

PRODUCT STORAGE AND HANDLING

F. Tarps and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarps and covers shall be arranged to prevent ponding of water.

1.3 EXTENDED STORAGE

A. In the event that certain items of major equipment such as air compressors, pumps and mechanical aerators have to be stored for an extended period of time, the Contractor shall provide satisfactory long-term storage facilities that are acceptable to the Owner. The Contractor shall provide all special packaging, protective coverings, protective coatings, power, nitrogen purge, desiccants, lubricants and exercising necessary or recommended by the manufacturer to properly maintain and protect the equipment during the period of extended storage.

1.4 HANDLING

- A. All equipment, materials and products shall be carefully handled to prevent damage or excessive deflections during unloading or transportation. All equipment, materials and products damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to the Owner prior to being incorporated into the Work.
- B. Lifting and handling drawings and instructions furnished by the manufacturer or supplier shall be strictly followed. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Shafts and operating mechanisms shall not be used as lifting points. Spreader bars or lifting beams shall be used when the distance between lifting points exceeds that permitted by standard industry practice. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.
- C. Under no circumstances shall equipment or products such as pipe, structural steel, casting, reinforcement, lumber, piles, poles, etc., be thrown or rolled off of trucks onto the ground.
- D. Items such as nonmetallic pipe, nonmetallic conduit, flagpoles, and lighting poles shall be handled using nonmetallic slings or straps.

1.5 OWNER FURNISHED EQUIPMENT AND MATERIALS

A. The Contractor shall provide storage and protection for all Owner furnished equipment and materials on site as required, including extended storage as specified above.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION – Not Used

EXECUTION AND CLOSEOUT REQUIREMENTS

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Starting of systems.
- D. Demonstration and instructions.
- E. Protecting installed construction.
- F. Project record documents.
- G. Operation and maintenance data and manuals.
- H. Manual for materials and finishes.
- I. Spare parts and maintenance products.
- J. Product warranties and product bonds.
- K. Maintenance service.

1.2 CLOSEOUT PROCEDURES

- A. Submit written certification that the Work has been completed, that all Work has been installed according to the Contract Documents and request a final inspection.
- B. Provide all O&M manuals, valve testing certifications, pressure test forms, daily reports, concrete delivery tickets, Record Drawings, and other documentation that the Owner may require to close out the Contract.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Submit lien waiver.
- E. Successfully complete the 30-day operating period.
- F. Execute the final change order.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Clean debris from street, drainage systems, and all other work areas (including staging and storage areas).
- C. Contractor shall clean site, sweep paved areas, and rake clean landscaped surfaces.
- D. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify the Engineer and Owner seven days prior to start-up of each item.
- C. Execute start-up under supervision of applicable manufacturer's representative and Contractors' personnel in accordance with manufacturers' instructions.
- D. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- E. Submit a written report in accordance with Section 01 33 23 Shop Drawings, Product Data and Samples, that equipment or system has been properly installed and is functioning correctly.
- F. Not all equipment will be started up at the same time. Some equipment will be started up and turned over to the Owner before other equipment.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel prior to date of final inspection.
- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- E. Required instruction time for each item of equipment and system is specified in individual sections.

1.6 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Prohibit traffic from landscaped areas.

1.7 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 3. Field changes of dimension and detail.
 - 4. Details not on original Contract drawings.
- G. Submit documents to Engineer with claim for final Application for Payment.

1.8 OPERATION AND MAINTENANCE DATA

A. Prepare and submit for each piece of equipment two (2) copies of O&M Manuals for review by the Engineer. Submit Manuals 60 days prior to start up of the equipment. Correct items noted in marked up Manual from the Engineer. Submit six (6) copies of the O&M Manual for the Owner's use.

- B. Manuals shall be specific to the equipment supplied.
 - 1. Manuals applicable to many different configurations and which require the operator to selectively read portions of the instructions will not be accepted.
 - 2. The equipment model that the Manual applies to shall be indicated by an arrow.
- C. Provide a Table of Contents Specific to each Manual. Include Table of Contents for each volume, with each product or system description identified, typed on white paper.
- D. Submit data bound in 8-1/2 x 11-inch text pages, three D side binders with durable plastic covers.
- E. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- F. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
 - 1. At the beginning of each Manual, provide a description of the equipment to include model numbers, purchase order numbers, serial numbers, motor information, and performance and design criteria.
 - 2. Correlate manuals with the approved shop drawings and include the following minimum information.
 - a. Parts list of each component, including recommended spare parts list
 - b. Guaranties and warranties.
 - c. Recommended maintenance instructions.
 - d. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - e. Recommended lubricants and lubrication instructions.
 - f. Address and telephone number of the source for repairs, spare parts and service. Also include a directory, listing names, addresses, and telephone numbers of, Contractor, Subcontractors, and suppliers.
 - g. Detailed description of operating procedure for the item of equipment specifically written for this installation, including start-up and shutdown procedures.
 - h. Equipment performance specifications and certifications, including certified pump test curves and raw data.
 - i. Include a tab in the manual for startup results. The results of start-up and any further recommendations resulting from start-up shall be inserted into manual at a later date.
 - j. Current cost for each recommended spare part and agreement to provide updated costs at Owner's request.
 - 3. Provide a maintenance and lubrication schedule to be a summary of all preventative maintenance and lubrication, including the following information:
 - a. Title
 - b. Type of activity (inspection, adjustment, oil change, etc.).
 - c. Brief description of activity.
 - d. Type of lubricant.
 - e. Frequency (daily, weekly, etc.).
 - 4. The manufacturer shall provide the Owner with a log chart to record all servicing and maintenance required during the equipment warranty period

EXECUTION AND CLOSEOUT REQUIREMENTS

- 5. For process-oriented equipment, treatment plants, etc., provide a detailed description of the process operation and trouble-shooting of problems.
- G. Provide clear and legible copies. Type parts lists, etc.
- H. Layout and detail drawings shall be reduced to a maximum size of 11" x 17", unless written approval is received from the Engineer prior to submittal of Manuals. For larger drawings, when approved, provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- I. Provide a clearly labeled three-ring binder for Manuals having a thickness greater than 1/4". Provide sheet lifters if binder is more than 2/3 full. Provide multiple binders for Manuals having a thickness greater than 2". Identify each binder is volume X of XX.

1.9 MANUAL FOR MATERIALS AND FINISHES

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before completion of Work. Engineer will review draft and return one copy with comments.
- B. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy to be reviewed and returned, with Engineer comments. Revise content of document sets as required prior to final submission.
- C. Submit six sets of revised final volumes in final form within 10 days after final inspection.
- D. Building Products: Include product data, with catalog number, size, composition, and color designations. Include information for re-ordering standard or custom manufactured products.
- E. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- F. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
- G. Additional Requirements: As specified in individual product specification sections.
- H. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.10 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to and place in location as directed by Owner; obtain receipt prior to final payment.

1.11 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
- B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.
- F. Submit prior to final Application for Payment.

1.12 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in specification sections during warranty period.
- B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.
- D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

CONSTRUCTION LAYOUT

SECTION 01 73 23.13

CONSTRUCTION LAYOUT

PART 1 GENERAL

1.1 SCOPE

- A. Construction staking shall include all of the surveying work required to layout the Work and control the location of the finished Project. The Contractor shall have the full responsibility for constructing the Project to the correct horizontal and vertical alignment, as shown on the Drawings, as specified, or as ordered by the Engineer. The Contractor shall assume all costs associated with rectifying work constructed in the wrong location.
- B. From the information shown on the Drawings and the information to be provided as indicated under Project Conditions below, the Contractor shall:
 - 1. Be responsible for setting reference points and/or offsets, establishment of baselines, and all other layout, staking, and all other layout, staking, and all other surveying required for the construction of the Project.
 - 2. Safeguard all reference points, stakes, grade marks, horizontal and vertical control points, and shall bear the costs of re-establishing same if disturbed.
 - 3. Stake out the permanent and temporary easements or the limits of construction to ensure that the Work is not deviating from the indicated limits, and shall bear the costs of reestablishing same if disturbed.
 - 4. Be responsible for all damage done to reference points, baselines, center lines and temporary benchmarks as a result of the operations, and shall bear the costs of reestablishing same if disturbed.
- C. Baselines shall be defined as the line to which the location of the Work is referenced, i.e., edge of pavement, road centerline, property line, right-of –way or survey line.
- D. Record Drawing surveys shall be performed in accordance with Section 01 32 00 Construction Progress Documentation of these specifications.

1.2 PROJECT CONDITIONS

- A. The Drawings provide the location and/or coordinates of principal components of the Project. The alignment of some components of the Project may be indicated in the Specifications. The Engineer may order changes to the location of some of the components of the Project or provide clarification to questions regarding the correct alignment.
- B. The Engineer will provide one vertical control point on the Project site with its elevation.

1.3 QUALITY ASSURANCE

A. The Contractor shall furnish documentation, prepared by a surveyor currently registered in the State of Georgia, confirming that staking is being done to the horizontal and vertical alignment shown in the Contract Documents. This requires that the Contractor hire, at the Contractor's

CONSTRUCTION LAYOUT

own expense, a currently registered surveyor, acceptable to the Owner, to provide ongoing construction staking or confirmation of such.

- B. Any deviations from the Drawings shall be confirmed by the Engineer prior to construction of that portion of the Project.
- C. Construction Surveying Cash Allowance:
 - 1. This cash allowance is solely for the use of the Owner for verification of the Contractor's reference points, centerlines and work performed.
 - 2. The presence of this cash allowance in no way relieves the Contractor of the responsibility of installing reference points, centerlines, temporary benchmarks, verifying that the work has been performed accurately, and all other work covered by this Section.

1.4 SITE WORK

- A. Staking Precision: The precision of construction staking shall match the precision of the component location indicated on the Drawings. Staking of utilities shall be done in accordance with generally accepted practice for the type of utility.
- B. Written certification, by a licensed surveyor, that structure base grade and structure corner locations match the locations shown on the Drawings is required prior to beginning construction of the structure.

1.5 SEWERS AND ACCESSORIES

A. Staking Precision: The precision of construction staking required shall be no less than 1:10,000. Horizontal distances shall be measured with a precision of no less than 0.01 feet, and horizontal angles measured with a precision of no less than 10 seconds.

B. Reference Points:

- 1. The surveyor shall obtain the coordinates on each manhole and provide this information to the Engineer.
- 2. Reference points shall be placed, at or no more than three feet, from the outside of the construction easement or right-of-way. The location of the reference points shall be recorded in a log with a copy provided to the Engineer for use prior to his verifying reference point locations. Distances between reference points and the manhole centerlines shall be accurately measured to 0.01 foot.
- 3. The Contractor shall give the Engineer reasonable notice that reference points are set. The reference point locations must be verified by the Engineer prior to commencing clearing and grubbing operations.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

CLOSEOUT PROCEDURES

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 PROJECT MAINTENANCE AND WARRANTY

- A. Maintain and keep in good repair the Work covered by these Drawings and Specifications until acceptance by the Owner.
- B. The Contractor shall warrant for not less than a period of one year from the date of Owner's written acceptance of certain segments of the Work and/or Owner's written final acceptance of the Project, as defined in the Contract Documents, that the completed work is free from all defects due to faulty products or workmanship and the Contractor shall promptly make such corrections as may be necessary by reason of such defects. The Owner will give the Contractor notice of observed defects with reasonable promptness. In the event that the Contractor should fail to make such repairs, adjustments or other work that may be made necessary by such defects, the Owner may do so and charge the Contractor the cost thereby incurred. The Performance Bond shall remain in full force and effect throughout the warranty period.
- C. The Contractor shall warrant for a period not less than five years from the date of Owner's written final acceptance of the Project, that the completed work is free from any latent defects due to faulty products or workmanship. In the event that latent defects are observed by the Owner, the Contractor shall be notified with reasonable promptness and shall perform any work as may be necessary to correct such defects and repair any damage they may have caused. If the Contractor fails to make such corrections, the Owner may take whatever action is deemed appropriate and necessary against the Contractor based on the circumstances and observations of the Owner.
- D. The Contractor shall not be obligated to make replacements which become necessary because of ordinary wear and tear, or as a result of improper operation or maintenance, or as a result of improper work or damage by another Contractor or the Owner, or to perform any work which is normally performed by a maintenance crew during operation.
- E. In the event of multiple failures of major consequences prior to the expiration of the one-year warranty described above, the affected unit shall be disassembled, inspected, and modified or replaced as necessary to prevent further occurrences. All related components which may have been damaged or rendered non-serviceable as a consequence of the failure shall be replaced. A new 12-month warranty against defective or deficient design, workmanship, and materials shall commence on the day that the item is reassembled and placed back into operation. As used herein, multiple failures shall be interpreted to mean two or more successive failures of the same kind in two or more items. Major failures may include, but are not limited to, cracked or broken housings, piping, or vessels, excessive deflections, bent or broken shafts, broken or chipped gear teeth, premature bearing failure, excessive wear, or excessive leakage around seals. Failures which are directly and clearly traceable to operator abuse, such as operations in conflict with published operating procedures or improper maintenance, such as substitution of unauthorized replacement parts, use of incorrect lubricants or chemicals,

CLOSEOUT PROCEDURES

flagrant over- or under-lubrication and using maintenance procedures not conforming with published maintenance instructions, shall be exempted from the scope of the one-year warranty. Should multiple failures occur in a given item, all products of the same size and type shall be disassembled, inspected, modified, or replaced as necessary by the Contractor and re-warranted for one year.

- F. The Contractor shall, at Contractor's own expense, furnish all labor, materials, tools and equipment required and shall make such repairs and removals and shall perform such work or reconstruction as may be made necessary by any structural or functional defect or failure resulting from neglect, faulty workmanship or faulty materials, in any part of the Work performed by the Contractor. Such repair shall also include refilling of trenches, excavations or embankments which show settlement or erosion after backfilling or placement.
- G. Except as noted on the Drawings or as specified, all structure such as embankments and fences shall be returned to their original condition prior to the completion of the Contract. Any and all damage to any facility not designated for removal, resulting from the Contractor's operations, shall be promptly repaired by the Contractor at no cost to the Owner.
- H. The Contractor shall be responsible for all road and entrance reconstruction and repairs and maintenance of same for a period of one year from the date of final acceptance. In the event the repairs and maintenance are not made immediately and it becomes necessary for the owner of the road to make such repairs, the Contractor shall reimburse the Owner of the road for the cost of such repairs.
- I. In the event the Contractor fails to proceed to remedy the defects upon notification within 15 days of the date of such notice, the Owner reserves the right to cause the required materials to be procured and the work to be done, as described in the Drawings and Specifications, and to hold the Contractor and the sureties on Contractor's bond liable for the cost and expense thereof.
- J. Notice to Contractor for repairs and reconstruction will be made in the form of a registered letter addressed to the Contractor at Contractor's home office address as supplied by the Contractor.
- K. Neither the foregoing paragraphs nor any provision in the Contract Documents, nor any special guarantee time limit implies any limitation of the Contractor's liability within the law of the place of construction.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

RECORD DRAWINGS

SECTION 01 78 39

RECORD DRAWINGS

PART 1 GENERAL

1.1 SCOPE

- A. The Work under this Section includes, but is not necessarily limited to, the compiling, maintaining, recording, and submitting of project record documents as herein specified.
- B. Record documents include, but are not limited to:
 - 1. Drawings;
 - 2. Specifications;
 - 3. Change orders and other modifications to the Contract;
 - 4. Field orders or written instructions, including Requests for Information (RFI) and Clarification Memorandums;
 - 5. Reviewed shop drawings, product data and samples;
 - 6. Test records;
 - 7. Equipment and Material;
 - 8. Electrical, Electronic and Equipment Systems;
 - 9. Architectural Components;
 - 10. Operation and Maintenance Manuals;
 - 11. Finishes.
- C. The Contractor shall maintain on the Project site throughout the Contract Time an up to date set of Record Drawings.

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Storage:

- 1. Store documents and samples in the Contractor's field office, apart from documents used for construction.
- 2. Provide files and racks for storage of documents.
- 3. Provide locked cabinet or secure storage space for storage of samples.
- B. File documents and samples in accordance with format of these Specifications.

C. Maintenance:

- 1. Maintain documents in a clean, dry, legible condition and in good order.
- 2. Do not use record documents for construction purposes.
- 3. Maintain at the site for the Owner one copy of all record documents.
- D. Make documents and samples available at all times for inspection by Owner.
- E. Failure to maintain the Record Documents in a satisfactory manner may be cause for withholding of a certificate for payment.

1.3 QUALITY ASSURANCE

- A. Unless noted otherwise, Record Drawings shall provide dimensions, distances and coordinates to the nearest 0.1-foot.
- B. Unless noted otherwise, Record Drawings shall provide elevations to the nearest 0.01-foot for all pertinent items constructed by the Contractor.
- C. The Contractor shall employ a currently registered surveyor to prepare the Record Drawings from a post-construction field-run survey. The Record Drawings shall provide elevations to the nearest 0.01-foot for all manhole inverts, manhole frames and other pertinent items constructed by the Contractor. The Record Drawings shall provide dimensions, distances, and coordinates to the nearest 0.01-foot and horizontal angles to the nearest 10 seconds using State Plain West Mean Sea Level coordinates.

1.4 RECORDING

- A. Label each document "PROJECT RECORD" in neat, large printed letters.
- B. Recording:
 - 1. Record information concurrently with construction progress.
 - 2. Do not conceal any Work until required information is recorded.

1.5 RECORD DRAWINGS

- A. Record Drawings shall be reproducible, shall have a title block indicating that the drawings are Record Drawings, the name of the company preparing the Record Drawings, and the date the Record Drawings were prepared. The Contractor will be provided paper sepias of the Drawings, or it may elect to provide reproducible drawings via another method. Reproducible shall be defined as being translucent so as to allow a blueline print to be produced.
- B. Legibly mark drawings to record actual construction, including:
 - 1. All Construction:
 - a. Changes of dimension and detail.
 - b. Changes made by Requests for Information (RFI), field order, clarification memorandums or by change order.
 - c. Details not on original Drawings.
 - 2. Site Improvements, Including Underground Utilities:
 - a. Horizontal and vertical locations of all exposed and underground utilities and appurtenances, both new facilities construction and those utilities encountered, referenced to permanent surface improvements.
 - b. Location of and dimensions of roadways and parking areas, providing dimensions to back of curb when present.
 - c. The locations shall be referenced to at least two easily identifiable, permanent landmarks (e.g., power poles, valve markers, etc.) or benchmarks.
 - d. The Record Drawings shall include the horizontal angle and distance between manhole covers.
 - 3. Structures:
 - a. Depths of various elements of foundation in relation to finish first floor datum or top of wall.

b. Location of internal and buried utilities and appurtenances concealed in construction, referenced to visible and accessible features of the structure.

1.6 SPECIFICATIONS

- A. Legibly mark each section to record:
 - 1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 - 2. Changes made by Requests for Information (RFI), field order, clarification memorandums, or by change order.

1.7 PRODUCT INFORMATION BINDER (PIB)

- A. The PIB shall contain information related to the equipment and material that is incorporated into the project. The Contractor shall create, update, maintain and submit the PIB with the rest of the Project Documents.
 - 1. All equipment incorporated into the project including, but not limited to, valves, gates and operators; pumps and motors; meters and backflow preventers; hoists; HVAC; surge control, air and vacuum relief valves; etc. shall be contained in the PIB.
 - 2. All material incorporated into the project including, but not limited to, concrete and grout; concrete masonry units, brick and mortar; ladder and handrail; caulk and sealant; insulation; etc. shall be contained in the PIB.
- B. Quantity: Two copies of the PIB shall be submitted with the Record Documents. The PIB shall be a 3-ring binder.
- C. The size of the pages shall be 8-1/2" by 11". Pages of 11" by 17" in size will be allowed but shall be folded to 8-1/2" by 11" so as to fit the PIB.
- D. The PIB shall be divided into sections and shall contain a Table of Contents (TOC). The sectional breakdown of the PIB shall be similar to the Specifications.
- E. In addition to the information required above, the following information shall be supplied for all mechanical, electrical, electronic, and equipment systems incorporated into the project:
 - 1. Section of the Specifications to which the item relates.
 - 2. The manufacturer.
 - 3. The manufacturers cut sheet and data on the item.
 - 4. Model and serial numbers.
 - 5. Operators manual.
 - 6. Maintenance manual.
 - 7. A list of the spare parts furnished, including part numbers.
 - 8. A list and diagram of spare parts available, including part numbers.
- F. The following data shall be supplied for all doors and hardware components incorporated into the project:
 - 1. Manufacturer.
 - 2. Model number.
 - 3. Manufacturers cut sheet.
 - 4. Material, color, finish, grade, etc.
 - 5. Type of door, frame, size, etc.

- 6. Location used (i.e. door number).
- G. The following data shall be supplied for all finishes incorporated into the project:
 - 1. Paint:
 - a. Location used (walls, floors, doors, equipment, etc.).
 - b. Paint manufacturer.
 - c. Manufacturer's color code for primer and finish coats.
 - 2. Water proofing, damp proofing and water repellant:
 - a. Location used.
 - b. Manufacturer.
 - c. Manufacturer's model number.
 - d. Manufacturer's cut sheets, including the Manufacturer's Safety Data Sheet (MSDS).
 - 3. Floor Covering:
 - a. Type of Covering (tile, vinyl, paint, floor hardener, etc.).
 - b. Location used.
 - c. Manufacturer.
 - d. Manufacturers model number, color code, stock number, etc.
 - Roof Covering:
 - a. Manufacturer.
 - b. Installer.
 - c. Type of roof and material including flashing, sealants, sheet metal, substrate, etc.
 - d. Manufacturers cut sheet.
 - e. Sketch showing all roof penetrations including a short description of the size and type of item penetrating the roof. For example 24" x 24" exhaust fan.
 - f. The names and dates the manufacturer's authorized representative was present on the site to inspect the roof and its installation for compliance with the manufacturer's installation procedures.
 - g. A copy of the Warranty and/or Bond.
- H. Calibration Procedures: All equipment and components of the project that require calibration, or are capable of being calibrated, shall have a calibration procedure included in this section of the PIB. All pertinent information shall be submitted and shall include, but not be limited to the following:
 - 1. Description of the Equipment, including the manufacturer, model and serial numbers, supplier, date of installation, etc.
 - 2. Range of calibration.
 - 3. Detailed step by step calibration procedure, including sketch's and/or details, on how to calibrate the item.

1.8 SUBMITTAL

- A. At contract closeout, deliver Record Documents to the Owner.
- B. Accompany submittal with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. Title and number of each record document
 - 5. Signature of Contractor or Contractor's authorized representative

RECORD DRAWINGS

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

GEOTECHNICAL INVESTIGATION

SECTION 02 32 00

GEOTECHNICAL INVESTIGATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Southern Geotechnical Consultants (SGC) has performed a subsurface investigation at the project site and prepared a report of their findings. A copy of SGC's geotechnical report is included as an Attachment of these specifications. See SGC Report No. 73536 dated January 16, 2020.
- B. The purpose of the report was to explore subsurface conditions as well as determine structural design conditions and not to determine quantities of material or methods of excavation. The Contractor shall make his own analysis of the amount and quantity of various types of materials to be removed, how they shall be removed and the cost. The quantity and type of soil investigations contained in the report may be helpful but are not sufficient to determine the quantities of the various materials to be excavated, difficulty of excavation or dewatering requirements.
- C. This soil investigation information is offered as an aid in bidding only. The report and boring logs are not a warranty of subsurface conditions. The Owner, Engineer, and Geotechnical Engineer assume no responsibility for any variation between materials encountered during construction and those indicated in the report, or for any variation between the location of the water table encountered and that indicated on the boring logs at the date the borings were taken.
- D. Additional Investigation: The Contractor shall visit the site and become acquainted with site conditions. Prior to bidding, prospective Contractors may make their own site and subsurface investigations to satisfy themselves with site and subsurface conditions. The Contractor shall provide adequate notification to the Owner of the dates said investigations will be performed and shall assume all responsibility for any damage to property caused as a result of the Contractor's investigation.
- E. Location of Borings: Contractors shall be responsible for making their own determination of the location of the soil borings on this project

PART 2 PRODUCTS

Not Used.

PART 3 PRODUCTS

Not Used.

STRUCTURE DEMOLITION

SECTION 02 41 16

STRUCTURE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Scope

1. See drawings for demo requirements of existing structures (if any) and scope.

B. Section Includes:

- 1. Demolishing designated equipment and fixtures.
- 2. Demolishing designated construction.
- 3. Cutting and alterations for completion of the Work.
- 4. Removing designated items for reuse and possible Owner's retention.
- 5. Protecting items designated to remain.
- 6. Removing demolished materials.
- 7. Salvage value of scrap materials.

C. Related Sections

- 1. Section 02 41 19 Selective Equipment Demolition.
- 2. Section 02 41 26 Selective Electrical Demolition.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Demolition Schedule: Indicate on schedule and interruptions to plant operation required for demolition work.

C. Shop Drawings:

- 1. Indicate demolition and removal sequence.
- 2. Determine in field if Owner wants any demolished material prior to demolishing.
- 3. Indicate location and construction of temporary work.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of relocated utilities, capped utilities, concealed utilities discovered during demolition, subsurface obstructions, and over excavations limits. This information shall be turned over to the Engineer and will be recorded on the permanent as-built drawings.

1.4 QUALITY ASSURANCE

- A. Conform to applicable codes for demolition work, dust control, disposal, safety of adjacent structures, products requiring electrical disconnection and re-connection.
- B. Conform to applicable codes for procedures when hazardous or contaminated materials are discovered.
- C. Obtain required permits from authorities having jurisdiction.
- D. Perform Work in accordance with Owner's standards.
- E. Maintain one copy of each document on site.

1.5 PRE-DEMOLITION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-demolition meeting.
- B. Convene minimum one week prior to commencing work of this section.
- C. Discuss demolition plan, planned interruptions to utilities, location setup and road access, Owner retained material, start date, locking out/tag out electrical circuits, etc.

1.6 SEQUENCING

- A. Section 01 10 00 Summary: Requirements for sequencing.
- B. Contractor shall verify with Owner before demolition begins to remove materials Owner chooses to retain.

1.7 SCHEDULING

- A. Section 01 30 00 Administrative Requirements and 01 32 16 Construction Progress Schedule: Requirements for scheduling.
- B. Schedule Work to coincide with new construction.
- C. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation in adjoining spaces.
- D. Coordinate utility and service interruptions with Owner.
 - 1. Schedule tie-ins to existing systems to minimize disruption.
 - 2. Coordinate Work to ensure treatment plant remains in operation in occupied areas.

1.8 PROJECT CONDITIONS

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Owner assumes no responsibility for actual condition of structures to be demolished.

- C. No materials have been tested to determine if any hazardous materials (lead, asbestos, mold, etc.) are present on the structure, or equipment or any other items required to be demolished.
- D. The Owner and Engineer have no knowledge of any presence of hazardous materials existing on the structure, or equipment or any other items required to be demolished.
- E. Notify Owner and Engineer upon discovery of hazardous materials.
- F. Cease operations immediately if structure appears to be in danger and notify Engineer. Do not resume operations until directed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

- A. See Contract Drawings for additional demolition notes.
- B. Notify affected utility companies before starting work and comply with their requirements.
- C. Mark location and termination of utilities.
- D. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the Owner's personnel and existing improvements indicated to remain.
- E. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structures.

3.2 EXAMINATION

- A. Examine existing structures indicated to be demolished before demolition.
- B. Verify Owner procedures related to the work, including Lock out Tag Out.
- C. Determine where removals may result in structural deficiency or unplanned structure collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.
- D. Determine where demolition may affect structural integrity or weather resistance of adjacent structures indicated to remain.
 - 1. Identify measures required to protect structures from damage.
 - 2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings indicated to remain in structurally sound and weathertight and watertight condition.

E. Verify hazardous material abatement, if required, is complete before beginning demolition.

3.3 SALVAGE REQUIREMENTS

- A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.
- B. Tag components and equipment Owner designates for salvage.
- C. Protect designated salvage items from demolition operations until items can be removed.
- D. Carefully remove building components and equipment indicated to be salvaged.
- E. As required, remove dirt, sludge, debris and other deleterious materials from the exterior of equipment and materials designated for salvage.
- F. Disassemble as required to permit removal.
- G. Package small and loose parts to avoid loss.
- H. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
- I. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.
- J. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.4 DEMOLITION

- A. If certain structures are shown to be removed by the Contractor, the structures shall be removed to at least 3 feet below existing grade or 3 feet below proposed grade whichever is the lowest elevation unless shown otherwise on the Contract Drawings.
- B. All demolished materials not retained by the Owner shall be removed from the site and disposed of in a legal landfill or sold for reuse or scrap.
- C. The Contractor shall provide information to the Owner concerning the disposition of materials from any demolished buildings or equipment.
- D. The Contractor shall include the scrap prices in the lump sum bid.
- E. Use of explosives is not permitted.
- F. Conduct demolition to minimize interference with adjacent areas and structures.
- G. Do not close or obstruct roadways.

- H. Cease operations immediately when adjacent structures appear to be in danger. Notify Owner and Engineer. Do not resume operations until directed.
- I. Cease operations immediately when structure appears to be in danger and notify Engineer.
- J. Disconnect and remove utilities within demolition areas.
- K. Conduct operations with minimum interference to public or private accesses to occupied adjacent structures. Maintain egress and access from adjacent structures at all times.
- L. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.
- M. Sprinkle Work with water to minimize dust. Provide hoses and water connections required for this purpose.
- N. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.
- O. Demolish in orderly and careful manner. Protect existing structures.
- P. Continuously clean-up and remove demolished materials from site. Do not allow materials to accumulate on site.
- Q. Carefully remove building components indicated to be reused.
 - 1. Disassemble components as required to permit removal.
 - 2. Package small and loose parts to avoid loss.
 - 3. Mark components and packaged parts to permit reinstallation.
 - 4. Store components, protected from construction operations, until reinstalled.
- R. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
- S. Repair adjacent construction and finishes damaged during demolition and extension work.
- T. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- U. Remove temporary Work.

END OF SECTION

SELECTIVE EQUIPMENT DEMOLITION

SECTION 02 41 19

SELECTIVE EQUIPMENT DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Demolishing specific equipment as shown on the Drawings.
- B. Related Sections:
 - 1. Section 02 41 16 Structure Demolition.
 - 2. Section 02 41 26 Selective Electrical Demolition

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Demolition Schedule: Indicate demolition work on the overall schedule and interruptions required for performing all work.
- C. Shop Drawings:
 - 1. Indicate demolition and removal sequence.
 - 2. Indicate location of items designated for Owner's retention.
 - 3. Indicate location and construction of temporary work.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and any subsurface obstructions.
- C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

1.4 PRE-DEMOLITION/INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-demolition/installation meeting.
- B. Convene minimum one week prior to commencing work of this section.
- C. Discuss demolition plan, planned interruptions to utilities, location setup and road access, Owner retained material, start date, locking out/tag out electrical circuits, etc.

1.5 SEQUENCING

A. Section 01 10 00 - Summary: Requirements for sequencing.

1.6 SCHEDULING

- A. Section 01 30 00 Administrative Requirements and 01 32 16 Construction Progress Schedule: Requirements for scheduling.
- B. Schedule Work to coincide with new construction.
- C. Cooperate and coordinate with Owner in scheduling this work.

1.7 PROJECT CONDITIONS

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Owner assumes no responsibility for actual condition of equipment to be demolished.
- C. No materials have been tested to determine if any hazardous materials (lead, asbestos, mold, etc.) are present on the structure, or equipment or any other items required to be demolished.
- D. The Owner and Engineer have no knowledge of any presence of hazardous materials existing on the structure, or equipment or any other items required to be demolished.
- E. Notify Owner and Engineer upon discovery of hazardous materials.
- F. Cease operations immediately if structure appears to be in danger and notify Engineer. Do not resume operations until directed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

- A. Notify the Owner before starting work and comply with their requirements.
- B. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the Owner and existing improvements indicated to remain.

3.2 SALVAGE REQUIREMENTS

- A. Coordinate with Owner to identify any equipment required to be removed and delivered to Owner.
- B. Tag components and equipment Owner designates for salvage.
- C. Protect designated salvage items from demolition operations until items can be removed.

SELECTIVE EQUIPMENT DEMOLITION

- D. Carefully remove components and equipment indicated to be salvaged.
- E. As required, remove dirt, sludge, debris and other deleterious materials from the exterior of equipment and materials designated for salvage.
- F. Disassemble as required to permit removal.
- G. Package small and loose parts to avoid loss.
- H. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
- I. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.
- J. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.3 EXAMINATION

- A. Examine existing equipment indicated to be demolished before demolition.
- B. Verify Owner procedures related to the work, including Lock out Tag Out.
- C. Determine where removals may result in structural deficiency or unplanned structure collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.
- D. Determine where demolition may affect structural integrity or weather resistance of adjacent structures indicated to remain.
 - 1. Identify measures required to protect structures from damage.
 - 2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings indicated to remain in structurally sound and weathertight and watertight condition.
- 3.4 Verify hazardous material abatement, if required, is complete before beginning demolition

3.5 DEMOLITION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Do not close or obstruct roadways.
- C. Cease operations immediately when structure appears to be in danger and notify Engineer.
- D. Disconnect power and tag out equipment scheduled to be removed or replaced.
- E. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.

SELECTIVE EQUIPMENT DEMOLITION

- F. Demolish in orderly and careful manner. Protect existing equipment.
- G. Carefully remove components to be reused.
 - 1. Disassemble components as required to permit removal.
 - 2. Package small and loose parts to avoid loss.
 - 3. Mark components and packaged parts to permit reinstallation.
 - 4. Store components, protected from construction operations, until reinstalled.
- H. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
- I. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- J. Remove temporary Work.

END OF SECTION

ELECTRICAL DEMOLITION

SECTION 02 41 26

SELECTIVE ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

- 1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
- 2. Disposal of materials.
- 3. Storage of removed materials.
- 4. Identification of utilities.
- 5. Salvaged items.
- 6. Protection of items to remain.
- 7. Relocate existing equipment to accommodate construction.

B. Related Sections:

1. Section 02 41 16 - Selective Equipment And Structure Demolition

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items; location and construction of temporary work. Describe demolition removal procedures and schedule.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of capped, abandoned or relocated utilities, conduits and equipment abandoned in place.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with applicable electrical codes and standards.

1.5 PRE-DEMOLITION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-demolition meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.6 SEQUENCING

A. Section 01 10 00 - Summary: Requirements for sequencing.

1.7 SCHEDULING

- A. Section 01 30 00 Administrative Requirements and 01 32 16 Construction Progress Schedule: Requirements for scheduling.
- B. Schedule work to coincide with new construction.
- C. See Electrical Contract Drawings for additional demolition notes.
- D. Cease operations immediately when structure appears to be in danger and notify Engineer, in writing. Do not resume operations until directed.

1.8 PROJECT CONDITIONS

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Owner assumes no responsibility for actual condition of equipment to be demolished.
- C. No materials have been tested to determine if any hazardous materials (lead, asbestos, mold, etc.) are present on the structure, or equipment or any other items required to be demolished.
- D. The Owner and Engineer have no knowledge of any presence of hazardous materials existing on the structure, or equipment or any other items required to be demolished.
- E. Notify Owner and Engineer upon discovery of hazardous materials.
- F. Cease operations immediately if structure appears to be in danger and notify Engineer, in writing. Do not resume operations until directed.

1.9 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Conduct demolition to minimize interference with adjacent and occupied structures and areas.
- C. Coordinate demolition work with new construction. See Electrical Contract Drawings for notes regarding reusing conduits, either buried or exposed.
- D. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.

E. Shut-down Periods:

- 1. Arrange timing of shut-down periods of in service panels with Owner. Do not shut down any utility without prior written approval.
- 2. Keep shut-down period to minimum as directed by the Owner.

F. Identify salvage items in cooperation with Owner. The Owner may choose to keep items of use from the control panel or motors.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify Owner procedures related to the work, including Lock out Tag Out.
- C. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- D. Verify termination points for demolished services.

3.2 PREPARATION

A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the Owner and Contractor's employees, and existing improvements to remain.

3.3 DEMOLITION

- A. Demolition Drawings are based on casual field observation. Report discrepancies to Owner and Engineer before disturbing existing installation.
- B. Remove all exposed electrical equipment.
- C. Remove buried electrical equipment to the point that it is not interfering with new construction.
- D. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project. Properly tag out all equipment and services.
- E. Install temporary wiring and connections to maintain existing systems in service during construction.
- F. Perform work on energized equipment or circuits with experienced and trained personnel.
- G. Remove, relocate, and extend existing installations to accommodate new construction.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.

- I. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components. Cut embedded support elements flush with walls and floors.
- J. Clean and repair existing equipment to remain.
- K. Protect and retain power to existing active equipment remaining.
- L. Cap abandoned empty conduit at both ends.

3.4 EXISTING PANELBOARDS

- A. Ring out circuits in existing panel(s) affected by the Work. Where additional circuits are needed, reuse available circuits.
- B. Tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, utilize sensing measuring devices to verify circuits feeding Project area are not in use.
- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated directories.

3.5 SALVAGE ITEMS

- A. Remove and protect items to be salvaged and turn over to Owner.
- B. As required, remove dirt, sludge, debris and other deleterious materials from the exterior of equipment and materials designated for salvage.
- C. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.6 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove equipment, materials, or fixtures which are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.
- C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.7 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove demolished materials as work progresses. Legally dispose.
- C. Keep workplace neat.

ELECTRICAL DEMOLITION

3.8 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

END OF SECTION

CONCRETE FORMING AND ACCESSORIES

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in place concrete.
 - 2. Shoring, bracing, and anchorage.
 - 3. Architectural form liners.
 - 4. Form accessories.
 - 5. Form stripping.
- B. Related Sections:
 - 1. Section 03 20 00 Concrete Reinforcing.
 - 2. Section 03 30 00 Cast-In-Place Concrete.
 - 3. Section 03 35 00 Concrete Finishing
 - 4. Section 03 39 00 Concrete Curing.
 - 5. Section 03 60 00 Grouting

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 117 Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 Specifications for Structural Concrete.
 - 3. ACI 318 Building Code Requirements for Structural Concrete.
 - 4. ACI 347 Guide to Formwork for Concrete.
- B. American Forest and Paper Association:
 - 1. AF&PA National Design Specifications for Wood Construction.
- C. The Engineered Wood Association:
 - 1. APA/EWA PS 1 Voluntary Product Standard for Construction and Industrial Plywood.
- D. ASTM International:
 - 1. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types).
 - 2. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials.

1.3 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line and dimension as indicated on Drawings.

1.4 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

- 1. Submit formwork, accessories, shoring, and reshoring shop drawings.
- 2. Indicate the following:
 - a. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
 - b. Means of leakage prevention for concrete exposed to view in finished construction.
 - c. Sequence and timing of erection and stripping assumed compressive strength at time of stripping, height of lift and height of drop during placement.
 - d. Vertical, horizontal and special loads in accordance with ACI 347, Section 2.2 and camber diagrams, when applicable.
 - e. Notes to formwork erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318, Section 6.3.
 - f. Procedure and schedule for removal of shores and installation and removal of reshores.
- C. Product Data: Submit data on void form materials and installation requirements.

D. Design Data:

- 1. Indicate design data for formwork and shoring.
- 2. Indicate loads transferred to structure during process of concreting, shoring and reshoring.
- 3. Include structural calculations to support design.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 318.
- B. For wood products furnished for work of this Section, comply with AF&PA.
- C. Perform Work in accordance with most currently adopted standards for the Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Products storage and handling requirements.
- B. Deliver void forms and installation instructions in manufacturer's packaging.
- C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.7 COORDINATION

A. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Form Materials: At discretion of Contractor.

B. Lumber Forms:

- 1. Application: Use for edge forms and unexposed finish concrete.
- 2. Boards: 6 inches or 8 inches in width, ship lapped or tongue and groove, "Standard" Grade Douglas Fir, conforming to WCLIB Standard Grading Rules for West Coast Lumber. Surface boards on four sides.

C. Plywood Forms:

- 1. Application: Use for exposed finish concrete.
- 2. Forms: Conform to PS 1; full size 4 x 8 feet panels; each panel labeled with grade trademark of APA/EWA.
- 3. Plywood for Surfaces to Receive Membrane Waterproofing: Minimum of 5/8 inch thick; APA/EWA "B-B Plyform Structural I Exterior" grade.
- 4. Plywood where "Smooth Finish" is required, as indicated on Drawings: APA/EWA "HD Overlay Plyform Structural I Exterior" grade, minimum of 3/4 inch thick.

2.2 FORMWORK ACCESSORIES

- A. Form Ties: Snap-off type, and fixed length, free of defects, capable of leaving a cavity larger than 1 inch in concrete surface.
 - 1. Form ties for water holding structures or below grade structures shall include an integral water stop to ensure the water tightness of the structure.
 - 2. The cavities left in faces of concrete work by removal of form ties shall be pointed-up with non-shrink mortar.
 - 3. The contractor shall be responsible for the design strength and spacing of the form ties.
 - 4. Manufacturers:
 - a. Dayton Superior
 - b. Substitutions: Section 01 60 00 Product Requirements.
- B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face. Wire ties, wood spreaders or through bolts are not permitted.
- C. Form Anchors and Hangers:
 - 1. Do not use anchors and hangers in exposed concrete leaving exposed metal at concrete surface.
 - 2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
 - 3. Penetration of structural steel members is not permitted.
- D. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.
 - 1. Manufacturers:
 - a. Arcal Chemical Corporation Arcal-80.

CONCRETE FORMING AND ACCESSORIES

- b. Industrial Synthetics Company Synthex.
- c. Nox-Crete Company Nox-Crete Form Coating.
- d. Substitutions: Section 01 60 00 Product Requirements.
- E. Exposed corners: Chamfer, wood strip type; 0.75 inch x 0.75 inch size unless otherwise noted on Contract Drawings.
 - a. Substitutions: Not Permitted.
- F. Bituminous Joint Filler: ASTM D1751.
- G. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.
- H. Vapor Barrier: A continuous membrane of 0.006" thickness polyethylene plastic film under all slabs on grade.
- I. Expansion Joints: Provide suitable expansion joint filler material as manufactured by W.R. Meadows or equal, when required, or as shown.
- J. Water Stops: Rubber, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, 6 inch wide for construction joints and 9 inches wide for expansion joints, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.
 - 1. Manufacturers:
 - a. Horn Durajoint.
 - b. Greenstreak.
 - c. Substitutions: Section 01 60 00 Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- B. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

3.2 INSTALLATION

- A. Earth Forms:
 - 1. Trench earth forms neatly, accurately, and at least 3 inches wider than footing widths indicated on Drawings.
 - 2. Trim sides and bottom of earth forms.
 - 3. Construct wood edge strips at top of each side of trench to secure reinforcing and prevent trench from sloughing.
 - 4. Form sides of footings where earth sloughs.

CONCRETE FORMING AND ACCESSORIES

5. Tamp earth forms firm and clean forms of debris and loose material before depositing concrete.

B. Formwork - General:

- 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
- 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
- 3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
- 4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
- 5. Complete wedging and bracing before placing concrete.

C. Forms for Smooth Finish Concrete:

- 1. Use steel, plywood or lined board forms.
- 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
- 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
- 4. Use full size sheets of form lines and plywood wherever possible.
- 5. Tape joints to prevent protrusions in concrete.
- 6. Use care in forming and stripping wood forms to protect corners and edges.
- 7. Level and continue horizontal joints.
- 8. Keep wood forms wet until stripped.
- D. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

E. Framing, Studding and Bracing:

- 1. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
- 2. Construct beam soffits of material minimum of 2 inches thick.
- 3. Distribute bracing loads over base area on which bracing is erected.
- 4. When placed on ground, protect against undermining, settlement or accidental impact.
- F. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 318.
- G. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- H. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.
- I. Install chamfer strips on exposed corners of walls, beams, joists, columns, supports, etc.
- J. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.3 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.
- D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Install formed openings for items to be embedded in or passing through concrete work.
- B. Locate and set in place items required to be cast directly into concrete.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Position recessed reglets for brick veneer masonry anchors in accordance with spacing and intervals indicated on Drawings.
- E. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- F. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.
- G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

I. Form Ties:

- 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
- 2. Place ties at least 2 inch away from finished surface of concrete.
- 3. Leave inner rods in concrete when forms are stripped.
- 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- J. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- K. Construction Joints:

- 1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
- 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
- 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
- 4. Arrange joints in continuous line straight, true and sharp.

L. Embedded Items:

- 1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
- 2. Do not embed wood or uncoated aluminum in concrete.
- 3. Obtain installation and setting information for embedded items furnished under other Specification sections.
- 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
- 5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

M. Openings for Items Passing Through Concrete:

- 1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections
- 2. Coordinate work to avoid cutting and patching of concrete after placement.
- 3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

N. Screeds:

- 1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
- 2. Slope slabs to drain where required or as shown on Drawings.
- 3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

O. Screed Supports:

- 1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
- 2. Staking through membrane is not permitted.

P. Cleanouts and Access Panels:

- 1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
- 2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.

- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms.
 - 1. Do not use de-icing salts.
 - 2. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure.
 - 3. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Cutting ties back from the face of the wall will not be permitted
- D. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms. Wood forms shall be completely removed from all portions of the work so that no material will remain for termite infestation
- E. Under normal conditions, the time elapsing before the forms may be stripped shall be not less than that shown in the following schedule; the use of the schedule shall not relieve the Contractor from his responsibility for the safety of the structure.
 - 1. Slabs (Suspended not on Grade)

14 Days.

- 2. Columns, Walls, and Pedestals supporting other work
- 7 Days.
- 3. Columns, Walls, and Pedestals not supporting other work
- 2 Days.

3.7 ERECTION TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 318.
- B. Camber slabs and beams as shown on the drawings.

3.8 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- B. Notify Engineer after placement of reinforcing steel in forms, a minimum of 24 hours prior to placing concrete.
- C. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

CONCRETE REINFORCING

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

- 1. Reinforcing bars.
- 2. Welded wire fabric.
- 3. Reinforcement accessories.

B. Related Sections:

- 1. Section 03 10 00 Concrete Forming and Accessories.
- 2. Section 03 30 00 Cast-In-Place Concrete.
- 3. Section 03 35 00 Concrete Finishing
- 4. Section 03 39 00 Concrete Curing.
- 5. Section 03 60 00 Grouting

1.2 REFERENCES

A. American Concrete Institute:

- 1. ACI 301 Specifications for Structural Concrete.
- 2. ACI 318 Building Code Requirements for Structural Concrete.
- 3. ACI 530.1 Specifications for Masonry Structures.
- 4. ACI SP-66 ACI Detailing Manual.

B. ASTM International:

- 1. ASTM A82/A82M Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- ASTM A184/A184M Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
- 3. A185/A185M-07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
- 4. ASTM A496/A496M Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
- 5. ASTM A497/A497M Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
- 6. ASTM A615/A615M Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- 7. ASTM A704/A704M Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
- 8. ASTM A706/A706M Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
- 9. ASTM A767/A767M Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
- 10. ASTM A775/A775M Standard Specification for Epoxy-Coated Steel Reinforcing Bars.

- 11. ASTM A884/A884M Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
- 12. ASTM A934/A934M Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
- 13. ASTM A996/A996M Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
- C. American Welding Society:
 - 1. AWS D1.4 Structural Welding Code Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute:
 - 1. CRSI Manual of Standard Practice.
 - 2. CRSI Placing Reinforcing Bars.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures
- B. Shop Drawings: Indicate bar sizes, material, yield strength, spacing, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.
- C. Certificates: Submit AWS qualification certificate for welders employed on the Work.
- D. Manufacturer's Certificate: Certify products meet or exceed specifications.
 - 1. Submit certified copies of mill test report of reinforcement materials analysis.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 318.

1.5 QUALIFICATIONS

A. Welders: AWS qualified within previous 12 months.

1.6 COORDINATION

A. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade.
- B. The steel for bars shall be made by the open hearth, basic oxygen, or electric furnace process and the bars shall be rolled from billets or ingots of properly identified heats.

- C. Welded Deformed Wire Fabric shall conform to the requirements of ASTM A185 or A 497 and unless otherwise indicated on the Drawings, shall be 4x4-W4xW4.
- D. The use of cold twisted bars will not be permitted.

2.2 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.
- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces:
 - 1. Use only all plastic type.
 - 2. Size and shape to meet Project conditions.
- D. To support bottom mat of steel for slabs on grade, use:
 - 1. All plastic chairs (no metal) such as "3059-RC2 Dual Rebar Chair" as manufactured by Polylok, Inc.
- E. Reinforcing Splicing Devices: Exothermic welding type shall only be used if approved by the Engineer.
- F. Reinforcing Splicing Devices: Mechanical splices may be used as an alternative to lap splices and shall be used where there is insufficient space for a lap splice.
 - 1. All mechanical splices shall be capable of developing 150% of the bar yield strength.
 - 2. Manufacturers:
 - a. Richmond "Dowel Bar Splice System", Bar-lock.
 - b. Substitutions: Section 01 60 00 Product Requirements.
- G. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.
- H. Reinforcement across expansion joints shall consist of either smooth dowels or deformed bars with appropriate bond breaking material applied to one end.
 - 1. Manufacturers:
 - a. Greenstreak "Speed Dowels" type
 - b. Substitutions: Section 01 60 00 Product Requirements.

2.3 FABRICATION

- A. Fabricate concrete reinforcement in accordance with ACI 318.
- B. Form standard hooks for 180 degree bends, 90 degree bend, stirrup and tie hooks, and seismic hooks as indicated on Drawings.
 - 1. Bend radius shall be measured to the outside face of the bar.
 - 2. The free end of 135° and 180° bends shall have an extension of 4 bar diameters (minimum 2.5 inches) on the free end.

3. Hooks of 90°, 135° or 180° shall have a minimum radius of bend as shown in the following table.

| Minimum bend radius for Hooks | |
|-------------------------------|---------------------|
| Bar Size | Minimum Radius (in) |
| 3 | 1-1/2 |
| 4 | 2 |
| 5 | 2-1/2 |
| 6 | 3 |
| 7 | 3-1/2 |
| 8 | 4 |
| 9 | 5-3/4 |
| 10 | 6-1/2 |
| 11 | 7 |

- C. Ties and stirrups shall be sized and spaced as detailed on the Contract Drawings and as shown in the typical details. Ties and stirrups shall be closed end with 135° hooks.
- D. Fabricate column reinforcement with offset bends at reinforcement splices.
- E. Form spiral column reinforcement from minimum 3/8 inch diameter continuous deformed bar or wire.
- F. Weld reinforcement in accordance with AWS D1.4. "Structural Welding Code Reinforcing Steel".
 - 1. A mill test is required for each lot of bars to be welded for calculating carbon equivalent (CE). Welding techniques shall be adjusted to suit CE values and job temperatures.
 - 2. The correct strength, grade and size of low hydrogen electrodes shall be kept oven dry.
 - 3. A qualification test is required to certify all welders before beginning a project.
 - 4. All welding operations shall be continuously supervised. 25% of all welds shall be radiographically inspected by a firm approved by the Engineer. All costs associated with radiographic testing shall be borne by the Contractor.
- G. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. All splice locations shall be reviewed and approved by the Engineer.

2.4 SHOP FINISHING

- A. Galvanized Finish for Steel Bars: ASTM A767/A767M, Class II, hot dip galvanized after fabrication.
- B. Epoxy Coated Finish for Steel Bars: ASTM A775/A775M.
- C. Epoxy Coated Finish for Steel Wire: ASTM A884/A884M; Class A using ASTM A775/A775M.

2.5 SOURCE QUALITY CONTROL

A. Make completed reinforcement available for inspection at manufacturer's factory prior to packaging for shipment. Notify Engineer at least seven days before inspection is allowed.

- B. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance.
 - 1. Do not weld crossing reinforcement bars for assembly.
- B. Do not displace or damage vapor barrier.
 - 1. Repair all damages to vapor barrier with additional vapor barrier material and tape.
 - 2. Repair material shall extend beyond the damaged material by at least 6 inches.

C. Openings.

- 1. Openings 12 inches and larger through concrete walls and slabs shall have additional reinforcement placed around the opening.
- 2. Reinforcement shall consist of vertical, horizontal, and diagonal bars. Bars shall be sized and placed as shown in the typical details of the Drawings.
- D. Bar spacing, cover, minimum clearance, bond and anchorage shall conform to the requirements of the ACI Building Code (ACI 318, and ACI 350), and/or as indicated on the Drawings.
- E. Splices and dowels shall have laps as required by ACI 318 and 350 and/or as shown in the typical details of the Drawings.
 - 1. All reinforcing steel shall be 100% tied. This includes splices and bars crossing each other. Reinforcing bars shall be tied 100% to insure movement of rebar does not occur when placing concrete.
 - 2. Splices shall occur in low stress areas.
 - 3. Splice lengths shall conform to code requirements relative to bar location and stress levels at the splice location.
 - 4. Splices in horizontal reinforcement shall be staggered
 - 5. The minimum clear distance between spliced bars, except when bar clamps are specified, shall be 1-1/2 bar diameters, but in no case less than 1-inch, nor less than 1.5 times the maximum size of coarse aggregate.
 - 6. All other lap splices shall conform to the minimum and maximum clear distance requirements as specified above and in the applicable sections of the ACI code.

F. Wire mesh reinforcement;

- 1. Shall be secured in position by spacer bars and chairs. Spacer bars shall be lapped not less than 5 inches.
- 2. Precast concrete mortar blocks may be used in lieu of metal chairs for slabs on grade.
- 3. Mesh shall be checked for position during placing of concrete and any displacement corrected.

4. Mesh overlap measured between outermost cross wires of each sheet shall be 6-inches at edges unless otherwise indicated on the Drawings, and shall be securely tied at ends and overlap.

3.2 ERECTION TOLERANCES

A. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

| Reinforcement Spacing | Depth Tolerance | Concrete Cover Tolerance |
|-----------------------|------------------------|--------------------------|
| Greater than 8 inches | plus or minus 3/8 inch | minus 3/8 inch |
| Less than 8 inches | plus or minus 1/2 inch | minus 1/2 inch |

B. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

3.3 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with ACI 318.
- B. Reinforcement Inspection:
 - 1. Placement Acceptance: Specified and ACI 318 material requirements and specified placement tolerances.
 - 2. Welding: Inspect welds in accordance with AWS D1.4.
 - 3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
 - 4. Weldability Inspection: Inspect for reinforcement weldability when formed from steel other than ASTM A706/A706M.
 - 5. Continuous Weld Inspection: Inspect reinforcement as required by ACI 318.
 - 6. Periodic Weld Inspection: Other welded connections.

3.4 REINFORCEMENT - STORAGE AND PROTECTION

- A. Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports, and shall be protected as far as is practicable, from mechanical injury and surface deterioration.
- B. When placed in the work, it shall be free from rust, dirt, scale, paint, oil, or other foreign matter, which may reduce or destroy bond.

3.5 SOURCE OF SUPPLY AND QUALITY OF MATERIALS

- A. The source of supply of all materials and equipment shall be submitted to the Engineer for review before orders are placed.
- B. Suppliers of reinforcing steel fabricated metal work and metal castings may be required to submit guarantees of conformity with the Drawings and Specifications.

- C. Representative preliminary samples of the character and quality prescribed shall be submitted by the Contractor or producer for examination and tested in accordance with the methods specified below.
- D. Only materials conforming to the requirements of the specifications shall be used in the work.
- E. All materials proposed to be used may be inspected or tested during their preparation and use. If, after inspecting and testing and/or trial, it is found that initial sources of supply do not furnish an acceptable product in conformity with the Specifications, the Contractor shall furnish material from other sources.
- F. No materials, which after approval have become unfit for use, shall be used in the work or remain on the job-site.

3.6 SAMPLES AND THE TESTING OF MATERIALS

- A. Unless otherwise specified, materials tests shall be made in accordance with the standards of the American Society for Testing Materials, and by a commercial testing laboratory approved by the Engineer; reports of tests shall promptly be furnished to the Engineer.
- B. Tests shall be arranged by the Contractor as directed by the Engineer. The cost of all specified inspection and testing of materials shall be paid by the Contractor whether called for in this section or other sections.

3.7 SCHEDULE OF MATERIALS AND STANDARD TESTS

- A. The following materials, and the tests to which each is to be subjected, are listed below. (ASTM Standards shall be as amended to date.)
 - 1. Certified copies of Mill Test for all heat runs.
 - 2. Up to 50 thousand pounds; field inspection for rust, shape, and dimensions.
 - 3. 50 thousand pounds and up; independent laboratory inspection as follows;
 - a. Billet Steel ASTM A 615
 - b. Roll Steel ASTM A 616
 - c. Cold-Drawn Steel Wire ASTM A 82
 - d. Wire Fabric ASTM A 185

END OF SECTION

CAST-IN-PLACE CONCRETE

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SCOPE

- A. The work described by this Section consists of furnishing all materials and equipment and performing all labor necessary for the complete construction of all concrete work, including all work and appurtenances thereto, as shown or specified, or both.
- B. Work shall include the installation of all sleeves, inserts, piping, hangers, anchors, frames, plastic liner plates, and other items to be built into the concrete work, and all other work and appurtenances specified or required, or both, for proper execution of the work.
- C. All items shall be correctly positioned in form work and must be inspected and approved by the Engineer before concrete is placed.
- D. The Contractor has the option of selecting fly ash or slag cement. Once this option has been selected, the Contractor shall use the same mix throughout the project.
- E. All of the concrete on this project shall be provided by a single concrete supply company with a local central batch plant.

1.2 SUMMARY

- A. Section includes cast-in-place concrete for the complete construction of all concrete work.
- B. Related Sections:
 - 1. Section 03 10 00 Concrete Forming and Accessories.
 - 2. Section 03 20 00 Concrete Reinforcing.
 - 3. Section 03 35 00 Concrete Finishing.
 - 4. Section 03 39 00 Concrete Curing.
 - 5. Section 03 60 00 Grouting.

1.3 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 Specifications for Structural Concrete.
 - 2. ACI 305 Hot Weather Concreting.
 - 3. ACI 306.1 Standard Specification for Cold Weather Concreting.
 - 4. ACI 308.1 Standard Specification for Curing Concrete.
 - 5. ACI 318 Building Code Requirements for Structural Concrete.
 - 6. ACI 350 Building Code Requirements for Environmental Engineering Concrete Structures.

B. ASTM International:

- 1. ASTM C31/C31M Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- 2. ASTM C33 Standard Specification for Concrete Aggregates.
- 3. ASTM C39/C39M Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- 4. ASTM C42/C42M Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- 5. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete.
- 6. ASTM C109/C109M 08 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)
- 7. ASTM C143/C143M Standard Test Method for Slump of Hydraulic Cement Concrete.
- 8. ASTM C150 Standard Specification for Portland Cement.
- 9. ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete.
- 10. ASTM C173/C173M Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- 11. ASTM C191 Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle
- 12. ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- 13. ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete.
- 14. ASTM C330 Standard Specification for Lightweight Aggregates for Structural Concrete.
- 15. ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete.
- 16. ASTM C595 Standard Specification for Blended Hydraulic Cements.
- 17. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
- 18. ASTM C685/C685M Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
- 19. ASTM C827 Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
- 20. ASTM C845 Standard Specification for Expansive Hydraulic Cement.
- 21. ASTM C989 Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
- 22. ASTM C1017/C1017M Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- 23. ASTM C1064/C1064M Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
- 24. ASTM C1107/C1107M Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- 25. ASTM C1157 Standard Performance Specification for Hydraulic Cement.
- 26. ASTM C1218/C1218M Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
- 27. ASTM C1240 Standard Specification for Silica Fume Used in Cementitious Mixtures.
- 28. ASTM D994 Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

- 29. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- 30. ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- 31. ASTM D6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
- 32. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials.
- 33. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
- 34. ASTM E1643 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures
- B. Concrete Supplier Qualifications:
 - 1. Submit qualifications on the proposed concrete supply company. The concrete supply company shall be in good standing with the Owner.
 - 2. The Owner and Engineer shall review and approve the Contractor's proposed concrete supplier selection.
 - 3. The concrete supplier shall be ACI certified.
 - 4. The Contractor shall provide additional qualifications from the concrete supply company if required by the Owner or Engineer.
- C. Product Data: Submit data on:
 - 1. Admixtures
 - 2. Cement
 - 3. Fly Ash
 - 4. Aggregate
 - 5. Other concrete materials

D. Design Data:

- 1. Submit concrete mix design for each concrete strength, type, and class.
- 2. Submit separate mix designs when admixtures are required for the following:
 - a. Hot and cold weather concrete work.
 - b. Air entrained concrete work.
- 3. Identify mix ingredients and proportions, including admixtures, and the volume in cubic feet of each ingredient in a cubic yard of concrete.
- 4. Identify chloride content of admixtures and whether or not chloride was added during manufacture.
- 5. Include in the submittal, a list of all the materials proposed for use in the concrete.
 - a. For each material, show the specific gravity, the total weight of material to be used in a cubic yard of concrete, and the volume of each material to be used in a cubic yard of concrete.
- E. Samples: Submit two 24 inch long samples of expansion joint and control joint.

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- F. Laboratory Test Reports:
 - 1. Submit laboratory test reports for concrete materials and mix design.
- G. Cylinder Break Reports:
 - 1. Submit proposed test cylinder break report form from the concrete testing lab.
- H. Concrete Batch and Delivery Tickets:
 - 1. Submit examples of concrete batch tickets and concrete delivery tickets that are proposed for use.
- I. Concrete batched on the project will not be allowed.

1.5 QUALITY ASSURANCE

- A. Imperfect and damaged work shall be satisfactorily removed; new work and materials, which are in accordance with the requirements of the Drawings and Construction Specifications, shall be furnished and installed at no additional expense to the Owner.
- B. Removal of concrete work and installation of subsequent work and materials shall be accomplished in a manner which will not impair the strength of the structure.
- C. Perform Work in accordance with ACI 318 and ACI 350.
- D. Conform to ACI 305 when concreting during hot weather.
- E. Conform to ACI 306.1 when concreting during cold weather.
- F. Acquire cement and aggregate from one source for Work.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01 33 00 – Shop Drawings, Product Data and Samples: Environmental conditions affecting products on site.

1.7 COORDINATION

A. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland Cement:
 - 1. Cement shall satisfy the requirements of ASTM C 150, as amended to date. Cement for normal Class "A", "B", and "C" concrete shall be Type I.

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B. Slag Cement:

1. Slag cement, if used, shall be Grade 120 and satisfy the requirements of ASTM C 989 and ACI 233R, both as amended to date.

C. Coarse Aggregates:

1. Coarse Aggregates shall be washed gravel or crushed stone consisting of hard, strong, durable, and uncoated particles; and shall contain neither vegetable matter nor soft, friable, thin, and elongated particles in quantities considered deleterious by the Engineer. Coarse aggregates shall satisfy the requirements of ASTM C 33, as amended to date, and have gradation as follows:

Coarse Aggregate Gradation:

| Sieve Size | Percent Passing, by Weight |
|--------------|----------------------------|
| 1-1/2" Sieve | 100 |
| 1" Sieve | 95 to 100 |
| ½" Sieve | 25 to 60 |
| No. 4 Sieve | 0 to 10 |
| No. 8 Sieve | 0 to 5 |

D. Fine Aggregates:

1. Fine aggregate shall be natural sand consisting of hard, strong, durable, and uncoated particles having a fineness modulus of not less than 2.30 nor more than 3.10; variation in fineness modulus shall be limited to +0.20 from the average of all tests. Aggregate shall satisfy the requirements of ASTM C 33, as amended to date, and have gradation as follows:

Fine Aggregate Gradation:

| Sieve Size | Percent Passing, by Weight |
|---------------|----------------------------|
| 3/8" Sieve | 100 |
| No. 4 Sieve | 95 to 100 |
| No. 8 Sieve | 80 to 100 |
| No. 16 Sieve | 50 to 85 |
| No. 30 Sieve | 25 to 60 |
| No. 50 Sieve | 5 to 30 |
| No. 100 Sieve | 0 to 10 |

E. Fly Ash

1. Fly ash, if used, shall satisfy the requirements of ASTM C 618 Class F, as amended to date, except that the loss-on-ignition shall be no more than 6%.

F. Water

- 1. Water shall be fresh, clean, and free of injurious amounts of oil, acid, alkali and organic materials.
- 2. Water shall not contain more than 1,000 parts per million of chlorides calculated as Cl, nor more than 1,000 milligrams per liter of sulfates calculated as SO₄.

2.2 ADMIXTURES

A. Manufacturers:

- 1. Master Builders
- 2. Substitutions: Section 01 60 00 Product Requirements.
- B. Air Entrainment: ASTM C260.
 - 1. The air entrainment agent shall be Master Builders "AE-90".
 - 2. The agent shall be added in such amounts that not less than 4% or more than 6% of air by volume is entrained in the concrete as it enters the forms.
- C. Water Reducing: ASTM C494/C494M Type A or D.
 - 1. The water-reducing admixture shall be Master Builders "Pozzolith".
 - 2. To be added in accordance with the admixture manufacturer's printed instructions.
- D. Retarding: ASTM C494/C494M Type B or D
- E. Accelerating: ASTM C494/C494M Type C.
 - 1. Accelerating admixtures are not permitted.
- F. Water Reducing and Accelerating: ASTM C494/C494M Type E
 - 1. Type E admixtures are not permitted.
- G. Water Reducing, High Range: ASTM C494/C494M Type F.
 - 1. Type F admixtures are not permitted.
- H. Water Reducing, High Range and Retarding: ASTM C494/C494M Type G.
 - 1. Type G admixtures are not permitted.
- I. Plasticizing: ASTM C1017/C1017M Type I, plasticizing.
 - 1. The use of super plasticizer is not permitted for any water retaining structure.
- J. Chlorides:
 - 1. The use of calcium chloride as an admixture is prohibited.
 - 2. Admixtures shall not contain chloride ions in excess of 0.25% by weight of the admixture.

2.3 CONCRETE MIX

A. General

- 1. Concrete shall be composed of cement, slag cement (if required), fly ash (if required), admixtures (if required), fine aggregate, coarse aggregate, and water proportioned and mixed to produce a plastic workable mix in accordance with the requirements of this Section, and shall be suitable for the specific conditions of placement.
- 2. The Contractor shall select the source of the concrete aggregates which he proposes to use in the work, and shall furnish suitable samples of those aggregates to the testing laboratory for testing and preparation of design mix.
- 3. The mix shall be submitted not more than 60 days nor less than 30 days in advance of the time of proposed use.

B. Pump Concrete

- 1. Pumped concrete is allowed for this project, and may be necessary in some cases where concrete is heavily reinforced or inaccessible. If a special design mix for pumped concrete is required it shall be submitted for approval.
- 2. The Engineer shall review the pumping equipment and methods.

C. Lightweight Concrete

- 1. Lightweight concrete shall have a compressive strength of not less than 4,000 psi and shall be used as shown on the Contract Drawings.
- 2. The mix shall incorporate the use of lightweight coarse aggregate and standard weight sands.
- 3. Lightweight concrete shall have maximum 28-day air-dry unit weight of 115 pounds per cubic foot.

D. Class "A" Concrete

- 1. Class "A" concrete shall have 28-day compressive strength of not less than 4,000 psi, and shall have normal setting characteristics.
- 2. Class "A" concrete shall be used for reinforced concrete work, and for unreinforced footings not thicker than 8-inches.

E. Class "B" Concrete

- 1. Class "B" concrete shall have 28-day compressive strength of not less than 3,000 psi, and shall have normal setting characteristics.
- 2. Class "B" concrete shall be used for blocking, gravity type walls, pipe encasement, and unreinforced footings and slabs thicker than 8-inches.

F. Class "C" Concrete

- 1. Class "C" concrete shall have a compressive strength of not less than 1,500 psi, and shall have normal setting characteristics.
- 2. Class "C" shall be used for concrete sub-foundations, and concrete backfill where required.

G. Design Mix

- 1. Design mix for each classification of concrete to be used in the work shall be prepared and tested by an independent commercial testing laboratory approved by the Owner and/or Engineer for the testing of materials.
- 2. The Contractor has the option of selecting a fly ash or slag cement concrete mix. Once this option has been selected, the Contractor shall use the same mix throughout the project.
- 3. The design mix shall be prepared using samples of cement, slag cement (if required), fly ash (if required), admixture (if required), and the aggregates to be used in the work.
- 4. Not fewer than four (4) cylinders shall be made from the design mix for each classification of concrete; two (2) cylinders shall be tested at 7 days, and two (2) shall be tested at 28 days. Cylinders shall be made and tested in accordance with ASTM C 31 and C 39.
- 5. If an existing design mix that was recently prepared using the same source of proposed materials is demonstrated to conform to this specification, the Engineer may approve its use in the work.

H. Proportioning

- 1. Proportioning of materials shall be accomplished in a manner that will produce a workable mixture having a slump within the required limits, and having minimum water content.
- 2. The exact proportion of materials to be used in concrete shall be as determined by the Laboratory Design Mix, and as directed by the Engineer.
- 3. The Contractor shall furnish the equipment necessary to positively determine and control actual amounts of materials entering into the concrete.
- 4. The proportions of materials used in the mix shall be changed whenever, in the opinion of the Engineer, a change is necessary to obtain the required strength, and the desired density for uniformity and workability. In structures intended to be watertight, good workability will be considered to be of primary importance.
- 5. All materials shall be measured by weight, except for water, which may be measured by volume.
 - a. One (1) gallon of water to weigh 8.33 pounds.
 - b. One (1) bag of Portland cement shall be considered to weigh 94 pounds.
- 6. Each cubic yard of concrete shall contain not less than the following quantities of cement and fly ash:

Cement (Non Slag):

| Concrete Class | Portland Cement | Fly Ash |
|----------------|---------------------|---------------|
| | | |
| A-1 | 470 pounds (5 bags) | 100 pounds |
| B-1 | 376 pounds (4 bags) | 100 pounds |
| C-1 | 376 pounds (4 bags) | None Required |
| C-1 | 3/6 pounds (4 bags) | None Required |

Slag Cement:

| Concrete Class | Portland Cement | Slag |
|----------------|---------------------|---------------|
| A-S | 424 pounds (5 bags) | 141 pounds |
| B-S | 376 pounds (4 bags) | 100 pounds |
| C-S | 376 pounds (4 bags) | None Required |
| | | |

Lightweight Concrete:

| Concrete Class | Portland Cement | Fly Ash |
|-----------------------|---------------------|------------|
| LWC | 480 pounds (5 bags) | 190 pounds |

7. In calculating the total water content of mixes, the amount of water borne on the surface of the aggregate particles shall be included. The amount of water to be used in the mix

shall, in all cases, be the least amount necessary to produce a plastic mix having the required strength and the desired density, uniformity, workability, and characteristics within the required slump limits. The intent of the specifications is to produce a maximum water cement ratio for Class "A" concrete of 0.49 or less.

Maximum Water Addition:

| Component | Water |
|---------------------------|--------------------------------|
| Portland Cement – Class A | 5.6 gallons/bag cement/CY |
| Portland Cement – Class B | 7.7 gallons/bag cement/CY |
| Fly Ash | 5.5 gallons/100 lbs fly ash/CY |
| Slag | 5.5 gallons/bag cement/CY |

8. The total volume of aggregates to be used in each cubic yard of concrete, and the proportion of fine aggregate to coarse aggregate, shall be that necessary to produce a dense mixture having the required workability, as determined by the Laboratory Design Mix, and as directed by the Engineer.

I. Admixtures:

- 1. Admixture may be added to Class "A" and Class "B" concrete if the Engineer allows its addition.
- 2. The use of admixtures is solely at the discretion of the Engineer and all such admixtures shall be submitted to the Engineer for review and approval.
- 3. A standard dispenser shall be used to introduce the admixture into the mix. The Contractor shall provide for the services of the admixture manufacturer's representative in order to install and establish the operation of the dispenser.

J. Slump Limits:

- 1. The slump of concrete to be placed in formed work such as columns, slabs, beams, piers and walls shall be not less than 4 inches, or more than 6 inches.
- 2. The Slump of concrete to be placed in slabs on earth and rock shall be not less than 1 inch, or more than 4 inches.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 CONCRETE PRE-CONSTRUCTION MEETING

A. A concrete pre-construction meeting shall be held a minimum of seven (7) days prior to the placement of any concrete.

B. Attendance:

- 1. The following persons are required to attend the meeting:
 - a. Owner
 - b. Contractor
 - c. Engineer
 - d. Concrete Supplier
 - e. Testing Lab Representative

C. Submittals

- 1. A minimum of seven (7) days prior to the meeting, the following submittals shall be made.
 - a. Proposed Design Mix
 - b. Proposed Test Cylinder Break Report
 - c. Proposed Concrete Batch Ticket Report Form
 - d. Proposed Concrete Loading/Delivery Ticket Form

3.3 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent at vertical construction joints, and grout at horizontal construction joints. Remove laitance, coatings, and unsound materials.

B. Bonding:

- 1. Before placing new concrete work on, and against, concrete work which has recently set, the surfaces of recently set concrete work shall be thoroughly roughened and made free from all foreign matter and laitance, the forms placed and tightened, and the surfaces of that concrete slushed with grout.
- 2. New concrete shall be placed before grout has attained its initial set.
- 3. Bonding work shall be accomplished in a manner that will ensure complete bonding.
- 4. Two (2) inches to four (4) inches of grout shall be applied to all horizontal construction joints.

C. Time:

- 1. When concrete is loaded onto a truck at the central mix plant, the time that the loading occurs shall be stamped on the load/batch ticket.
- 2. If the elapsed time between the time stamped on the load/batch ticket and discharge of the concrete from the truck exceeds 60 minutes, the inspector may require that the truck and contents of the truck be removed from the project.
- 3. If the elapsed time between the time stamped on the load/batch ticket and discharge of the concrete from the truck exceeds 90 minutes, the truck shall be rejected and the concrete will be deemed unacceptable for use in this project.
- 4. This rejected truck shall leave the site and all concrete contents from the truck shall be removed prior to batching another load in this truck.
- D. Accumulated water and debris shall be removed from excavations and from formwork into which concrete is to be placed.
 - 1. Flow of water into those places shall be diverted into side drains or sumps and be removed without disturbing newly placed concrete.

- E. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout unless otherwise shown on the Drawings.
- F. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- G. Forms, unless lined, shall be thoroughly wetted with water before concrete is placed so as to tighten joints and prevent leakage of the mix.
- H. Concrete Floor Surfaces and Slabs:
 - 1. Before constructing concrete slabs on earth, all piping that will be under these slabs shall be successfully tested.
 - 2. The sub-grade shall provide solid bearing, and shall be brought to a true and even plane.
 - 3. All pipes, except perforated pipe shall be encased in concrete.
 - 4. Provide a continuous membrane of polyethylene plastic film under all slabs on grade.
 - 5. Provide compacted crushed stone under all slabs on grade.

3.4 PLACING CONCRETE

- A. Place concrete in accordance with ACI 318.
- B. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
- C. Before concrete is placed, the depth and character of the foundations, the adequacy of forms and false-work, and the placing of steel and appurtenant work shall be inspected, and must be accepted by the Engineer.
 - 1. That acceptance, however, shall not relieve the Contractor from the responsibility to produce the finished work.
- D. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints are not disturbed during concrete placement.
- E. Ensure conduits and pipes embedded in concrete follow ACI 318-6.3:
 - 1. Conduits and pipes made of aluminum shall be effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
 - 2. Conduits, pipes, and their fittings embedded within a column shall not displace more than 4-percent of the area of cross section.
 - 3. Conduits, pipes, and their fittings, shall not be larger in outside dimension that 1/3 the overall thickness of slab, wall, or beam in which they are embedded.
 - 4. Conduits, pipes, and their fittings shall not be spaced closer than 3 diameters or widths on center.
 - 5. Conduits, pipes, and their fittings shall not significantly impair the strength of the construction as determined by the design engineer.
 - 6. No liquid, gas, or vapor shall be placed in embedded pipes until concrete has attained its design strength.
 - 7. In slabs, piping shall be placed between the top and bottom reinforcement.
 - 8. Concrete cover for conduits, pipes, and their fittings shall not be less than 1-1/2-in.

- 9. Conduits, pipes, and their fittings shall be so fabricated and installed that cutting, bending, or displacement of reinforcement from its proper location will not be required.
- F. Install construction joint devices in coordination with floor slab pattern placement sequence.
 - 1. Set top to required elevations.
 - 2. Secure to resist movement by wet concrete.
- G. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor and wall finish.
- H. Install joint covers in longest practical length, when adjacent construction activity is complete.
- I. Transporting From Mixer:
 - 1. Concrete shall be transported from the mixer to the point of deposit by a pump, a crane handled bottom dump concrete bucket, with concrete buggies, or with wheelbarrows.
 - 2. Runways for buggies and wheelbarrows, if used, shall not be supported by formwork.
 - 3. Concrete shall be conveyed in a manner that will not disturb forms.
 - 4. In the event the quality of the concrete as it reaches the form, and the method and placing thereof, in the opinion of the Engineer, is not satisfactory, the Contractor shall change his method of operation so as to place concrete in a manner suitable to the Engineer.
- J. Concrete shall be placed in a manner which will prevent the possibility of segregating aggregates, displacing reinforcing, and coating and splattering the reinforcing steel which is in place.
 - 1. Troughs, pipes, hoppers, chutes, and canvas tremies shall be arranged and used in a manner that will ensure that the concrete is placed in the manner specified.
 - 2. The maximum distance between the end of the concrete hopper, chute, tremie, pump hose, etc. shall not exceed five (5) feet above the fresh concrete.
- K. The placing of concrete within formwork shall be regulated in a manner that will ensure that the pressure within the formwork caused thereby shall not exceed the design pressure of the formwork.
- L. Concrete shall be placed in continuous horizontal layers, the thickness of which, in general, shall not exceed 12 inches.
- M. Care shall be used to fill each part of the forms; concrete shall be deposited to as near final position as possible. After the concrete has taken its initial set, care shall be used to avoid jarring the formwork, and placing strain and vibration on the ends of projecting reinforcing bars.
- N. When placing concrete, each batch and each layer shall be placed following the preceding batch or layer so closely that there will be no "cold joints" in the work.
- O. If concrete must be dropped more than five (5) feet, it shall be deposited through a tremie.
- P. Consolidating Concrete:
 - 1. Concrete, when placed, shall be compacted with mechanical, internal vibrating equipment supplemented with hand spading with a slicing rod.

- 2. Vibrating shall not be used to transport concrete within forms. Vibrating equipment shall maintain an impulse rate of not less than 5,000 impulses per minute, when submerged in concrete.
- 3. Not less than one (1) spare vibrator shall be maintained on the job site as a relief.
- 4. The duration of vibration shall be limited to that time necessary to satisfactorily consolidate the concrete without causing objectionable segregation.
- 5. The vibrator shall not be inserted into lower layers that have begun to set.

Q. Thin Section Work:

- 1. Thin section work shall be thoroughly worked with a steel rod; faces shall be shaped and mortar flushed to the surface of the form.
- 2. Small diameter holes shall be drilled in formwork beneath large wall sleeves and inserts to prevent the entrapment of air beneath those sleeves and inserts when concrete is placed.
- R. The placement of concrete within units of the work between construction joints, once begun, shall continue without interruption so that the unit will be monolithic in construction.
- S. Concrete shall be placed and compacted in a manner that will form a dense, compact, impervious structure having smooth faces on exposed surfaces. Sections of concrete work found to be porous, plastered, or otherwise defective, in the opinion of the Engineer shall be removed and replaced in whole, or in part, as directed by the Engineer, at no additional expense to the Owner.
- T. Concrete shall be placed in daylight. Placing of concrete in a portion of the work shall not be started if that portion of the work cannot be completed during daylight, unless an adequate lighting system is provided.
- U. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

3.5 PLACEMENT IN COLD WEATHER

- A. Concrete shall not be placed when the atmospheric temperature is below 35°F or the temperature of the concrete is below 55°F.
- B. Methods for obtaining proper concrete temperature for mixing and placing concrete are listed under Cold Weather Concreting in ACI 306.
- C. If, after placing concrete, the atmospheric temperature becomes lower than 35°F, the Contractor shall enclose, heat, and protect the concrete in a manner which will keep the air surrounding the fresh concrete at a temperature above 45°F for a period of 6 days after concrete is placed.
- D. The Contractor shall assume all risk connected with the cold weather placing and protecting of concrete and, should that concrete be unsatisfactory, it shall be rejected and replaced at no additional cost to the Owner.

3.6 PLACEMENT IN HOT WEATHER:

- A. When the ambient temperature is 90°F or above, special precautions shall be taken during mixing, placing, and curing.
- B. At times when the temperature exceeds 90°F, the Engineer may require that placement of the concrete be at night or during early morning hours.
- C. In no case should the temperature of the concrete, when placed, be above 90°F.
- D. Methods of lowering concrete temperature are listed under Hot Weather Concreting in ACI 305R.
- E. Attention shall be given to coordinating the dispatching of trucks with the rate of placement to avoid delays in delivery.
- F. When elapsed time from batching to placement is so long as to result in significant increases in mixing water demand, or in slump loss, mixing in the trucks should be delayed until only sufficient time remains to accomplish mixing before the concrete is placed.
- G. On truck arrival at the job site, addition of water is allowed to achieve specified slump but shall not exceed that shown on the batch ticket. The forms and reinforcing steel should be cooled to a temperature of not more than 90°F by spraying with fog nozzles.
- H. The concrete shall be cured with water.

3.7 WATERTIGHTNESS

- A. Concrete will be allowed to cure for a minimum of 14-days and have full strength prior to testing for watertightness.
- B. All concrete structures for holding and transporting water, and pits below ground level, shall be watertight;
 - 1. A drop in the water level of more than 1/4 inches within 24 hours will not be permitted when water holding structures are filled.
 - 2. If the structure fails to meet this requirement, the Contractor shall submit a plan to correct this deficiency to the Engineer.
 - a. If the Engineer accepts this corrective action plan, then the Contractor may proceed.
 - b. If the Engineer does not accept this corrective action plan, the Contractor shall resubmit another plan until a plan is accepted by the Engineer.
- C. All exposed surfaces of water-holding structures, and interiors of pits below ground water level, shall be free from visible damp spots and seepage before acceptance.
 - 1. If the structure fails to meet this requirement, the Contractor shall submit a plan to correct this deficiency to the Engineer.
 - a. If the Engineer accepts this corrective action plan, then the Contractor may proceed.

- b. If the Engineer does not accept this corrective action plan, the Contractor shall resubmit another plan until a plan is accepted by the Engineer.
- D. The Contractor shall continue to make corrective repairs in order to provide the Owner with structures that meet these specifications.

3.8 FLOOR SLOPE:

A. In areas with floor drains, maintain floor elevation at walls, pitch surfaces uniformly to drains at ¼ inch per foot nominal unless otherwise indicated on the Contract Drawings.

3.9 TESTING

- A. The Contractor shall arrange and pay for all concrete testing services on the referenced project.
- B. Tests for Concrete Materials:
 - 1. Fine aggregate shall satisfy the requirements of ASTM C 33, as amended to date. Coarse aggregate shall satisfy the requirements of ASTM C 33, as amended to date.
 - 2. Cement shall have normal setting characteristics and satisfy the requirements of ASTM C 150 for Type I cement, as amended to date (Cement which has been stored for more than four months after being tested shall be re-tested before use).
 - 3. Slag Cement shall be Grade 120 and shall satisfy the requirements of ASTM C 989 and ACI 233R as amended to date.
 - 4. Fly Ash, if required, shall satisfy the requirements of ASTM C 618 Class F, as amended to date, except loss-on-ignition shall be not more than 6%.

C. Testing During Construction

- 1. A representative of an independent testing lab shall be on site to make test cylinders for concrete, slump test, air entrainment, and concrete temperature all of which shall be included on the report for the cylinder broken, along with the truck number and date of test. The truck and load number shall be used to coordinate the test cylinder with the load sampled.
- 2. When the proportioning and mixing is accomplished at the central mix plant, a laboratory representative shall be present to observe, confirm and report the proportioning and mixing of Class "A" concrete, except as may be otherwise approved by the Engineer.
- 3. Concrete cylinders for testing purposes shall be made in accordance with the procedure described in ASTM C 31, as amended to date.
- 4. Slump tests shall be made with an accurately made sheet iron test cone, and in accordance with the procedure described in ASTM C 143, as amended to date.
- 5. Air content shall be determined according to the appropriate ASTM specification as amended to date:

| Type of Cement | ASTM Specification | Method | |
|-----------------|--------------------|-------------|--|
| Non Slag Cement | C 173 | Volumetric | |
| | C 138 | Gravimetric | |

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| | C 231 | Pressure |
|-------------|-------|------------|
| Slag Cement | C 173 | Volumetric |
| Lightweight | C 173 | Volumetric |

- 6. Compression tests shall be made at the age of 7 days and 28 days by the testing laboratory in accordance with the procedure described in ASTM C 39, as amended to date, and as required by the Engineer.
- 7. After beginning work, the number of tests shall be as listed in the following table, but shall be not less than one for each type of concrete for each pour. Each test shall consist of at least four cylinders; two to be properly stored at the site; and two for laboratory control, one each to be broken at 7 days and one each at 28 days.

| Total Cubic Yards Concrete Placed | Minimum Number of Tests | | |
|--|--------------------------------|--|--|
| 0 / 100 | 0 5 1 5 | | |
| 0 to 100 | One Each Pour | | |
| 100 to 1,000 | One Each 250 CY | | |
| | | | |
| 1,000 to 2,000 | One Each 350 CY | | |
| 2,000 and Over | One Each 500 CY | | |
| | | | |

8. If Contractor desires to strip forms early, additional cylinders shall be taken to determine strength of concrete at the desired time of form removal.

3.10 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.11 CLEANING

- A. Upon completion of the work, all forms, equipment, protective covering and rubbish resulting there from shall be removed from the premises.
- B. Finished concrete surfaces shall be left in a condition satisfactory to the Engineer.

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END OF SECTION

CONCRETE FINISHING

SECTION 03 35 00

CONCRETE FINISHING

PART 1 GENERAL

1.1 SCOPE

- A. The work described by this Section consists of furnishing all materials and equipment, and performing all labor necessary to finish the concrete, including all work and appurtenances thereto, as shown or specified, or both.
- B. Work shall include any type of finish as required by these Specifications or as shown on the Contract Drawings.

1.2 SUMMARY

- A. Section includes finishing all cast-in-place concrete on the project.
- B. Related Sections:
 - 1. Section 03 10 00 Concrete Forming and Accessories.
 - 2. Section 03 20 00 Concrete Reinforcing.
 - 3. Section 03 30 00 Cast-In-Place Concrete.
 - 4. Section 03 39 00 Concrete Curing.
 - 5. Section 03 60 00 Grouting

1.3 REFERENCES

- A. American Concrete Institute:
- B. ASTM International:

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on;
 - 1. Floor Hardener.

1.5 QUALITY ASSURANCE

- A. Imperfect and damaged work shall be satisfactorily removed; new work and materials, which are in accordance with the requirements of the Drawings and Construction Specifications, shall be furnished and installed at no additional expense to the Owner.
- B. Removal of concrete finishing work and installation of subsequent work and materials shall be accomplished in a manner which will not impair the strength of the structure.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 33 00 Shop Drawings, Product Data and Samples: Environmental conditions affecting products on site.
- B. Properly store all materials according to the manufacturer's recommendations. These recommendations shall be submitted with the shop drawings.

1.7 COORDINATION

- A. Coordinate finishing of concrete with other concrete work and other trades.
- B. The Contractor shall propose, during the initial project schedule submittal, alternate concrete finishing methods for the Owner and Engineer to review and accept; only if the Contractor's formwork methods conflict with finishing/rubbing the concrete surfaces.

PART 2 PRODUCTS

2.1 FLOOR HARDENER

- A. Floor hardener shall be chemically active and compatible with air entrained concrete.
- B. It shall be Lapidolith as manufactured by Sonneborn or equal.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare surfaces to receive finishing by completely removing all exposed snap tie ends and any she bolts or formwork supports. Remove any and all laitance, coatings, and unsound materials.

3.2 CONCRETE FINISHING

- A. Exterior concrete surfaces shall be finished to levels not shallower than 12 inches below finish grade levels; interior concrete surfaces, and other concrete surfaces exposed-to-view, shall be finished.
- B. Interior of basins shall be finished to a level not less than 12 inches below normal water level.
- C. Concrete not exposed to view shall have rough edges tooled off and shall be pointed and spot finished to fill any irregularities.
- D. Depressions resulting from removal of form ties, and all other holes and rough places, shall be thoroughly wetted with water and pointed with non-shrink sand cement mortar.
 - 1. Pointing and surface repair shall commence immediately after forms are removed.
- E. All imperfect concrete shall be removed to dense solid concrete and repairs made as directed by the Engineer.

CONCRETE FINISHING

F. Concrete Rubbing:

- 1. Rubbing of finished surfaces shall begin immediately after pointed surfaces and surface repairs have set sufficiently to allow rubbing to commence.
- 2. Chamfered surfaces shall be rubbed only once, and this shall not be done during the first rubbing.
- 3. The surface of the curing, moist, concrete shall be kept wet with water and rubbed with a medium course carborundum stone or equal abrasive, bringing a paste to the surface.
- 4. The rubbing shall continue until all form marks and projections are removed and a smooth, dense surface having no pits or irregularities is produced.
- 5. The material that has been ground to a paste in the process shall be carefully and uniformly spread over the entire surface and allowed to rest.
- 6. The entire concrete surface shall be kept moist during rubbing to assure adequate curing.
- 7. The first rub shall be applied at the time specified herein.
- 8. If the Contractor postpones the finishing beyond this time or has insufficient labor to keep it up to date, the Owner will order him to stop any other work until the progress of finishing is satisfactory.
- 9. The final rub may be given to the structure no earlier than 24 hours after the first rub, and it shall be done with a fine carborundum stone or equal abrasive leaving a smoothly textured surface, uniform in color.
- 10. The final rub shall be accomplished prior to the application of any Protective Surface Treatment which the Drawings or Specifications may require.
- 11. "White washing" of the finished areas by the use of separately mixed grout or paste on the rubbing stone or spread on the surface to be rubbed will not be allowed.
- 12. All areas of structures disfigured by drip from concrete placement or from the rubbing process shall be thoroughly cleaned and blended into the surrounding surfaces.

G. Floating:

- 1. All floors, walks, platforms, stairs, and other slab work shall have a wood float finish.
- 2. After screeding to the required grade while the concrete is still green, but has hardened sufficiently to bear the finisher's weight, the concrete surface shall be floated with a wood float to a true and even plane, have no visible coarse aggregate, and shall be sufficiently rough (broom finish) to prevent slipping.

H. Floor Hardener:

- 1. Floor hardener shall be applied on all slabs.
- 2. Floor hardener shall be applied in strict accordance with the hardener manufacturer's printed instructions.

3.3 ACCEPTABLE RUBBED FINISH

- A. After the forms are removed on the first concrete pour, the Contractor shall rub a section of concrete. The Owner and Engineer shall observe/inspect this test section. This test section, once it has been accepted by the Owner and Engineer, shall become the acceptable rubbed concrete standard. All remaining concrete rubbed on this project shall be similar to this standard.
- B. All concrete surfaces to be rubbed shall be done by experienced personnel and shall be done such that all rubbed surfaces look similar and are aesthetically pleasing.
- C. The Owner shall be the final determination if rubbed surfaces are acceptable.

CONCRETE FINISHING

D. Any rubbed surfaces found to be defective or inconsistent with the rubbed standard shall be removed and reworked until acceptable to the Owner.

3.4 CLEANING

- A. Upon completion of work, all forms, equipment, protective covering and rubbish resulting there from shall be removed from the premises.
- B. Finished concrete surfaces shall be left in a condition satisfactory to the Owner and Engineer.

END OF SECTION

CONCRETE CURING

SECTION 03 39 00

CONCRETE CURING

PART 1 GENERAL

1.1 SCOPE

A. The work described by this Section consists of furnishing all materials and equipment, and performing all labor necessary for curing cast-in-place concrete.

B. Related Sections:

- 1. Section 03 10 00 Concrete Forming and Accessories.
- 2. Section 03 20 00 Concrete Reinforcing.
- 3. Section 03 30 00 Cast-In-Place Concrete.
- 4. Section 03 35 00 Concrete Finishing.
- 5. Section 03 60 00 Grouting.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 Specifications for Structural Concrete.

B. ASTM International:

- 1. ASTM C156 09a Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete
- 2. ASTM C309 07 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- 3. ASTM C1315 08 Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Provide data sheets and complete submittals on all types of curing compounds proposed for use on the Project.
- B. Provide written certification that the curing compounds meet or exceed the requirements set forth in ASTM C309.
- C. Provide written certification that the cure and seal compounds meet or exceed the requirements set forth in ASTM C1315.

1.4 QUALITY ASSURANCE

A. Imperfect and damaged work shall be satisfactorily removed; new work and materials, which are in accordance with the requirements of the Drawings and Construction Specifications, shall be furnished and installed at no additional expense to the Owner.

B. Removal of any subsequent work and materials (after application of curing compounds) not compatible with the curing compounds used or residue remaining from curing compounds and re-installation of subsequent work and materials shall be accomplished in a manner which will not impair the strength of the structure and shall be performed at no additional costs to the Owner.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 33 00 Shop Drawings, Product Data and Samples: Environmental conditions affecting products on site.
- B. Store compounds as recommended by manufacturer.
- C. Protect concrete and curing compound applied to concrete as required by compound manufacturer.

1.6 COORDINATION

- A. Coordinate application and type of curing compound with concrete requirements, such as floor hardeners, air entrained concrete, etc.
- B. If curing compounds are used, they shall be allowed to dissipate/disintegrate and properly wear off before installation of subsequent work. If the schedule does not allow for the compound to dissipate, then the concrete shall be water cured.
- C. If the Contractor plans on removing the curing compound by physical, chemical or some other means (i.e. not waiting for compound to dissipate), the information shall be included in the submittal.
- D. Provide information in the shop drawing that the manufacturer of the paint/coating system and any other subsequent trades do not have any issues or concerns of applying their product over the resin-type curing compounds.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Aqua Kure Clear.
 - 2. W.R. Meadows.
 - 3. Substitutions: Section 01 60 00 Product Requirements

2.2 MEMBRANE CURING COMPOUNDS

- A. Membrane Curing Compound:
 - 1. All curing compounds shall contain a fugitive dye. This will allow the Engineer to see the compound is completely covering the concrete surface.
 - 2. Type I-D with a red fugitive dye.

CONCRETE CURING

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify requirements for membrane curing compound to dissipate.

3.2 PREPARATION

A. Prepare surface prior to application of membrane curing compound or applying water curing. Remove laitance, coatings, and unsound materials.

3.3 MIXING AND APPLICATION

- A. Mix product at the jobsite in accordance with the manufacturer's recommendations.
- B. Apply product in accordance with the manufacturer's recommendations. Apply product at the proper time after placement of concrete and before concrete dries.
- C. Apply enough curing compound so that all surfaces are covered and Engineer can visually check the red dye applied over the entire concrete surface area.
- D. Apply the number of coats and at proper intervals as recommended by manufacturer.
- E. Do not mix different types of curing compounds together.

3.4 CURING AND PROTECTION

- A. Freshly placed concrete shall be protected from rain and flowing water. Concrete shall not be allowed to dry out from the time it is placed until the expiration of the specified curing period.
- B. Methods of curing, unless otherwise approved by the Engineer, shall be as follows:
 - 1. Curing with Water:
 - a. Concrete slabs in water holding structures shall be kept wet with clean water and burlap for a period of 7 days after placing. Wet cure concrete slabs on grade by "flooding" the slab with 1 to 2 inches of standing water. Keep slab completely wet for seven days. If the slab does not have starter walls or the slope is such that the slab cannot be kept flooded, cover the slab with burlap or manufactured sand and water to keep slab wet.
 - b. Walls, beams and columns shall be cured with burlap continuously soaked or cured with the forms in place continuously wet for a period of 7 days.
 - c. Suspended or elevated slabs shall be cured with burlap continuously soaked (with the formwork in place) for a period of 7 days.

2. Membrane Curing:

- a. For non water holding structures above grade, in lieu of curing with water, the Contractor at his option may use a membrane curing compound to seal in the water in the concrete except for surfaces which are to receive future concrete or mortar
- b. Use curing compound such as W.R. Meadows 1240-White on concrete paving.
- c. Methods to lower concrete temperature will also be required during hot weather.

CONCRETE CURING

- d. The membrane curing compound shall be applied in accordance with the manufacturer's directions and in sufficient thickness to effectively hold the water in the concrete.
- e. The curing compound shall have a record of successful use for at least two years.
- f. The curing compound shall not adversely affect the air entrained concrete or the floor hardener applied to the concrete.
- g. The Contractor may request the Engineer review and approve the use of curing compounds for water holding structures. The Contractor shall provide this request, in writing, and include the proposed curing compound and the specific structure to be cured. The Engineer may approve on a case by case basis. Not all water holding structures may be approved. Curing compounds may not be allowed on structures that will contain potable water.

3.5 CLEANING

- A. Upon completion of work, all unused material and rubbish resulting there from shall be removed from the premises.
- B. Finished concrete surfaces shall be left in a condition satisfactory to the Engineer.

END OF SECTION

SECTION 03 60 00

GROUTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Portland cement grout.
 - 2. Rapid curing epoxy grout.
 - 3. Non-shrink cementitious grout.
- B. Related Sections:
 - 1. Section 03 10 00 Concrete Forming and Accessories.
 - 2. Section 03 30 00 Cast-In-Place Concrete.
 - 3. Section 03 35 00 Concrete Finishing.
 - 4. Section 03 39 00 Concrete Curing.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 Specifications for Structural Concrete.
 - 2. ACI 318 Building Code Requirements for Structural Concrete.
- B. American Society of Testing and Materials:
 - 1. ASTM C33 Standard Specification for Concrete Aggregates.
 - 2. ASTM C40 Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - 3. ASTM C150 Standard Specification for Portland Cement.
 - 4. ASTM C191 Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
 - 5. ASTM C307 Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.
 - 6. ASTM C531 Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
 - 7. ASTM C579 Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, monolithic Surfacings and Polymer Concretes.
 - 8. ASTM C827 Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
- C. U. S. Army Corps of Engineers Concrete Research Division (CRD):
 - 1. CRD C621 Non-Shrink Grout.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit product data on grout, admixtures and any components of grout mix.

- C. Manufacturer's Installation Instructions: Submit manufacturer's instructions for mixing, handling, surface preparation and placing epoxy type and non-shrink type grouts.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver grout in manufacturer's unopened containers with proper labels intact.
- C. Store grout in a dry shelter, protect from moisture.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Handling Requirements: Environmental conditions affecting products on site.
- B. Do not perform grouting if temperatures exceed 90 degrees F.
- C. Maintain minimum temperature of 40 degrees F before, during, and after grouting, until grout has set.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT GROUT MATERIALS

A. Portland Cement: ASTM C150, Type I and II. Use only one type and brand of cement throughout project.

B. Water:

- 1. Potable; free from deleterious amounts of alkalis, acids and organic matter and containing no impurities, suspended particles, algae, or dissolved natural salts in quantities capable of causing:
 - a. Corrosion of steel.
 - b. Volume change increasing shrinkage cracking.
 - c. Efflorescence.
 - d. Excess air entraining.

C. Fine Aggregate:

- 1. Washed natural sand.
- 2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
- 3. Free from injurious amounts of organic impurities as determined by ASTM C40.

D. Mix:

1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 RAPID CURING EPOXY GROUT

A. Rapid Curing Epoxy Grout: High strength, three component epoxy grout formulated with thermosetting resins and inert fillers. Rapid-curing, high adhesion, and resistant to ordinary chemicals, acids and alkalis.

| Property | Test | Result |
|--------------------------|--|----------------------|
| Compressive Strength | ASTM C579 | 12,000 psi at 7 days |
| Tensile Strength | ASTM C307 | 2,000 psi minimum |
| Coefficient of Expansion | Coefficient of Expansion ASTM C531 30x10-6 in per degree | |
| Shrinkage | ASTM C827 | None |

2.3 NON-SHRINK CEMENTITIOUS GROUT

- A. Non-Shrink Grout: ASTM C1107/C1107M;
 - 1. Non-shrink grout shall contain only pre-measured, prepackaged materials supplied by the manufacturer.
 - 2. Water to be used for mixing Portland cement manufactured grout shall be potable.
 - 3. Manufacturer must submit certified information verifying the following:
 - a. Plastic Volume Change:
 - 1) The grout shall show no shrinkage (0.0%) and a maximum of 4.0% expansion at any time before initial set when tested according to ASTM C 827.
 - b. Hardened Volume Change
 - 1) The grout shall show no shrinkage (0.0%) and a maximum of 0.2% expansion on the hardened state.
 - c. Compressive Strength
 - 1) All non-shrink cement based grout shall show a minimum 28-day compressive strength of 5,000 psi at standard laboratory temperatures when tested according to ASTM C 109.
 - d. Placeability:
 - 1) All non-shrink cement based grouts shall be capable of a flowable consistency (124-145 flow) when tested according to ASTM C 109.
 - 2) Standard non-shrink cement based grout shall have a minimum initial set time of 60 minutes when tested according to ASTM C 191.
 - e. Soundness:
 - 1) The grout shall contain no metallic substances, aluminum powder, or other materials known to compromise long-term durability.
 - f. Technical Service:
 - 1) Technical service shall be made available by the manufacturer upon request of the Contractor for purposes of advising on proper procedures dealing with grout installation.
 - g. Manufacturer
 - 1) Sika Corporation, Sikagrout 212

- 2) U.S. Grout Corporation Five Star Grout.
- 3) Substitutions: Section 01 60 00 Product Requirements.
- B. Properties: Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with CRD-C621, for Type D non-shrink grout:

| Property | Test | Time | Result | |
|----------------------|-----------|---------|--------------------------|--|
| Setting Time | ASTM C191 | Initial | 2 hours (Approx) | |
| | | Final | 3 hours (Approx) | |
| Expansion | | | 0.10% - 0.4% Maximum | |
| Compressive Strength | CRD-C621 | 1 day | 4,000 psi | |
| | | 7 days | 7,000 psi | |
| | | 28 days | 10,000 psi to 10,800 psi | |

2.4 FORMWORK

A. Refer to Section 03 10 00 for formwork requirements.

2.5 CURING

A. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or with use of wet burlap method.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify areas to receive grout.

3.2 PREPARATION

- A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.
- B. Rough concrete lightly, but not enough to interfere with placement of grout.
- C. Remove foreign materials from metal surfaces in contact with grout.
- D. Align, level and maintain final positioning of components to be grouted.
- E. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

3.3 INSTALLATION - FORMWORK

- A. Construct leak proof forms anchored and shored to withstand grout pressures.
- B. Install formwork with clearances to permit proper placement of grout.

3.4 MIXING

A. Portland Cement Grout:

- 1. Use proportions of 2 parts sand and 1 part cement, measured by volume.
- 2. Prepare grout with water to obtain consistency to permit placing and packing.
- 3. Mix water and grout in two steps; pre-mix using approximately 2/3 of water; after partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing 2 to 3 minutes.
- 4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
- 5. Do not add additional water after grout has been mixed.
- 6. Capable of developing minimum compressive strength of 2,000 psi in 48 hours and 5,000 psi in 28 days.
- B. Mix and prepare rapid curing epoxy grout in accordance with manufacturer's instructions.
- C. Mix and prepare non-shrink cementitious grout in accordance with manufacturer's instructions.
- D. Mix grout components in proximity to work area and transport mixture quickly and in manner not permitting segregation of materials.

3.5 PLACING GROUT

- A. Place grout material quickly and continuously.
- B. Do not use pneumatic-pressure or dry-packing methods.
- C. Apply grout from one side only to avoid entrapping air.
- D. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.
- E. Thoroughly compact final installation and eliminate air pockets.
- F. Do not remove leveling shims for at least 48 hours after grout has been placed.

3.6 CURING

- A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. After grout has attained its initial set, keep damp for minimum of three (3) days.

3.7 FIELD QUALITY CONTROL

- A. Section 01 45 23 Testing Laboratory Services: Field inspecting, testing, adjusting, and balancing.
- B. Field inspection and testing will be performed in accordance with ACI 301. The Contractor shall arrange and pay for all grout testing services on the referenced project.
- C. Submit proposed mix design of each class of grout for review prior to commencement of Work.
- D. Tests of grout components may be performed to ensure conformance with specified requirements.

END OF SECTION

SECTION 04 00 00

MASONRY

PART 1 GENERAL

1.1 SUMMARY

- A. This Specification addresses requirements for materials and construction of masonry structures.
- B. The scope of the work is outlined below. All these tasks and materials will not appear in every project. This article addresses the furnishing and construction of masonry including the following:
 - 1. Furnishing and placing masonry units, grout, mortar, masonry lintels, sills, copings, throughwall flashing, and connectors.
 - 2. Furnishing, erecting and maintaining of bracing, forming, scaffolding, rigging, and shoring.
 - 3. Furnishing and installing other equipment for constructing masonry.
 - 4. Cleaning masonry and removing surplus material and waste.
 - 5. Installing lintels, nailing blocks, inserts, window and door frames, connectors, and construction items to be built into the masonry, and building in vent pipes, conduits and other items furnished and located by other trades.

1.2 DEFINITIONS

Acceptable, accepted: Acceptable to or accepted by the Architect/Engineer.

- Architect/Engineer: The architect, engineer, architectural firm, engineering firm, or architectural and engineering firm, issuing drawings and specifications, or administering the work under project specifications and project drawings, or both.
- Area, gross cross-sectional: The area delineated by the out-to-out dimensions of masonry in the plane under consideration.
- Area, net cross-sectional: The area of masonry units, grout, and mortar crossed by the plane under consideration based on out-to-out dimensions.
- Autoclaved aerated concrete: low-density cementitious product of calcium silicate hydrates.
- Autoclaved aerated concrete (AAC) masonry: Autoclaved aerated concrete units, manufactured without reinforcement, set on a mortar leveling bed, bonded with thin-bed mortar, placed with or without grout, and placed with or without reinforcement.
- Bond beam: A horizontal, sloped, or stepped element that is fully grouted, has longitudinal bar reinforcement, and is constructed within a masonry wall.
- Bonded prestressing tendon: Prestressing tendon that is encapsulated by prestressing grout in a corrugated duct that is bonded to the surrounding masonry through grouting.
- Cleanouts: Openings that are sized and spaced to allow removal of debris from the bottom of the grout space.
- Collar joint: Vertical longitudinal space between wythes of masonry or between masonry and back up construction, which is permitted to be filled with mortar or grout.
- Compressive strength of masonry: Maximum compressive force resisted per unit of net cross-sectional area of masonry, determined by testing masonry prisms; or a function of individual masonry units, mortar and grout in accordance with the provisions of this Specification.

- Contract Documents: Documents establishing the required Work, and including in particular, the Drawings and Specifications.
- Contractor: The person, firm, or corporation with whom the Owner enters into an agreement for construction of the Work.
- Cover, grout: thickness of grout surrounding the outer surface of embedded reinforcement, anchor, or tie.
- Cover, masonry: thickness of masonry units, mortar, and grout surrounding the outer surface of embedded reinforcement, anchor, or tie.
- Cover, mortar: thickness of mortar surrounding the outer surface of embedded reinforcement, anchor, or tie.
- Dimension, nominal: The specified dimension plus an allowance for the joints with which the units are to be laid. Nominal dimensions are usually stated in whole numbers. Thickness is given first, followed by height and then length.
- Dimensions, specified: Dimensions specified for the manufacture or construction of a unit, joint, or element.
- Drawings: The Drawings that, along with the Project Specifications, complete the descriptive information for constructing the Work required or referred to in the Contract Documents.
- Glass unit masonry: Non-load-bearing masonry composed of glass units bonded by mortar.
- Grout: A plastic mixture of cementitious materials, aggregates, and water, with or without admixtures, initially produced to pouring consistency without segregation of the constituents during placement. The hardened equivalent of such mixtures.
- Grout, self-consolidating: A highly fluid and stable grout typically with admixtures, that remains homogeneous when placed and does not require puddling or vibration for consolidation.
- Grout lift: An increment of grout height within a total grout pour. A grout pour consists of one or more grout lifts.
- Grout pour: The total height of masonry to be grouted prior to erection of additional masonry. A grout pour consists of one or more grout lifts.
- Inspection, continuous: The Inspection Agency's full-time observation of work by being present in the area where the work is being performed.
- Inspection, periodic: The Inspection Agency's part-time or intermittent observation of work during construction by being present in the area where the work has been or is being performed, and observation upon completion of the work.
- Masonry, partially grouted: Construction in which designated cells or spaces are filled with grout, while other cells or spaces are un-grouted.
- Masonry unit, hollow: A masonry unit with net cross-sectional area of less than 75 percent of its gross cross-sectional area when measured in any plane parallel to the surface containing voids.
- Masonry unit, solid: A masonry unit with net cross-sectional area of 75 percent or more of its gross cross-sectional area when measured in every plane parallel to the surface containing voids.
- Mean daily temperature: The average daily temperature of temperature extremes predicted by a local weather bureau for the next 24 hours.
- Minimum daily temperature: The low temperature forecast by a local weather bureau to occur within the next 24 hours.
- Minimum/maximum (not less than . . . not more than): Minimum or maximum values given in this Specification are absolute. Do not construe that tolerances allow lowering a minimum or increasing a maximum.

Otherwise required: Specified differently in requirements supplemental to this Specification.

Owner: The public body or authority, corporation, association, partnership, or individual for whom the Work is provided.

Partition wall: An interior wall without structural function.

Post-tensioning: Method of prestressing in which prestressing tendons are tensioned after the masonry has been placed.

Prestressed masonry: Masonry in which internal compressive stresses have been introduced by prestressed tendons to counteract potential tensile stresses resulting from applied loads.

Prestressing grout: A cementitious mixture used to encapsulate bonded prestressing tendons.

Prestressing tendon: Steel element such as wire, bar, or strand, or a bundle of such elements, used to impart prestress to masonry.

Pretensioning: Method of prestressing in which prestressing tendons are tensioned before the transfer of stress into the masonry.

Prism: An assemblage of masonry units and mortar, with or without grout, used as a test specimen for determining properties of the masonry.

Quality assurance: The administrative and procedural requirements established by the Contract Documents to assure that constructed masonry is in compliance with the Contract Documents.

Reinforcement: Nonprestressed steel reinforcement.

Running bond: The placement of masonry units such that head joints in successive courses are horizontally offset at least one-quarter the unit length.

Slump flow: The circular spread of plastic selfconsolidating grout, which is evaluated in accordance with ASTM C1611.

Specifications: The written documents that specify requirements for a project in accordance with the service parameters and other specific criteria established by the Owner or his agent.

Specified compressive strength of masonry, f'_m: Minimum compressive strength, expressed as force per unit of net cross-sectional area, required of the masonry used in construction by the Specifications or Drawings, and upon which the project design is based.

Stone masonry: Masonry composed of field, quarried, or cast stone units bonded by mortar.

Stone masonry, ashlar: Stone masonry composed of rectangular units having sawed, dressed, or squared bed surfaces and bonded by mortar.

Stone masonry, rubble: Stone masonry composed of irregular shaped units bonded by mortar.

Submit, submitted: Submit, submitted to the Architect/Engineer for review.

Tendon anchorage: In post-tensioning, a device used to anchor the prestressing tendon to the masonry or concrete member; in pretensioning, a device used to anchor the prestressing tendon during hardening of masonry mortar, grout, prestressing grout, or concrete.

Tendon coupler: A device for connecting two tendon ends, thereby transferring the prestressing force from end to end.

Tendon jacking force: Temporary force exerted by a device that introduces tension into prestressing tendons.

Unbonded prestressing tendon: Prestressing tendon that is not bonded to masonry.

Veneer, adhered: Masonry veneer secured to and supported by the backing through adhesion.

Visual stability index (VSI): An index, defined in ASTM C1611, that qualitatively indicates the stability of self-consolidating grout

Wall: A vertical element with a horizontal length to thickness ratio greater than 3, used to enclose space.

Wall, load-bearing: A wall supporting vertical loads greater than 200 lbs. per linear foot in addition to its own weight.

Wall, masonry bonded hollow: A multi-wythe wall built with masonry units arranged to provide an air space between the wythes and with the wythes bonded together with masonry units.

When required: Specified in requirements supplemental to this Specification.

Work: The furnishing and performance of equipment, services, labor, and materials required by the Contract Documents for the construction of masonry for the project or part of project under consideration.

Wythe: Each continuous vertical section of a wall, one masonry unit in thickness.

1.3 REFERENCE STANDARDS

A. American Concrete Institute:

1. ACI 530.1/ASCE 6 – Building Code Requirements and Specification for Masonry Structures

B. ASTM International:

- ASTM C62 Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
- 2. ASTM C67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
- 3. ASTM C90 Standard Specification for Loadbearing Concrete Masonry Units
- ASTM C216 Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
- 5. ASTM C270 Standard Specification for Mortar for Unit Masonry
- 6. ASTM 476 Standard Specification for Grout for Masonry
- 7. ASTM C482 Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement Paste
- 8. ASTM C652 Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
- 9. ASTM C1019 Standard Test Method for Sampling and Testing Grout
- 10. ASTM C1314 Standard Test Method for Compressive Strength of Masonry Prisms
- 11. ASTM C1532 Standard Practice for Selection, Removal and Shipment of Manufactured Masonry Units and Masonry Specimens from Existing Construction
- 12. ASTM C1611 Standard Test Method for Slump Flow of Self-Consolidating Concrete

1.4 SYSTEM DESCRIPTION

A. Compressive strength requirements: Compressive strength of masonry in each masonry wythe and grouted collar joint shall equal or exceed the applicable f_m or f_{AAC} . For partially grouted masonry, the compressive strength of both the grouted and un-grouted masonry shall equal or exceed the applicable f_m . At the transfer of prestress, the compressive strength of the masonry shall equal or exceed f_{mi} .

B. Compressive strength determination

1. Methods for determination of compressive strength: Determine the compressive strength for each wythe by the unit strength method or by the prism test method as specified here.

2. Unit strength method

- a. Clay masonry: Use Table 1 to determine the compressive strength of clay masonry based on the strength of the units and the type of mortar specified. The following requirements apply to masonry:
 - 1) Units are sampled and tested to verify conformance with ASTM C62, ASTM C216, or ASTM C652.
 - 2) Thickness of bed joints does not exceed 5/8 in.
 - 3) For grouted masonry, the grout conforms to Section 04 05 16

Table 1 - Compressive strength of masonry based on the compressive strength of clay masonry units and type of mortar used in construction

| Net area compressive strength | Net area compressive strength of clay masonry units | | |
|-------------------------------|---|---------------|--|
| of clay masonry, psi | Type M or S mortar | Type N mortar | |
| 1,000 | 1,700 | 2,100 | |
| 1,500 | 3,350 | 4,150 | |
| 2,000 | 4,950 | 6,200 | |
| 2,500 | 6,600 | 8,250 | |
| 3,000 | 8,250 | 10,300 | |
| 3,500 | 9,900 | | |
| 4,000 | 11,500 | | |

- b. Concrete masonry: Use Table 2 to determine the compressive strength of concrete masonry based on the strength of the unit and type of mortar specified. The following Articles must be met:
 - 1) Units are sampled and tested to verify conformance with, ASTM C90.
 - 2) Thickness of bed joints does not exceed 5/8 in.
 - 3) For grouted masonry, the grout conforms to Section 04 05 16

Table 2 - Compressive strength of masonry based on the compressive strength of concrete masonry units and type of mortar used in construction

| Net area compressive strength | Net area compressive strength of clay masonry units | | |
|-------------------------------|---|---------------|--|
| of clay masonry, psi | Type M or S mortar | Type N mortar | |
| 1,700 | | 1,900 | |
| 1,900 | 1,900 | 2,350 | |
| 2,000 | 2,000 | 2,650 | |
| 2,250 | 2,600 | 3,400 | |
| 2,500 | 3,250 | 4,350 | |
| 2,750 | 3,900 | | |
| 3,000 | 4,500 | | |

^{*}For units of less than 4 in. nominal height, use 85 percent of the values listed.

- 3. Prism test method: Determine the compressive strength of clay masonry and concrete masonry by the prism test method in accordance with ASTM C1314.
- 4. Testing prisms from constructed masonry: When approved by the building official, acceptance of masonry that does not meet the requirements of Article 1.4 B.2 or 1.4 B.3 is permitted to be based on tests of prisms cut from the masonry construction.
 - a. Prism sampling and removal: For each 5,000 square feet of wall area in question, sawcut a minimum of three prisms from completed masonry. Select, remove and transport prisms in accordance with ASTM C1532. Determine the length, width and

- height dimensions of the prism and test prisms when at least 28 days old in accordance with ASTM C1314.
- b. Compressive strength calculations: Calculate the compressive strength of prisms in accordance with ASTM C1314.
- c. Compliance: Strengths determined from saw-cut prisms shall equal or exceed the specified compressive strength of masonry. Additional testing of specimens cut from construction in question is permitted.
- C. Adhered veneer requirements: When adhered veneer is not placed in accordance with Article 3.3 C, determine the adhesion of adhered veneer unit to backing in accordance with ASTM C482.

1.5 SUBMITTALS

- A. Submittal Procedures: Section 01 33 00.
- B. Submit the following:
 - 1. Mix designs and test results
 - a. One of the following for each mortar mix, excluding thin-bed mortar for AAC:
 - 1) Mix designs indicating type and proportions of ingredients in compliance with the proportion specification of ASTM C270, or
 - 2) Mix designs and mortar tests performed in accordance with the property specification of ASTM C270.
 - b. One of the following for each grout mix:
 - 1) Mix designs indicating type and proportions of the ingredients according to the proportion requirements of ASTM C476, or
 - 2) Mix designs and grout strength test performed in accordance with ASTM C476, or
 - 3) Compressive strength tests performed in accordance with ASTM C1019, and slump flow and Visual Stability Index (VSI) as determined by ASTM C1611.
 - c. Construction procedures
 - 1) Cold weather construction procedures.
 - 2) Hot weather construction procedures.
- C. Indicate the following on shop drawings:
 - 1. Bonding
 - 2. Mortar color
 - 3. Joint tooling
 - 4. Brick color and texture
 - 5. Reinforcement
 - 6. Workmanship
 - 7. Cavity clearance
 - 8. Masonry cleaning

1.6 QUALITY ASSURANCE

- A. Testing Agency's services and duties
 - 1. Sample and test in accordance with Table 3, 4, or 5, as specified for the project.
 - a. Unless otherwise specified, scheduled, or noted, Level B Quality Assurance per Table 4 is required.
 - b. For bidding purposes, the Contractor shall assume that Level B Quality Assurance per Table 4 is required.

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MASONRY

- 2. Unless otherwise required, report test results to the Architect/Engineer, Inspection Agency, and Contractor promptly after they are performed. Include in test reports a summary of conditions under which test specimens were stored prior to testing and state what portion of the construction is represented by each test.
- 3. When there is reason to believe that any material furnished or work performed by the Contractor fails to fulfill the requirements of the Contract Documents, report such discrepancy to the Architect/Engineer, Inspection Agency, and Contractor.
- 4. Unless otherwise required, the Owner will retain the Testing Agency.

Table 3 – Level A Quality Assurance

MINIMUM VERIFICATION

Prior to construction, verify certificates of compliance used in masonry construction

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Table 4 – Level B Quality Assurance

MINIMUM TESTS

Verification of Slump flow and Visual Stability Index (VSI) as delivered to the project site in accordance with Article 1.5 B.1.b.3 for self-consolidating grout

Verification of f_m and f'_{AAC} in accordance with Article 1.4 B prior to construction,

except where specifically exempted by the Code.

| | MINIMUM SPECIAL INSPECTION | | | | | |
|----|----------------------------|---|--------------|------------------|--|---|
| | | | Frequency(a) | | Reference for Criteria | |
| | | Inspection Task | Continuous | Periodic | TMS 402/ ACI 530/ ASCE 6 | TMS 602/ ACI 530.1/ ASCE 6 |
| 1. | | ify compliance with the approved submittals. | | X | | Art. 1.5 |
| 2. | | nasonry construction begins, verify that the following | | | | |
| | are | in compliance: | | | | |
| | a. | Proportions of site-prepared mortar | | X | | Art. 2.1, 2.6 A |
| | b. | Construction of mortar joints | | X | | Art. 3.3 B |
| | c. | Grade and size of prestressing tendons and anchorages | | X | | Art. 2.4 B, 2.4 H |
| | d. | Location of reinforcement, connectors, and prestressing tendons and anchorages | | X | | Art. 3.4, 3.6 A |
| | e. | Prestressing technique | | X | | Art. 3.6 B |
| | f. | Properties of thin-bed mortar for AAC masonry | $X^{(b)}$ | X ^(C) | | Art. 2.1 C |
| 3. | | r to grouting, verify that the following are in apliance: | | | | |
| | a. | Grout space | | X | | |
| | b. | Grade, type, and size of reinforcement and anchor bolts, and prestressing tendons and anchorages | | X | | Art. 3.2 D, 3.2 F |
| | c. | Placement of reinforcement, connectors, and prestressing tendons and anchorages | | X | Sec. 6.1 | Art. 2.4, 3.4 |
| | d. | Proportions of site-prepared grout and prestressing grout for bonded tendons | | X | Sec. 6.1, 6.2.1, 6.2.6, 6.2.7 | Art. 3.2 E, 3.4, 3.6 A |
| | e. | Construction of mortar joints | | X | | Art. 2.6 B, 2.4 G.1.b |
| 4. | Ver | ify during construction: | | | | Art. 3.3 B |
| | a. | Size and location of structural elements | | X | | Art. 3.3 F |
| | b. | Type, size, and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction | | X | Sec. 1.21(e), 6.1.4.3, 6.2.1 | |
| | c. | Welding of reinforcement | X | | Sec.8.1.6.7.2 9.3.3.4 (c), 11.3.3.4(b) | |
| | d. | Preparation, construction, and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F) | | X | | Art. 1.8 C, 1.8 D |
| | e. | Application and measurement of prestressing force | X | | | Art. 3.6 B |
| | f. | Placement of grout and prestressing grout for bonded tendons is in compliance | X | | | Art. 3.5, 3.6 C |
| | g. | Placement of AAC masonry units and construction of thin-bed mortar joints | $X^{(b)}$ | X ^(C) | | Art. 3.3 B.9, 3.3 F.1.b |
| 5. | | serve preparation of grout specimens, mortar specimens, d/or prisms | | X | | Art. 1.4 B.2.a.3, 1.4 B.2.b.3, 1.4 B.2.c.3, 1.4 B.3, 1.4 B.4 |

- (a) Frequency refers to the frequency of Special Inspection, which may be continuous during the task listed or periodic during the listed task, as defined in the table.
- (b) Required for the first 5000 square feet (465 square meters) of AAC masonry
- (c) Required after the first 5000 square feet (465 square meters) of AAC masonry

Table 5 – Level C Quality Assurance

MINIMUM TESTS

Verification of f m and f AAC in accordance with Article 1.4 B prior to construction and for every 5,000 sq. ft during construction Verification of proportions of materials in premixed or preblended mortar, prestressing grout,

and grout other than self-consolidating grout as delivered to the project site

Verification of Slump flow and Visual Stability Index (VSI) as delivered to the project site in accordance with Article 1.5 B.1.b.3 for self-consolidating grout

MINIMUM SPECIAL INSPECTION Frequency^(a) **Reference for Criteria** TMS 402/ **Inspection Task** TMS 602/ ACI ACI 530/ Continuous Periodic 530.1/ ASCE 6 ASCE 6 Verify compliance with the approved submittals. X Art. 1.5 Verify that the following are in compliance: Art. 2.1, 2.6 A, Proportions of site-mixed mortar, grout, and prestressing Χ 2.6 B, 2.6 C, grout for bonded tendons 2.4 G.1.b Grade, type, and size of reinforcement and anchor bolts, X Sec. 6.1 Art. 2.4, 3.4 and prestressing tendons and anchorages Placement of masonry units and construction of mortar X Art. 3.3 B Sec. 6.1, Placement of reinforcement, connectors, and prestressing Art. 3.2 E, 3.4, Χ 6.2.1, tendons and anchorages 3.6 A 6.2.6, 6.2.7 Art. 3.2 D. e. Grout space prior to grouting Χ 3.2 F Placement of grout and prestressing grout for bonded X Art. 3.5, 3.6 C tendons Size and location of structural elements X Art. 3.3 F Type, size, and location of anchors including other details Sec. 1.2.1(e), of anchorage of masonry to structural members, frames, or X 6.1.4.3, 6.2.1 other construction Sec. 8.1.6.7.2, Welding of reinforcement Χ 9.3.3.4 (c), 11.3.3.4(b) Preparation, construction, and protection of masonry Χ during cold weather (temperature below 40°F) or hot Art. 1.8 C, 1.8 D weather (temperature above 90°F) Application and measurement of prestressing force Art. 3.6 B Χ Placement of AAC masonry units and construction of thin-Art. 3.3 B.9. X 3.3 F.1.b bed mortar joints Properties of thin-bed mortar for AAC masonry Χ Art. 2.1 C.1 Art. 1.4 B.2.a.3, Observe preparation of grout specimens, mortar specimens, 1.4 B.2.b.3, 1.4 X B.2.c.3, 1.4 B.3, and/or prisms 1.4 B.4

⁽a) Frequency refers to the frequency of Special Inspection, which may be continuous during the task listed or periodic during the listed task, as defined in the table.

B. Inspection Agency's services and duties

- 1. Inspect and evaluate in accordance with Table 3, 4, or 5, as specified for the project.
- 2. Unless otherwise required, report inspection results to the Architect/Engineer, and Contractor promptly after they are performed. Include in inspection reports a summary of conditions under which the inspections were made and state what portion of the construction is represented by each inspection.
- 3. Furnish inspection reports to the Architect/Engineer and Contractor.
- 4. When there is reason to believe that any material furnished or work performed by the Contractor fails to fulfill the requirements of the Contract Documents, report such discrepancy to the Architect/Engineer and to the Contractor.
- 5. Submit a final signed report stating whether the Work requiring Special Inspection was, to the best of the Inspection Agency's knowledge, in conformance. Submit the final report to the Architect/Engineer and Contractor.
- 6. Unless otherwise required, the Owner will retain the Inspection Agency.

C. Contractor's services and duties

- 1. Permit and facilitate access to the construction sites and the performance of activities for quality assurance by the Testing and Inspection Agencies.
- 2. The use of testing and inspection services does not relieve the Contractor of the responsibility to furnish materials and construction in full compliance.
- 3. To facilitate testing and inspection, comply with the following:
 - a. Furnish necessary labor to assist the designated testing agency in obtaining and handling samples at the Project.
 - b. Advise the designated Testing Agency and Inspection Agency sufficiently in advance of operations to allow for completion of quality assurance measures and for the assignment of personnel.
 - c. Provide masonry materials required for preconstruction and construction testing.
- 4. Provide and maintain adequate facilities for the sole use of the testing agency for safe storage and proper curing of test specimens on the Project Site.
- 5. In the submittals, include the results of testing performed to qualify the materials and to establish mix designs.

D. Sample Wall Panel

- 1. For masonry governed by Level B or C Quality Assurance (Table 4 or Table 5), construct sample panels of masonry walls of each type of Masonry (brick, CMU, etc.) using mortar, grout, and reinforcing.
 - a. Use materials and procedures accepted for the Work.
 - b. The minimum sample panel dimensions are 6'-0" long by 4'-0" high.
- 2. The acceptable standard for the Work is established by the accepted panel.
- 3. Panel location and orientation shall be coordinated with the Engineer, Owner, and Architect.
- 4. Perform masonry cleaning on complete sample panel, to ensure proposed masonry cleaning compound causes no staining or discoloration.
- 5. Prepare panel at least 14 days prior to beginning masonry work. Should panel be disapproved, prepare additional panels until approved by Owner.
- 6. Maintain panel throughout work as standard of masonry work. The undamaged, approved panel may remain as part of the complete work.
- 7. Panel shall contain mortar of a color matching the masonry units.
 - a. The Owner and Engineer's acceptance of the sample panel shall be based on dry, hard mortar.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements:
 - 1. Deliver material in accordance with Section 01 60 00 Product Requirements and in accordance with manufacturer's written instructions.
 - 2. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.
- B. Storage Requirements:
 - 1. Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.
 - 2. Masonry units shall be stacked on platforms.
 - 3. Cover and store units in a manner that will protect them from contact with soil, and from weather exposure.
 - 4. Do not use materials with stained faces in exposed work

1.8 PROJECT CONDITIONS

- A. Construction loads: Do not apply construction loads that exceed the safe superimposed load capacity of the masonry and shores, if used.
- B. Masonry protection: Cover top of unfinished masonry work to protect it from moisture intrusion.
 - 1. Covering shall overhang at least 2' on each side of the wall, and shall be anchored securely.
 - 2. Protect exposed masonry and masonry requiring coatings from staining.
- C. Cold weather construction: When ambient air temperature is below 40°F, implement cold weather procedures and comply with the following:
 - 1. Preparation: Comply with the following requirements prior to conducting masonry work:
 - a. Do not lay masonry units having either a temperature below 20°F or containing frozen moisture, visible ice, or snow on their surface.
 - b. Remove visible ice and snow from the top surface of existing foundations and masonry to receive new construction. Heat these surfaces above freezing, using methods that do not result in damage.
 - 2. Construction: These requirements apply to work in progress and are based on ambient air temperature. Do not heat water or aggregates used in mortar or grout above 140°F. Comply with the following requirements when the following ambient air temperatures exist:
 - a. 40°F to 32°F:
 - 1) Heat sand or mixing water to produce mortar temperature between 40°F and 120°F at the time of mixing.
 - 2) Heat grout materials when the temperature of the materials is below 32°F.
 - b. Below 32°F to 25°F:
 - 1) Heat sand and mixing water to produce mortar temperature between 40°F and 120°F at the time of mixing. Maintain mortar temperature above freezing until used in masonry.
 - 2) Heat grout aggregates and mixing water to produce grout temperature between 70°F and 120°F at the time of mixing. Maintain grout temperature above 70°F at the time of grout placement.
 - 3) Heat AAC units to a minimum temperature of 40°F before installing thin-bed mortar
 - e. Below 25°F to 20°F: Comply with paragraph above and the following:
 - 1) Heat masonry surfaces under construction to a minimum temperature of 40°F

- 2) Use wind breaks or enclosures when the wind velocity exceeds 15 mph.
- 3) Heat masonry to a minimum temperature of 40°F prior to grouting.
- d. Below 20°F: Comply with paragraph above and the following: Provide an enclosure and auxiliary heat to maintain air temperature above 32°F within the enclosure.
- 3. Protection: These requirements apply after masonry is placed and are based on anticipated minimum daily temperature for grouted masonry and anticipated mean daily temperature for ungrouted masonry. Protect completed masonry in the following manner:
 - a. Maintain the temperature of glass unit masonry above 40°F for the first 48 hr. after construction.
 - b. Maintain the temperature of AAC masonry above 32°F for the first 4 hr. after thin-bed mortar application.
 - c. 40°F to 25°F: Protect newly constructed masonry by covering with a weather resistive membrane for 24 hr. after being completed.
 - d. Below 25°F to 20°F: Cover newly constructed masonry completely with weather-resistive insulating blankets, or equal protection, for 24 hr. after completion of work. Extend time period to 48 hr. for grouted masonry, unless the only cement in the grout is Type III portland cement.
 - e. Below 20°F: Maintain newly constructed masonry temperature above 32°F for at least 24 hr. after being completed by using heated enclosures, electric heating blankets, infrared lamps, or other acceptable methods. Extend time period to 48 hr. for grouted masonry, unless the only cement in the grout is Type III portland cement
- D. Hot weather construction: Implement approved hot weather procedures and comply with the following provisions:
 - 1. Preparation: Prior to conducting masonry work:
 - a. When the ambient air temperature exceeds 100°F, or exceeds 90°F with a wind velocity greater than 8 mph:
 - 1) Maintain sand piles in a damp, loose condition.
 - 2) Provide necessary conditions and equipment to produce mortar having a temperature below 120°F.
 - b. When the ambient temperature exceeds 115°F, or exceeds 105°F with a wind velocity greater than 8 mph, implement the requirements of paragraph above and shade materials and mixing equipment from direct sunlight.
 - 2. Construction: While masonry work is in progress:
 - a. When the ambient air temperature exceeds 100°F, or exceeds 90°F with a wind velocity greater than 8 mph:
 - 1) Maintain temperature of mortar and grout below 120°F.
 - 2) Flush mixer, mortar transport container, and mortar boards with cool water before they come into contact with mortar ingredients or mortar.
 - 3) Maintain mortar consistency by retempering with cool water.
 - 4) Use mortar within 2 hr of initial mixing.
 - 5) Spread thin-bed mortar no more than four feet ahead of AAC masonry units.
 - 6) Set AAC masonry units within one minute after spreading thin-bed mortar.
 - b. When the ambient temperature exceeds 115°F, or exceeds 105°F with a wind velocity greater than 8 mph, implement the requirements of paragraph above and use cool mixing water for mortar and grout. Ice is permitted in the mixing water prior to use. Do not permit ice in the mixing water when added to the other mortar or grout materials.
 - 3. Protection: When the mean daily temperature exceeds 100°F or exceeds 90°F with a wind velocity greater than 8 mph, fog spray newly constructed masonry until damp, at least three times a day until the masonry is three days old.

1.9 RELATED DOCUMENTS

A. Specifications sections:

- 1. 04 01 00 Maintenance of Masonry
- 2. 04 05 13 Masonry Mortaring
- 3. 04 05 16 Masonry Grouting
- 4. 04 05 19 Masonry Anchorage & Reinforcing
- 5. 04 05 23 Masonry Accessories
- 6. 04 21 00 Brick Masonry
- 7. 04 22 00 Concrete Unit Masonry
- 8. 07 11 00 Dampproofing
- 9. 07 19 00 Water Repellent
- 10. 07 62 00 Sheet Metal Flashing and Trim
- 11. 07 65 00 Wall Flashing

PART 2 PRODUCTS

2.1 MORTAR MATERIALS

A. See Specifications Section 04 05 13

2.2 GROUT MATERIALS

A. See Specifications Section 04 05 16

2.3 MASONRY UNIT MATERIALS

A. Concrete masonry units

- 1. Provide concrete masonry units that conform to ASTM C55, C73, C90, C129, C744, or C1634 as specified
- 2. See specifications Section 04 22 00

B. Brick masonry

- 1. Provide clay or shale masonry units that conform to ASTM C34, C56, C62, C126, C212, C216, C652, C1088, or C1405 or to ANSI A 137.1, as specified
- 2. See specifications Section 04 21 13

C. Stone masonry units

- 1. Provide stone masonry units that conform to ASTM C503, C568, C615, C616, or C629, as specified.
- 2. See specifications Section 04 43 00

D. Glass masonry units

- 1. Provide hollow glass units that are partially evacuated and have a minimum average glass face thickness of 3/16 in.
- 2. Provide solid glass block units when required.
- 3. Provide units in which the surfaces intended to be in contact with mortar are treated with polyvinyl butyral coating or latex-based paint.
- 4. Do not use reclaimed units

E. AAC masonry units

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1. Provide AAC masonry units that conform to ASTM C1691 and ASTM C1693 for the strength class specified in the Contract Documents.

2.4 REINFORCEMENT

A. See Specifications Section 04 05 19

2.5 ACCESSORIES

A. See Specifications Section 04 05 23

PART 3 EXECUTION

3.1 INSPECTION

- A. Prior to the start of masonry construction, the Contractor shall verify:
 - 1. That foundations are constructed within a level alignment tolerance of $\pm 1/2$ in.
 - 2. That reinforcing dowels are positioned in accordance with the Drawings.
- B. If stated conditions are not met, notify the Engineer.

3.2 PREPARATION

- A. Clean reinforcement and shanks of anchor bolts by removing mud, oil, or other materials that will adversely affect or reduce bond at the time mortar or grout is placed. Reinforcement with rust, mill scale, or both are acceptable without cleaning or brushing provided that the dimensions and weights, including heights of deformations, of a cleaned sample are not less than required by the ASTM specification that governs this reinforcement.
- B. Prior to placing masonry, remove laitance, loose aggregate, and anything else that would prevent mortar from bonding to the foundation.
- C. Wetting masonry units
 - 1. Concrete masonry: Unless otherwise required, do not wet concrete masonry or AAC masonry units before laying. Wet cutting is permitted.
 - 2. Clay or shale masonry: Wet clay or shale masonry units having initial absorption rates in excess of 1 g per min. per in.², when measured in accordance with ASTM C67, so the initial rate of absorption will not exceed 1 g per min. per in.² when the units are used. Lay wetted units when surface dry. Do not wet clay or shale masonry units having an initial absorption rate less than 0.2 g per min. per in.².
- D. Debris: Construct grout spaces free of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.

3.3 MASONRY ERECTION

- A. Bond pattern
 - 1. Unless otherwise required, lay masonry in running bond.
- B. Placing mortar and units

- 1. Bed joints at foundations: In the starting course on foundations and other supporting members, construct bed joints so that the bed joint thickness is at least ¼ in. and not more than:
 - a. ³/₄ in. when the masonry is ungrouted or partially grouted.
 - b. 1¼ in. when the first course of masonry is solid grouted and supported by a concrete foundation.
- 2. Bed and head joints: Unless otherwise required, construct 3/8-in. thick bed and head joints, except at foundation or with glass unit masonry. Construct joints that also conform to the following:
 - a. Fill holes not specified in exposed and below grade masonry with mortar.
 - b. Unless otherwise required, tool joint with a round jointer when the mortar is thumbprint hard
 - c. Remove masonry protrusions extending 1/2 in. or more into cells or cavities to be grouted.
- 3. Collar joints: Unless otherwise required, solidly fill collar joints less than 3/4 in. wide with mortar as the project progresses.
- 4. Hollow units Place hollow units so:
 - a. Face shells of bed joints are fully mortared.
 - b. Webs are fully mortared in:
 - 1) All courses of piers, columns and pilasters;
 - 2) When necessary to confine grout or insulation.
 - c. Head joints are mortared, a minimum distance from each face equal to the face shell thickness of the unit.
 - d. Vertical cells to be grouted are aligned and unobstructed openings for grout are provided in accordance with the Drawings.
- 5. Solid units: Unless otherwise required, place mortar so that bed and head joints are fully mortared and:
 - a. Do not fill head joints by slushing with mortar.
 - b. Construct head joints by shoving mortar tight against the adjoining unit.
 - c. Do not deeply furrow bed joints.
- 6. Open-end units with beveled ends: Fully grout open-end units with beveled ends. Head joints of open-end units with beveled ends need not be mortared. At the beveled ends, form a grout key that permits grout within 5/8 in. of the face of the unit. Tightly butt the units to prevent leakage of grout.
- 7. Glass units
 - a. Apply a complete coat of asphalt emulsion, not exceeding 1/8 in. in thickness, to panel
 - b. Lay units so head and bed joints are filled solidly. Do not furrow mortar.
 - c. Unless otherwise required, construct head and bed joints of glass unit masonry ¼ in. thick, except that vertical joint thickness of radial panels shall not be less than 1/8 in. The bed-joint thickness tolerance shall be minus 1/16 in. and plus 1/8 in. The head-joint thickness tolerance shall be plus or minus 1/8 in.
 - d. Do not cut glass units.
- 8. All units
 - a. Place clean units while the mortar is soft and plastic. Remove and re-lay in fresh mortar any unit disturbed to the extent that initial bond is broken after initial positioning.
 - b. Except for glass units, cut exposed edges or faces of masonry units smooth, or position so that exposed faces or edges are unaltered manufactured surfaces.
 - c. When the bearing of a masonry wythe on its support is less than two-thirds of the wythe thickness, notify the Architect/Engineer.
- 9. AAC masonry

- a. Place mortar for leveling bed joint in accordance with the requirements above
- b. Lay subsequent courses using thin-bed mortar. Use special notched trowels manufactured for use with thin-bed mortar to spread thin-bed mortar so that it completely fills the bed joints. Unless otherwise specified in the Contract Documents, similarly fill the head joints. Spread mortar and place the next unit before the mortar dries. Place each AAC unit as close to head joint as possible before lowering the block onto the bed joint. Avoid excessive movement along bed joint. Make adjustments while thin-bed mortar is still soft and plastic by tapping to plumb and bring units into alignment. Set units into final position, in mortar joints at least 1/16-in. thick, by striking on the end and top with a rubber mallet.
- c. Lay units in alignment with the plane of the wall. Align vertically and plumb using the first course for reference. Make minor adjustments by sanding the exposed faces of the units and the bed joint surface with a sanding board manufactured for use with AAC masonry.

C. Placing adhered veneer

- 1. Brush a paste of neat portland cement on the backing and on the back of the veneer unit.
- 2. Apply Type S mortar to the backing and to the veneer unit.
- 3. Tap the veneer unit into place, completely filling the space between the veneer unit and the backing. Sufficient mortar shall be used to create a slight excess to be forced out between the edges of the veneer units. The resulting thickness of the mortar in back of the veneer unit shall not be less than 3/8 in. nor more than 1¼ in.
- 4. Tool the mortar joint with a round jointer when the mortar is thumbprint hard.
- D. Embedded items and accessories: Install embedded items and accessories as follows:
 - 1. Construct chases as masonry units are laid.
 - 2. Install pipes and conduits passing horizontally through masonry partitions.
 - 3. Place pipes and conduits passing horizontally through piers, pilasters, or columns.
 - 4. Place horizontal pipes and conduits in and parallel to plane of walls.
 - 5. Install and secure connectors, flashing, weep holes, weep vents, nailing blocks, and other accessories.
 - 6. Install movement joints.
 - 7. Aluminum
 - a. Do not embed aluminum conduits, pipes, and accessories in masonry, grout, or mortar, unless they are effectively coated or isolated to prevent chemical reaction between aluminum and cement or electrolytic action between aluminum and steel.
- E. Bracing of masonry
 - 1. Design, provide, and install bracing that will assure stability of masonry during construction
- F. Site tolerances: Erect masonry within the following tolerances from the specified dimensions.
 - 1. Dimensions of elements
 - a. In cross section or elevation: -1/4 in., +1/2 in.
 - b. Mortar joint thickness
 - 1) Bed joints between masonry courses: $\pm 1/8$ in.
 - 2) Bed joint between flashing and masonry: ½ in., +1/8 in.
 - 3) Head: $-\frac{1}{4}$ in., $+\frac{3}{8}$ in.
 - 4) Collar: $-\frac{1}{4}$ in., $+\frac{3}{8}$ in.
 - c. Grout space or cavity width, except for masonry walls passing framed construction: 1/4 in., + 3/8 in.
 - 2. Elements

- a. Variation from level:
 - 1) Bed joints: $\pm 1/4$ in. in 10 ft, $\pm 1/2$ in. maximum
 - 2) Top surface of load-bearing walls: $\pm 1/4$ in. in 10 ft, $\pm 1/2$ in. maximum
- b. Variation from plumb
 - 1) $\pm 1/4$ in. in 10 ft
 - 2) $\pm 3/8$ in. in 20 ft
 - 3) $\pm 1/2$ in. maximum
- c. True to a line
 - 1) $\pm 1/4$ in. in 10 ft
 - 2) $\pm 3/8$ in. in 20 ft
 - 3) $\pm 1/2$ in. maximum
- d. Alignment of columns and walls (bottom versus top)
 - 1) $\pm 1/2$ in. for load-bearing walls and columns
 - 2) $\pm 3/4$ in. for non-load-bearing walls
- 3. Location of elements
 - a. Indicated in plan: $\pm 1/2$ in. in 20 ft, $\pm 3/4$ in. maximum
 - b. Indicated in elevation: $\pm 1/4$ in. in story height, $\pm 3/4$ in. maximum
- 4. If the above conditions cannot be met due to previous construction, notify the Engineer.

G. INSTALLATION

- 1. Lay masonry plumb and true to line. Lay with courses level and spaced accurately. Use a story pole marked with all courses. Adjust coursing on story pole as necessary to work with heads and sills of openings to maintain jointing for all surfaces of the building.
- 2. Break each course joint with course below, unless shown otherwise. Keep bond plumb throughout. Bond of facing brick shall be as specified.
- 3. Lay corners and reveals plumb and true. Avoid pounding corners and jambs to fit units/make units plumb after they are set in position.
- 4. Adjust units to final position while mortar is soft and plastic.
- 5. Where adjustments must be made after mortar has started to harden, remove mortar and replace with fresh mortar.
- 6. Wipe excess mortar off masonry surfaces as work progresses.
- 7. For composite walls, fill cavity with mortar as work progresses.
- 8. For walls with cavities, keep the cavity clear of mortar and other materials which project into cavity (these could decrease cavity clearance to less than minimum dimension indicated).
- 9. Where required:
 - a. Adjust shelf angles to keep work level and at proper elevation. Provide for a 3/8" joint below shelf angle.
 - b. Provide brick expansion joints with pressure-relieving pads (continuous under shelf angles).
- 10. At end of each day's work, clean equipment used in mixing, moving, and storing mortar.

H. BUILDING IN

- 1. Build work of other trades into masonry work (including anchors, wall plugs, and accessories) as work progresses. Space and align built-in parts accurately. Exercise care not to displace other materials from proper position.
- 2. Fill spaces around built-in items solidly with mortar. Fill metal doorframes in masonry walls with mortar as wall is laid.
- 3. When flashing is laid on or against masonry, the surface of the masonry shall be smooth and free from projections, which might puncture the flashing material.

I. CUTTING AND PATCHING

- 1. Where cut edges of masonry units will be exposed in the finished wall, cut units with an abrasive power saw.
- 2. Where cutting and patching of finish masonry is required to accommodate work of other trades, perform work in a manner that will not damage or mar appearance of adjoining masonry. Cutting and patching shall be performed by masonry mechanics.

J. JOINING OF WORK

- 1. When joining fresh masonry to set or partially set masonry, remove loose brick and mortar, and clean and dampen exposed surface of set masonry prior to laying fresh masonry.
- 2. If it becomes necessary to "stop off" a horizontal run of masonry, rake back one-half brick length in each course. If grout is used, stop grout 4" back of rake. Toothing will not be permitted.
- 3. Stop-off horizontal run by racking back in each course; toothing is not permitted.

K. CONTROL JOINTS

- 1. Control joints in concrete masonry unit work shall be ½" wide in face joint and as follows:
- 2. In running wall, control joints shall be made with square end masonry unit having sash groove and synthetic rubber filler.
- 3. All mortar shall be omitted from joint.
- 4. At intersecting walls, provide control joint between the two walls and omit all mortar from face joint.
 - a. Where detailed on the Drawings, anchor the intersecting walls with corrugated metal ties 16" on center vertically in same bed joint in which the horizontal joint reinforcement occurs.
- 5. At structural columns, provide ½" wide control joints with all mortar omitted between masonry unit and column.
 - a. Where detailed on the Drawings, anchor walls to columns with anchors as detailed 16" on center vertically in same bed joint in which the horizontal joint reinforcement
- 6. At top joint, between block and structural slabs or beams, omit all mortar.
- 7. Caulking of the above control joints shall be as specified in the section of these Specifications for Thermal and Moisture Protection.

L. JOINT TREATMENT

- 1. Lay exposed units with joints tooled concave.
- 2. Joints in masonry which will be in contact with earth shall be struck flush; and when partially set, shall be tooled slightly concave.
- 3. Joints to receive caulking shall be raked out 3/4" and left ready for caulking.
- 4. Tool joints with a steel tool with pressure to squeeze mortar into joints

M. POINTING:

- 1. Point any holes in exposed masonry (except for weep holes).
- 2. Cut out defective joints and joints not in compliance with approved sample panel.
- 3. Repoint solidly with mortar, and tool.
- 4. Point work shall match adjoining joints.

3.4 REINFORCEMENT, TIE, AND ANCHOR INSTALLATION

A. See Specifications Section 04 05 19

3.5 GROUT PLACEMENT

A. See Specifications Section 04 05 16

3.6 FIELD QUALITY CONTROL

- A. Verify net compressive strength (f'_m) at 28 days.
- B. Sample, test, and verify grout strength.
- C. The contractor shall not load the masonry wall and/or structure until the it has reached the 28-day strength.
 - 1. The contractor shall have test results to demonstrate the masonry has reached the specified 28-day strength before loading the wall and/or structure.
- D. The wall and/or structure shall not be loaded until the masonry has aged at least 7-days.

3.7 CLEANING

A. Clean exposed masonry surfaces of stains, efflorescence, mortar and grout droppings, and debris using methods that do not damage the masonry.

B. Dry cleaning

- 1. Brush brick surfaces with stiff bristle brush.
- 2. Do not allow mortar droppings to harden on exposed surfaces.

C. Final cleaning

- 1. Methods and materials used to clean masonry shall be approved by the manufacturer of the brick masonry that is to be cleaned.
- 2. Before applying any cleaning agent to entire wall, apply agent to a sample wall area approximately 20 sq. feet. Apply in a location approved by the Engineer. After approval, clean remaining wall area with same cleaning materials and methods used on sample area.
- 3. If masonry is cleaned with an acid solution, thoroughly protect all exposed parts of the building.
- 4. Clean masonry from top down.
- 5. Masonry Cleaning Agent:
 - a. 1 part agent to 4 to 8 parts potable water, depending on application.
- 6. At least 21 days prior to application of specified cleaning solution to brick work, apply solution on half of the surface to brick work, apply solution on half of the surface of sample panel. Should discoloration of brick or mortar joints, staining or efflorescence appear on sample panel, notify Architect and await further instructions.
- 7. No wet cleaning shall take place within seven days of placing masonry.
- 8. Apply masonry cleaning compound on brick masonry as tested on sample panel in accord with manufacturer's product data. Flush with clean water.
- 9. At least two hours prior to application of cleaning solution to brick work, saturate mortar joints with clean water and flush off loose debris.
- 10. Begin cleaning process at highest point of wall, working downward. Work in areas of 20 sq. ft., maximum. As cleaning progresses, flush wall to prevent accumulation of scum.
- 11. Safely discard solutions containing debris and residue.
- 12. Do not scrub mortar joints with cleaning solution.
- 13. Protect materials adjacent to brick work which are subject to corrosion from contact with cleaning solution.

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14. Remove stains in accord with recommendations of the SBA/BIA, Technical Notes #20. Use cleaning agents only after pre-testing on sample panel.

END OF SECTION

MASONRY MORTARING

SECTION 04 05 13

MASONRY MORTARING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mortar used for masonry construction for brick masonry units and concrete masonry units.
- B. See Section 04 00 00 Masonry

1.2 SCOPE OF WORK

A. Furnish labor, materials, equipment and appurtenances required to complete execution of work shown on Drawings and specified herein.

1.3 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 530.1/ASCE 6 Building Code Requirements and Specification for Masonry Structures
- B. ASTM International:
 - 1. ASTM C91 Standard Specification for Masonry Cement
 - 2. ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
 - 3. ASTM C144 Standard Specification for Aggregate for Masonry Mortar
 - 4. ASTM C150 Standard Specification for Portland Cement
 - 5. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes
 - 6. ASTM C270 Standard Specification for Mortar for Unit Masonry
 - 7. ASTM C404 Standard Specification for Aggregates for Masonry Grout
 - 8. ASTM C780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

1.4 QUALITY ASSURANCE

A. Installer Qualifications shall include documented experience in completion of work similar in design, material, and extent specified

1.5 SUBMITTAL

- A. Submittal Procedures: Section 01 33 23
- B. Manufacturer's literature, data sheets, and mixing instructions for each product.
- C. Samples
 - 1. Color shall be premixed in the mortar.
 - 2. Submit samples of manufacturer's premixed colors with the Shop Drawing for review by the Engineer.

- 3. The Owner shall select the color.
 - a. If Drawings do show existing, then, for bidding purposes, the Contractor shall assume the mortar color shall match or be similar (in the opinion of the Owner) to the mortar used in other buildings or the brick columns for the fence (for perimeter fence brick columns) around the site.
 - b. Mortar used in the existing fence columns and the existing electrical building joints was Type S colored masonry with a color of Desert Bluff as manufactured by Holcim, Inc., Holly Hills, S.C.
- 4. Mortar: Molded, 4 inches long for each type, texture, and color
- D. Mix Designs indicating type and proportions of ingredients in compliance with the proportions specifications of ASTM C270.

E. Certificates

1. Submit certificates from manufacturer stating compliance to specification requirements and supporting test data furnished by independent testing laboratory.

F. Premixed Mortar

1. Premixed mortar shall be approved by the Engineer.

1.6 TESTING

A. Mortar shall be tested in accordance with ASTM C109 and ASTM C780.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Product handling shall comply with pertinent provisions of Section 01 60 00.
- B. Deliver materials in manufacturer's original containers, bearing labels indicating product and manufacturer's name.
- C. Store cementitious materials in waterproof locations to prevent damage by elements. Reject containers shown evidence of damage.
- D. Store aggregates in separate bins to prevent intrusion of foreign particles.
 - 1. Do not use bottom 6 inches of sand or other aggregates stored in contact with the ground.

1.8 RELATED DOCUMENTS

- A. Specifications sections:
 - 1. 04 00 00 Masonry
 - 2. 04 01 00 Maintenance of Masonry
 - 3. 04 05 16 Masonry Grouting
 - 4. 04 05 19 Masonry Anchorage & Reinforcing
 - 5. 04 05 23 Masonry Accessories
 - 6. 04 21 13 Brick Masonry
 - 7. 04 22 00 Concrete Unit Masonry
 - 8. 07 11 00 Dampproofing
 - 9. 07 19 00 Water Repellent
 - 10. 07 62 00 Sheet Metal Flashing and Trim
 - 11. 07 65 00 Wall Flashing

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. For purposes of designation of type and quality for the work under this Section, Drawings, and Specifications are based on products manufactured or furnished by LafargeHolcim, Inc.
- B. Products of the following manufacturers equal to those specified herein will be acceptable for use on the Project:
 - 1. Giant Portland Cement Company
 - 2. Lehigh Heidelberg Cement Group.
- C. Products for use on this project shall be of one manufacturer unless specifically noted otherwise

2.2 MORTAR

- A. Mortar shall conform to ASTM C270.
- B. For tanks and below grade applications, mortar shall be Type M.
- C. For other applications, mortar shall be Type S.
- D. Mortar Pigment
 - Natural or synthetic iron oxide and chromium oxides meeting the requirements of ASTM C979
 - 2. Pigment shall not exceed 10% of the weight of Portland cement.
 - 3. Carbon black shall not exceed 2% of Portland Cement.
 - 4. Color shall be selected by the Owner from the manufacturer's full range of colors.

2.3 MATERIALS

- A. Cementitious Materials:
 - 1. Portland cement shall conform to ASTM C150,
 - a. Type 1 above grade and Type II below grade.
 - 2. Masonry Cement: ASTM C91, Type S and meet the following criteria:
 - a. Prepackaged masonry cement shall contain Portland cement, hydrated lime and plasticizing admixtures or hydraulic hydrated lime.
 - b. Masonry cements which contain other materials, including ground limestone, ground slag, or other cementitious and non-cementitious materials, are not acceptable.
- B. Hydrated Lime:
 - 1. Hydrated lime shall conform to ASTM C207, Type S.
- C. Fine Aggregate:
 - 1. Fine aggregate (Sand) for masonry mortar shall conform to requirements of ASTM C144, except that 100% of the sand for mortar in 1/4" joints shall pass a No. 16 sieve.
- D. Coarse Aggregate:
 - 1. Aggregate for masonry grout shall conform to requirements of ASTM C404.
- E. Water:

1. Water shall be clean and free from deleterious amounts of oil, acids, alkalis, salt, organic materials or other deleterious substances.

F. Waterproofing of Mortar (Mortarproofing)

- 1. Common CMU:
 - a. Mortar shall contain a waterproofing admix, "Omicron" Mortarproofing of the Master Builders Company, Hydroxide by Sonneborn, "Mortaron" by Aquabar, or equal.
- 2. Split Faced CMU:
 - a. Mortar for use with split faced CMU shall contain a water repellant admixture. Admixture shall be "Dry-Block" Mortar Admixture by W.R. Grace or equal.

G. Mortar Color:

- 1. Pigments for mortar color shall consist of inorganic compounds used in the proportions recommended by the manufacturer.
- 2. Pigments used for buff or light colors shall not exceed 15 percent of the weight of the cement.
- 3. Pigments used for dark colors shall not exceed 4 percent of the weight of the cement, except that carbon black shall not exceed 3 percent of the weight of the cement

2.4 AGGREGATES

1. Gradation of aggregates used in mortar shall conform to ASTM C144

2.5 ADMIXTURES

- A. Do not use calcium chloride
- B. Do not use admixtures without written approval of Engineer.

2.6 MIXES

- A. Proportions for masonry mortar shall be one of the following:
 - 1. Proportions by volume: 1 part Portland cement to ½ or ½ parts hydrated lime, and aggregate volume of not less than 2-1/4 or more than 3 times the sum of the volume of cement and lime.
 - 2. Proportions by volume: 1/2 part Portland cement to 1 part masonry cement, and aggregate volume of not less than 2-1/4 or more than 3 times the sum of the volume of cement and lime
- B. For Glass unit masonry reduce the amount of water to account for the lack of absorption.

PART 3 EXECUTION

3.1 MIXING

A. Mortar shall be proportioned by methods that will ensure accurate proportioning of all ingredients; it shall be mixed by power driven mixer, until the entire batch is homogeneous and of proper consistency.

3.2 RE-TEMPERING

- A. All mortar shall be used within two hours of initial mixing and no mortar shall be used after it has begun to set.
- B. Re-tempering of mortar in which setting has started will not be permitted.

3.3 LIME PUTTY

- A. Lime putty shall be prepared by mixing dry hydrated lime with water to form stiff plastic putty.
- B. When the putty must be stored for more than 24 hours before use in mortar mixing, putty must be protected from exposure to sun to prevent excessive evaporation.

3.4 MORTAR COLOR

A. The color of mortar shall be based on the dry sample.

3.5 WATERPROOFING OF MORTAR (MORTARPROOFING)

- A. Mortarproofing shall be added to mortar used in exterior masonry work.
- B. It shall be added in compliance with manufacturer's recommendations.
- C. If the mortarproofing is added in liquid form, mixing water shall be reduced in equal quantity.

3.6 INSTALLATION

A. Install as specified between Masonry Unit sections in beds (see mortar beds and mortar joints).

3.7 FIELD QUALITY CONTROL OF WATER RETENTION

- A. Mortar materials used in construction shall be proportioned to meet the requirements of ASTM C91.
 - 1. Initial flow of 100 to 115 percent.
 - 2. Flow after suction of not less than 70 percent.

3.8 MORTAR BEDS

- A. Lay brick and/or CMU with full mortar coverage on horizontal and vertical joints in all courses.
- B. Provide sufficient mortar on ends of brick to fill head joints.
- C. Rock closures into place with head joints set against adjacent bricks.
- D. Do not pound corners or jambs to fit stretcher units after setting in place.
- E. Where adjustment to corners or jambs must be made after mortar has started to set, remove mortar and replace with fresh mortar.

3.9 MORTAR JOINTS

- A. Nominal joint thickness: 3/8".
- B. Tool joints exposed in finished work when "thumbprint" hard.
 - 1. Joints shall be tooled using a jointer at least 2,0" in length.
- C. Joint profile shall be concave.
- D. Trowel point or concave tool joints below grade.
- E. Flush-cut joints shall not to be exposed in finished work.
- F. As work progresses, trowel protruding mortar fins in cavity flat to inner face of wythe.
- G. Bonding pattern Lay brick in bonds as indicated on the drawings

END OF SECTION

MASONRY GROUTING

SECTION 04 05 16

MASONRY GROUTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grout used in construction concrete masonry units.
- B. See Section 04 00 00 Masonry

1.2 SCOPE OF WORK

A. Furnish labor, materials, equipment and appurtenances required to complete execution of work shown on Drawings and specified herein.

1.3 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 530.1/ASCE 6 Building Code Requirements and Specification for Masonry Structures
- B. ASTM International:
 - 1. ASTM C91 Standard Specification for Masonry Cement
 - 2. ASTM C150 Standard Specification for Portland Cement
 - 3. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes
 - 4. ASTM C404 Standard Specification for Aggregates for Masonry Grout
 - 5. ASTM C476 Standard Specification for Grout for Masonry
 - 6. ASTM C1019 Standard Test Method for Sampling and Testing Grout
 - 7. ASTM C1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
 - 8. ASTM C1611 Standard Test Method for Slump Flow of Self-Consolidating Concrete

1.4 QUALITY ASSURANCE

A. Installer Qualifications shall include documented experience in completion of work similar in design, material, and extent specified

1.5 SUBMITTAL

- A. Submittal Procedures: Section 01 33 23
- B. Manufacturer's literature, data sheets, and mixing instructions.
- C. Mix Designs indicating type and proportions of ingredients in compliance with the proportions specifications of ASTM C476.
- D. Compressive strength tests performed in accordance with ASTM C1019, and slump flow and Visual Stability Index (VSI) as determined by ASTM C1611 for self-consolidating grout.

E. Submit proposed mix design of each class of grout.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Product handling shall comply with pertinent provisions of Section 01 60 00.
- B. Deliver materials in manufacturer's original containers, bearing labels indicating product and manufacturer's name.
- C. Store cementitious materials in waterproof locations to prevent damage by elements. Reject containers shown evidence of damage.
- D. Store aggregates in separate bins to prevent intrusion of foreign particles.
 - 1. Do not use bottom 6 inches of sand or other aggregates stored in contact with the ground.

1.7 RELATED DOCUMENTS

- A. Specifications sections:
 - 1. 04 00 00 Masonry
 - 2. 04 01 00 Maintenance of Masonry
 - 3. 04 05 13 Masonry Mortaring
 - 4. 04 05 19 Masonry Anchorage & Reinforcing
 - 5. 04 05 23 Masonry Accessories
 - 6. 04 21 13 Brick Masonry
 - 7. 04 22 00 Concrete Unit Masonry
 - 8. 07 11 00 Dampproofing
 - 9. 07 19 00 Water Repellent
 - 10. 07 62 00 Sheet Metal Flashing and Trim
 - 11. 07 65 00 Wall Flashing

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. For purposes of designation of type and quality for the work under this Section, Drawings, and Specifications are based on products manufactured or furnished by LafargeHolcim, Inc.
- B. Products of the following manufacturers equal to those specified herein will be acceptable for use on the Project:
 - 1. Giant Portland Cement Company
 - 2. Lehigh Heidelberg Cement Group.
- C. Products for use on this project shall be of one manufacturer unless specifically noted otherwise

2.2 MATERIALS

- A. Cementitious Materials
 - 1. Portland cement shall conform to ASTM C150,
 - a. Type 1 above grade and Type II below grade.

MASONRY GROUTING

- 2. Masonry Cement: ASTM C91, Type S and meet the following criteria:
 - a. Prepackaged masonry cement shall contain Portland cement, hydrated lime and plasticizing admixtures or hydraulic hydrated lime.
 - b. Masonry cements which contain other materials, including ground limestone, ground slag, or other cementitious and non-cementitious materials, are not acceptable.

B. Hydrated Lime:

1. Hydrated lime shall conform to ASTM C207, Type S

C. Fine Aggregate for Grout:

1. Fine aggregate used in masonry grout shall conform to the requirements of ASTM C404

D. Coarse Aggregate for Grout:

1. Course aggregate for masonry grout, shall conform to requirements of ASTM C404 and shall be size No. 89.

E. Water:

Water shall be clean and free from deleterious amounts of oil, acids, alkalis, salt, organic materials or other deleterious substances.

2.3 MIXES

- A. Masonry Grout shall conform to the requirements of ASTM C476 and ACI 530.1/ASCE 6, and shall have a minimum compressive strength of 2,000 psi at 28 days.
- B. Fine grout shall be used in spaces less than 2 inches wide.
- C. Coarse grout shall be used in spaces 2 inches to 4 inches in width.
- D. Test grout for every 5,000 square feet of masonry, with a minimum of one test per structure.
- E. Slump: Unless otherwise required, mix grout other than self-consolidating grout to a consistency that has a slump between 8 and 11 in.
- F. Proportioning of self-consolidating grout at the project site is not permitted. Do not add water at the project site except in accordance with the self-consolidating grout manufacturer's recommendations.

2.4 ADMIXTURES

- A. Do not use calcium chloride
- B. Do not use admixtures without written approval of Engineer.
- C. Field addition of admixtures is not permitted.

MASONRY GROUTING

PART 3 EXECUTION

3.1 PREPARATION

- A. Mixing: Grout shall be proportioned by methods that will ensure accurate proportioning of all ingredients; it shall be mixed by power driven mixer, until the entire batch is homogeneous and of proper consistency.
- B. Re-tempering: No grout shall be used after it has begun to set.

3.2 INSTALLATION

- A. Grout shall be installed in all cells containing reinforcing steel and in locations indicated on the drawings and as specified.
- B. Placing time: Place grout within 1½ hour from introducing water in the mixture and prior to initial set.
 - 1. Discard site-mixed grout that does not meet the specified slump without adding water after initial mixing.
 - 2. For ready-mixed grout:
 - a. Addition of water is permitted at the time of discharge to adjust slump.
 - b. Discard ready-mixed grout that does not meet the specified slump without adding water, other than the water that was added at the time of discharge.
 - c. The time limitation is waived if the ready-mixed grout meets the specified slump.
- C. Confinement: Confine grout to the areas indicated on the Drawings. Use material to confine grout that permits bond between masonry units and mortar.

D. Grout Pour height: Do not exceed the maximum grout pour height given in the following Table

| Grout type ¹ | Maximum grout pour height (ft) | Minimum clear width of grout space ^{2,3} (in.) | Minimum clear grout space dimensions for grouting cells of hollow units, 3,4,5 (in. x in.) |
|-------------------------|--------------------------------|---|--|
| Fine | 1 | 3/4 | 1½ x 2 |
| Fine | 5.33 | 2 | 2 x 3 |
| Fine | 12.67 | 2½ | 2½ x 3 |
| Fine | 24 | 3 | 3 x 3 |
| Coarse | 1 | 1½ | 1½ x 3 |
| Coarse | 5.33 | 2 | 2½ x 3 |
| Coarse | 12.67 | 2½ | 3 x 3 |
| Coarse | 24 | 3 | 3 x 4 |

- 1. Fine and coarse grout are defined in ASTM C476
- 2. For grouting between masonry wythes
- 3. Minimum clear width of grout space and minimum clear grout space dimensions are the net dimension of the space determined by subtracting masonry protrusions and the diameters of horizontal bars from the as-built cross-section of the grout space. Select the grout type and maximum grout pour height based on the minimum clear space.
- 4. Area of vertical reinforcement shall not exceed 6% of the area of the grout space.
- 5. Minimum grout space dimensions for AAC masonry units shall be 3-in. x 3-in. or a 3-in. diameter cell

E. Grout lift height

- 1. Place grout in lifts not exceeding 12-ft 8-in. where the following conditions are met;
 - a. The masonry has cured for at least 4 hours.
 - b. The grout slump is maintained between 10-in. and 11-in.
 - c. No intermediate reinforced bond beams are placed between the top and the bottom of the pour height
- 2. Where there are bond beams present, limit the grout lift height to the bottom of the lowest bond beam that is more than 5-ft 4-in. above the bottom of the lift, but do not exceed a grout lift height of 12-ft 8-in.
- 3. For all other conditions, place grout in lifts no exceeding 5-ft 4-in.

F. Consolidation

- 1. Consolidate grout at the time of placement
 - a. Consolidate grout pours 12-in. or less in height by mechanical vibration or by puddling.
 - b. Consolidate pours exceeding 12-in. in height by mechanical vibration, and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.
 - c. Consolidation or reconsolidation is not required for self-consolidating grout.
- G. Grout key: when grouting, form grout keys between grout pours. Form grout keys between grout lifts when the first lift is permitted to set prior to placement of the subsequent lift
 - 1. Form a grout key by terminating the grout a minimum of $1\frac{1}{2}$ in. below a mortar joint.
 - 2. Do not form grout keys within beams.
 - 3. At beams or lintels laid with closed bottom units, terminate the grout pour at the bottom of the beam or lintel without forming a grout key.
- H. Alternate grout placement: place masonry units and grout using construction procedures employed in the accepted grout demonstration panel.

3.3 FIELD QUALITY CONTROL

- A. Section 01 45 23 Testing Laboratory Services: Field inspecting, testing, adjusting, and balancing.
- B. Field inspection and testing shall be performed in accordance with ASTM C1019. The Contractor shall arrange and pay for all grout testing services on the referenced project.

MASONRY GROUTING

- C. Each grout specimen shall have square cross-section 3-in. or larger.
- D. Test at least three (3) specimen for each grout pour.
- E. Measure and record the temperature of the grout sample per ASTM C1064
- F. The report shall include the following;
 - 1. Mix design
 - 2. Slump of the grout
 - 3. Type and number of units used to form the mold for specimen(s)
 - 4. Description of specimen(s) including dimensions and amount out of plumb in percent.
 - 5. Curing history, including initial temperature, maximum and minimum temperatures, and age of specimen(s) when transported to laboratory and when tested.
 - 6. Maximum load and compressive strength of each specimen and average compressive strength of all specimens.
 - 7. Description of failure
- G. The contractor shall not load the masonry wall and/or structure until the grout has reached the 28-day strength.
 - 1. The contractor shall have test results to demonstrate the grout has reached the specified 28-day strength before loading the wall and/or structure.
 - 2. The contractor shall make additional grout test cubes to determine the strength of the grout before 28-days if the structure is to be loaded.
 - 3. The wall and/or structure shall not be loaded until the grout has aged at least 7 days.

END OF SECTION

SECTION 04 05 19

MASONRY ANCHORAGE AND REINFORCING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Masonry joint reinforcement
 - 2. Masonry Anchors (e.g. to attach masonry to structural steel, concrete, and masonry veneer).
 - 3. Brick steel lintels
 - 4. Reinforcing bars used in masonry.
- B. See Section 04 00 00 Masonry

1.2 SCOPE OF WORK

A. Furnish labor, materials, equipment and appurtenances required to complete execution of work shown on Drawings and specified herein.

1.3 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 530.1/ASCE 6 Building Code Requirements and Specification for Masonry Structures
- B. ASTM International:
 - 1. ASTM A36 Standard Specification for Carbon Structural Steel
 - 2. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 3. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 4. ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - 5. ASTM A480 Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
 - 6. ASTM A580 Standard Specification for Stainless Steel Wire
 - 7. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 8. ASTM A641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - 9. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 10. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar
 - 11. ASTM A884 Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
 - 12. ASTM A899 Standard Specification for Steel Wire, Epoxy-Coated
 - 13. ASTM A951 Standard Specification for Steel Wire for Masonry Joint Reinforcement

- 14. ASTM A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
- 15. ASTM A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- C. American Iron and Steel Institute
 - 1. AISI 304 Stainless Steel
- D. American Welding Society:
 - 1. AWS D1.4 Structural Welding Code Reinforcing Steel.

1.4 QUALITY ASSURANCE

A. Qualifications:

- 1. Manufacturer:
 - a. Having 5 years' experience manufacturing components similar to or exceeding requirements of project.
 - b. Having sufficient capacity to produce and deliver required materials without causing delay in work.
 - c. Capable of providing field service representation during construction.
- 2. Installer:
 - a. Acceptable to the manufacturer and experienced in performing work of this section and has specialized in installation of work similar to that required for this project.
- B. Source of Supply and Quality of Materials
 - 1. The source of supply of all materials and equipment shall be submitted to the Engineer for review before orders are placed.
 - 2. Suppliers of reinforcing steel, fabricated metal work and metal castings may be required to submit guarantees of conformity with the Drawings and Specifications.
 - 3. Representative preliminary samples of the character and quality prescribed shall be submitted by the Contractor or producer for examination and tested in accordance with the methods specified below.
 - 4. Only materials conforming to the requirements of the specifications shall be used in the work.
 - 5. All materials proposed to be used may be inspected or tested during their preparation and use. If, after inspecting and testing and/or trial, it is found that initial sources of supply do not furnish an acceptable product in conformity with the Specifications, the Contractor shall furnish material from other sources.

1.5 SUBMITTALS

- A. Section 01 33 00 –Submittal Procedures
- B. Shop Drawings: Indicate bar sizes, material, yield strength, spacing, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.
- C. Manufacturer's Certificate: Certify products meet or exceed specifications.
- D. Submit certified copies of mill test report of reinforcement materials analysis.

- E. Samples: The following samples of materials prepared for use shall be submitted for approval before materials represented by the samples are ordered or delivered to the site.
 - 1. Anchors and Ties
 - a. Two of each type
 - 2. Joint Reinforcement
 - a. One piece of each type of reinforcement 18 inches long, showing at least two crossioints.
 - 3. Control Joint
 - a. One piece of each type.
 - Manufacturer's Data.

1.6 PRODUCT HANDLING

A. Delivery:

1. Deliver materials in manufacturer's original unopened containers with manufacturer's brand name and identification clearly marked.

B. Storage:

1. Material shall be stored in packs, on platforms, or on other supports above ground to prevent damage, deterioration, and/or contamination.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports, and shall be protected as far as is practicable, from mechanical injury and surface deterioration.
- B. When placed in the work, it shall be free from rust, dirt, scale, paint, oil, or other foreign matter, which may reduce or destroy bond.

1.8 RELATED DOCUMENTS

- A. Specifications sections:
 - 1. 04 00 00 Masonry
 - 2. 04 01 00 Maintenance of Masonry
 - 3. 04 05 13 Masonry Mortaring
 - 4. 04 05 16 Masonry Grouting
 - 5. 04 05 23 Masonry Accessories
 - 6. 04 21 13 Brick Masonry
 - 7. 04 22 00 Concrete Unit Masonry
 - 8. 07 11 00 Dampproofing
 - 9. 07 19 00 Water Repellent
 - 10. 07 62 00 Sheet Metal Flashing and Trim
 - 11. 07 65 00 Wall Flashing

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. For purposes of designating type and quality for the work under this section, drawings and specifications are based on products manufactured or furnished by Hohmann & Barnard, Inc.
- B. Acceptable Manufacturers.
 - a. Wire-Bond
 - b. Substitutions: Section 01 60 00 Product Requirements
- C. Products for use on this project shall be of one manufacturer unless noted specifically otherwise herein.

2.2 MATERIALS

- A. Wire (Carbon Steel): Prefabricated from cold-drawn steel wire conforming to ASTM A1064
 - 1. Tensile Strength 80,000 psi
 - 2. Yield strength 70,000 psi
- B. Wire (Stainless Steel): ASTM A580 AISI Type 304
- C. Sheet Metal (Carbon Steel): ASTM A1008
- D. Sheet Metal (Stainless Steel): ASTM A666, A480, and A240 AISI Type 304

2.3 MASONRY JOINT REINFORCEMENT

- A. Provide joint reinforcement that conforms to ASTM A951.
- B. Wire size:
 - 1. 3/16" Side Rods
 - 2. 9 Gauge Cross rods
- C. Spacing: 16" maximum spacing for the following;
 - 1. Spacing of cross wires in ladder-type joint reinforcement
 - 2. Points of connection of cross wires to longitudinal wires of truss-type or ladder-type joint reinforcement.
 - 3. Vertical spacing
- D. Single Wythe reinforcement shall consist of two (2) deformed longitudinal side rods welded at not more than 16" intervals to a continuous diagonal cross rod forming truss design.
 - 1. Out to out spacing of side rods shall be approximately 2 inches less than the nominal thickness of the wythe.
 - 2. Extra Heavy 120 Truss-Mesh by Hohmann & Barnard, Inc.
 - a. To be used in walls or sections of walls without vertical reinforcements.
 - 3. Extra Heavy 220 Ladder-Mesh by Hohmann & Barnard, Inc.
 - a. To be used in walls or sections of walls with vertical reinforcements.
- E. Double Wythe reinforcement shall consist of three (3) longitudinal rods and shall conform to the requirements for single wythe reinforcement with the following exceptions:

- 1. For composite walls (i.e. without an air gap and/or insulation)
 - a. Extra Heavy 130 Truss-Tri-Mesh by Hohmann & Barnard, Inc.
 - 1) To be used in walls or sections of walls without vertical reinforcements.
 - b. Extra Heavy 230 Ladder-Tri-Mesh by Hohmann & Barnard, Inc.
 - 1) To be used in walls or sections of walls with vertical reinforcements.
- 2. For CMU wall with brick veneer (i.e. with an air gap and/or insulation)
 - a. Extra Heavy 170 Truss Eye-Wire by Hohmann & Barnard, Inc.
 - 1) To be used in walls or sections of walls without vertical reinforcements.
 - b. Extra Heavy 270 Ladder Eye-Wire by Hohmann & Barnard, Inc.
 - 1) To be used in walls or sections of walls with vertical reinforcements.
 - c. Eye sections shall be spaced at than 16" on center or less, vertically and horizontally, and one pintle per every 1.77 square feet of wall.
 - d. Pintles shall have two legs and be a minimum of 3/16" in diameter.

F. Corner and Tee Sections:

1. Corner and tee sections shall be prefabricated units that form continuous reinforcement around corners and shall also be used to anchor abutting walls and partitions.

2.4 MASONRY ANCHORS & TIES

- A. Dovetail Type Veneer Anchor:
 - 1. Anchor: 315-BL by Hohmann & Barnard, Inc.
 - 2. Dovetail head: 14 Gauge
 - 3. Dovetail slot: 305 Dovetail Slot by Hohmann & Barnard, Inc. (24 Gauge)
 - 4. Use to anchor brick veneer to;
 - a. New concrete walls and/or columns
- B. Flexible Tie Veneer Anchor:
 - 1. Anchor: 345-BL by Hohmann & Barnard, Inc.
 - 2. Head: 12 Gauge
 - 3. Use to anchor brick veneer to:
 - a. Existing masonry
 - b. Existing concrete walls and/or columns
 - c. Metal studs
 - d. Structural steel
- C. Seismic Veneer Anchor:
 - 1. Anchor: DW-10HS / Byna-Lok by Hohmann & Barnard, Inc.
 - 2. Head: 12 Gauge
 - 3. Use to anchor brick veneer to:
 - a. Existing masonry
 - b. Existing concrete walls and/or columns
 - c. Metal studs
 - d. Structural steel
- D. High Strength Veneer Anchor:
 - 1. Anchor: HB-213-HS with Mighty-Lok Hook by Hohmann & Barnard, Inc.
 - 2. Backplate thicknes: 12 Gauge
 - 3. Use to anchor brick veneer or CMU to:
 - a. Existing masonry
 - b. Existing concrete walls and/or columns

- c. Metal studs
- d. Structural steel

2.5 BRICK LINTELS

A. Steel for lintels shall be as ASTM A36 or AISI Type 304 stainless steel and as sized on the drawings.

2.6 REINFORCING BARS (REBAR)

- A. Type and Grade of Reinforcement
 - 1. Rebar used in lintels, grouted in hollow core CMU walls, and any other applications related to masonry construction shall be ASTM A615, Grade 60 (Fy = 60 ksi) and shall be of the size and spacing indicated on the Drawings.

B. Minimum Reinforcement

- 1. Masonry work shall contain a minimum amount of reinforcement.
- 2. Unless noted otherwise, the minimum amount of reinforcing steel shall be number 4's at 48" on center.

C. Dowels

- 1. Dowels for reinforcement shall be cast in place with the concrete substructure.
- 2. Dowels shall be laid out to provide for the placement of filled cells next to openings.

D. Laps and Bends

- 1. When possible, reinforcing bars shall be furnished full length.
- 2. When reinforcement is not furnished full length, the bars shall be lapped according to the Bar Lap and Bending Schedule detailed on the Drawings.

E. Rebar Positioners

- 1. Rebar Positioners shall be used to position the rebar in cells of CMU at the locations detailed on the Drawings.
- 2. Type: RB Rebar Positioner by Hohmann & Barnard, Inc.
- 3. Wire Diameter: 9 Gauge
- 4. Spacing
 - a. Vertical: 16"
 - b. Horizontal: as required or detailed on drawings.

2.7 COATINGS FOR CORROSION PROTECTION

- A. Unless otherwise details or specified, protect carbon steel joint reinforcement, ties, anchors, steel plates and bars from corrosion by galvanizing or epoxy coating in conformance with the following minimums:
 - 1. Galvanized coatings:
 - a. Mill galvanized coatings:
 - 1) Joint reinforcement: ASTM A641 (0.4 oz./ft²)
 - 2) Sheet-metal ties and sheet-metal anchors: ASTM A653, Class G60 (0.6 oz./ft²)
 - b. Hot-dip galvanized coatings:
 - 1) Joint reinforcement, wire ties, and wire anchors: ASTM A153 (1.5 oz//ft2)
 - 2) Sheet-metal ties and sheet-metal anchors: ASTM A123 or ASTM A153, Class B

- 3) Steel plates and bars (as applicable to size and form indicated): ASTM A123 or ASTM A153, Class B.
- 2. Epoxy Coatings:
 - a. Joint reinforcement: ASTM A884, Class A, Type 1-7 mils
 - b. Wire ties and anchors: ASTM A899, Class C 20 mils
 - c. Sheet-metal ties and anchors: 20 mils per surface or manufacturer's specification.

2.8 PRECAST SECTIONS:

A. Units & reinforcement used in precast sections shall correspond to type(s) used in design.

PART 3 EXECUTION

3.1 BASIC REQUIREMENTS:

- A. Place reinforcement, wall ties, and anchors in accordance with the sizes, types, and locations indicated on the Drawings and as specified. Do not place dissimilar metals in contact with each other.
- B. If documents conflict and no statement is given as to the controlling criteria, please notify the design engineer before installation of rebar.

3.2 REINFORCEMENT

- A. Support reinforcement to prevent displacement caused by construction loads or by placement of grout or mortar, beyond the allowable tolerances.
- B. Completely embed reinforcing bars in grout
- C. Maintain clear distance between reinforcing bars and the interior of masonry unit or formed surface of at least 1/4 in. for fine grout and 1/2 in. for coarse grout, except where cross webs of hollow units are used as supports for horizontal reinforcement.
- D. Place reinforcing bars maintaining the following minimum cover:
 - 1. Masonry face exposed to earth or weather:
 - a. 2 in. for bars larger than No. 5
 - b. 1½ in. for No. 5 bars or smaller.
 - 2. Masonry not exposed to earth or weather:
 - a. $1\frac{1}{2}$ in. for all bar sizes.
- E. Maintain minimum clear distance between parallel bars of the nominal bar size or 1 in., whichever is greater.
- F. In columns and pilasters, maintain minimum clear distance between vertical bars of one and one-half times the nominal bar size or 1½ in., whichever is greater.
- G. Splice only where indicated on the Drawings, unless otherwise acceptable.
 - 1. Splicing by welding, where permitted by the Engineer in writing, shall be in conformance with the provisions of AWS D 1.4.

- H. Do not bend reinforcement after it is embedded in grout or mortar.
- I. Noncontact lap splices:
 - 1. Position bars spliced by noncontact lap splice no farther apart transversely than one-fifth the specified length of lap nor more than 8 in.
- J. Lintel Reinforcement:
 - 1. Lintels shall be reinforced as indicated on the drawings

3.3 JOINT REINFORCEMENT

- A. Place joint reinforcement so that longitudinal wires are embedded in mortar with a minimum cover of 1/2 in. when not exposed to weather or earth; or 5/8 in. when exposed to weather or earth.
- B. Provide minimum 6-in. lap splices for joint reinforcement.
- C. All ends of longitudinal wires of joint reinforcement at laps shall be embedded in mortar or grout.
- D. Joint reinforcement shall be installed in the first and second bed of masonry units, 16" O.C. immediately above lintels, below sills, at openings, and in bed joints at 16" O.C. vertical.
- E. Reinforcement in the second bed joint above or below openings shall extend two feet beyond the jambs.
- F. All other reinforcement shall be continuous except that it shall not pass through vertical masonry control joints.
- G. The diagonal cross wires of truss-type joint reinforcement will interfere with placement of vertical reinforcing bars relative to the tolerances of the Specification for Masonry Structures and can inhibit grout flow. Therefore, truss-type joint reinforcement should not be used in vertically reinforced single or multi-wythe masonry walls. Ladder-type joint reinforcement may be used, but the cross-rods shall be spaced at 16 inches on center.

3.4 PLACEMENT TOLERANCES

- A. Place reinforcing bars in walls and flexural elements within tolerances stated below when the distance from the centerline of reinforcing bars to the opposite face of masonry, "d":
 - 1. Where d equals 8 in. or less, then the tolerance shall be $\pm 1/2$ in.
 - 2. Where d is greater than 8 in. but less than or equal to 24", then the tolerance shall be ± 1 in.
 - 3. Where d is greater than 24 in., then the tolerance shall be $\pm 11/4$ in.
- B. Place vertical bars within:
 - 1. 2 in. of the required location along the length of the wall when the wall segment length exceeds 24 in.
 - 2. 1 in. of the required location along the length of the wall when the wall segment length does not exceed 24 in.
- C. If it is necessary to move bars more than one bar diameter or a distance exceeding the tolerance stated above to avoid interference with other reinforcing steel, conduits, or embedded items, notify the Engineer for acceptance of the resulting arrangement of bars.

D. Foundation dowels that interfere with unit webs are permitted to be bent to a maximum of 1 in. horizontally for every 6 in. of vertical height.

3.5 WALL TIES

- A. Embed the ends of wall ties in mortar joints.
- B. Embed wall tie ends at least 1/2 in. into the outer face shell of hollow units.
- C. Embed wire wall ties at least 11/2 in. into the mortar bed of solid masonry units or solid grouted hollow units.
- D. Unless otherwise required, install ties in accordance with the following requirements:
 - 1. One (1) tie for each 1.77 ft² of wall area
 - 2. Do not exceed 16 in. horizontal or vertical spacing
 - 3. The maximum misalignment of bed joints from one wythe to the other is 11/4 in.
 - 4. The maximum clearance between connecting parts of the ties is 1/16 in.
- E. Do not bend wall ties after being embeded in grout or mortar
- F. Install wire ties perpendicular to a vertical line on the face of the wythe from which they protrude. Where one-piece ties or joint reinforcement are used, the bed joints of adjacent wythes shall align.
- G. Unless otherwise required, provide additional unit ties around openings larger than 16 in. in either dimension. Space ties around perimeter of opening at a maximum of 16 in. on center. Place ties within 12 in. of opening.
- H. Unless otherwise required, provide unit ties within 12 in. of unsupported edges.

3.6 ANCHOR BOLTS

- A. For anchor bolts placed in the top of grouted cells and bond beams, maintain a clear distance between the bolt and the face of masonry unit of at least ¼ in. when using fine grout and at least ½ in. when using coarse grout.
- B. For anchor bolts placed through the face shell of a hollow masonry unit, drill a hole that is tight-fitting to the bolt or provide minimum clear distance that conforms to paragraph A above around the bolt and through the face shell. For the portion of the bolt that is within the grouted cell, maintain a clear distance between the bolt and the face of masonry unit and between the head or bent leg of the bolt and the formed surface of grout of at least ½ in. when using fine grout and at least ½ in. when using coarse grout.
- C. Place anchor bolts with a clear distance between parallel anchor bolts not less than the nominal diameter of the anchor bolt, nor less than 1 in.

END OF SECTION

MASONRY ACCESSORIES

SECTION 04 05 23

MASONRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Sections includes:
 - 1. Flashing
 - 2. Control and expansion joints
 - 3. Weepholes
 - 4. Grout pan/screen
 - 5. Masonry cleaning compound
- B. See Section 04 00 00 Masonry

1.2 SUBMITTAL

- A. Submittal Procedures: Section 01 33 23.
- B. Product Data: Submit specified products as follows:
 - 1. Manufacturer's product data, including manufacturer's product sheet.
 - 2. Manufacturer's installation instructions.
 - 3. Catalog pages illustrating products to be included in project.
 - 4. Material Safety Data Sheets (MSDS).

C. Test and Evaluation Reports:

1. Provide certified test reports showing compliance with specified performance characteristics and physical properties.

D. Source Quality Control:

1. Submit documentation verifying that components and materials specified in this Section are from single manufacturer.

E. Qualification Statements:

- 1. Submit letter of verification for Manufacturer's Qualifications.
- 2. Submit letter of verification for Installer's Qualifications.

F. Required Samples:

1. Provide two (2) samples of each type of accessory to be used on the project.

1.3 QUALITY ASSURANCE

A. Qualifications:

- 1. Manufacturer:
 - a. Having 5 years' experience manufacturing components similar to or exceeding requirements of project.
 - b. Having sufficient capacity to produce and deliver required materials without causing delay in work.

- c. Capable of providing field service representation during construction.
- 2. Installer:
 - a. Acceptable to the manufacturer and experienced in performing work of this section and has specialized in installation of work similar to that required for this project.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Acceptance Requirements:
 - 1. Deliver material in accordance with Section 01 60 00 Product Requirements and in accordance with manufacturer's written instructions.
 - 2. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.
- B. Storage and Handling Requirements:
 - 1. Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.

1.5 RELATED DOCUMENTS

- A. Specifications sections:
 - 1. 04 00 00 Masonry
 - 2. 04 01 00 Maintenance of Masonry
 - 3. 04 05 13 Masonry Mortaring
 - 4. 04 05 16 Masonry Grouting
 - 5. 04 05 19 Masonry Anchorage & Reinforcing
 - 6. 04 21 13 Brick Masonry
 - 7. 04 22 00 Concrete Unit Masonry
 - 8. 07 11 00 Dampproofing
 - 9. 07 19 00 Water Repellent
 - 10. 07 62 00 Sheet Metal Flashing and Trim
 - 11. 07 65 00 Wall Flashing
 - 12. 07 90 00 Sealants and Caulking

PART 2 PRODUCTS

2.1 FLASHING

- A. See Specifications Section 07 62 00 Sheet Metal Flashing and Trim.
- B. See Specifications 07 62 00 Sheet Metal Flashing and Trim.

2.2 CONTROL AND EXPANSION JOINTS

A. See Specifications Section 07 90 00 Sealants and Caulking

2.3 WEEPHOLES:

- A. Weephole ventilators for full head joint installation at grade level.
 - 1. Acceptable products:
 - a. Hohmann & Barnard, Inc., QV Quardo-Vent.

- b. Wire-Bond, Cell Vent 3601.
- 2. Characteristics:
 - a. Flexible ultra-violet resistant polypropylene co-polymer vent with cellular structure.
 - b. Color shall be as selected by Owner.
- B. Weep tubes with screens and wicks for all areas except grade level:
 - 1. Acceptable products:
 - a. Hohmann & Barnard, Inc., #341.
 - b. Wire-Bond, Series 3600.
 - 2. Characteristics:
 - a. Weep tubes should be made with 3/8" o.c. plastic tubes with brass screening at face and twisted synthetic rope wicks inserted in tube and extending minimum 6" at back (cavity) side.

2.4 GROUT PAN/SCREEN

- A. Acceptable products:
 - 1. MGS Mortar / Grout Screen by Hohmann & Barnard, Inc.
- B. To be used at cells where post installed epoxy type anchors that requiring grouted cells.

2.5 MASONRY CLEANING COMPOUND:

- A. Cleaning agent for facing brick and other exposed brickwork shall be Sure Klean masonry cleaning compound as manufactured by the Process Solvent Company, Inc., or equal.
- B. Product qualifications:
 - 1. To ensure proposed masonry cleaning compound causes no staining or discoloration of brick, compound shall be certified as acceptable by brick manufacturer and shall meet specified requirements including recommendations by compound manufacturer for selected brick.
 - 2. Products shall be specifically formulated for brick type, color, and material content and related data shall state whether the particular compound is acceptable for dark colored brick, light colored brick, brick subject to non-metallic staining, or brick subject to metallic staining.
 - 3. As outlined on the drawings and specified, the new masonry construction shall receive stain. The final cleaning shall be coordinated with the requirements for application of the specified stain.

C. Test panel:

1. Test each type and dilution of cleaning compound on sample panel, as further specified.

D. Formulation:

1. Compound of organic and inorganic acids, wetting agents and inhibitors.

E. Characteristics:

- 1. Compound shall be able to cling to masonry for an average dwell period of two minutes
- 2. Compound shall be able to loosen mortar residue for complete removal
- 3. Compound shall be water-washable upon completion
- 4. Compound shall not cause acid burns or streaks.

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F. Compound shall be able to be applied, based on dilution mount, by using a soft masonry brush or low pressure (40-50 psi) airless sprayer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior installation.
 - 1. Inform Engineer of unacceptable conditions immediately upon discovery.
 - 2. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from Engineer.

3.2 PREPARATION

A. Surface Preparation: Prepare surface in accordance with manufacturer's written recommendations.

3.3 INSTALLATION

- A. Coordinate with work of other trades for proper time and sequence to avoid construction delays.
- B. Install products per manufacturer's recommendations and where detailed on the Drawings.
- C. Accurately fit, align, securely fasten and install free from distortion or defects.

3.4 WEEPHOLES & RELATED ACCESSORIES:

- A. Weep holes shall be provided at spacing and locations as indicated on the drawings with a maximum spacing of 24" apart O.C. in mortar joints of exterior wythe. Locations where weep holes are required include:
 - 1. along the flashing over foundations
 - 2. at heads and sills of openings
 - 3. at bond beams
 - 4. at other water stops in the wall
 - 5. in exterior walls at grade
 - 6. any other locations where flashing is indicated
 - 7. other locations indicated on the drawing
- B. Weep holes shall be made by placing lengths of a well greased No. 10, 5/16" nominal diameter braided fiberglass cord in the mortar extending from the center to the exterior face of the wall to form a weep. The cord shall be removed when the mortar has set.
- C. Other methods of providing such weep holes may be used subject to the Engineer's review.
- D. Weephole ventilators:
 - 1. Provide weephole ventilators at grade level.
 - 2. Install weephole ventilator in open head joint, flush with low edge of adjacent brick.

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- E. Install weep tubes at all weep holes except at grade level where weephole ventilators are installed. Install weep tubes at bottom of head joint with screening to exterior; lay extra length of wick horizontally in cavity.
- F. Install cavity mortar drainage net in cavity behind wicks. Install continuous at grade.
- G. Keep weep holes and area above slashing free of mortar droppings.

3.5 FLASHING:

- A. Ensure surface of masonry is smooth and free from projections which might puncture flashing material.
- B. Place through-wall flashing on bed of mortar and cover with mortar as specified in Flexible (Through-Wall) Flashing section.

3.6 SEALANT JOINTS

A. Retain ½" wide sealant joint around outside perimeter of exterior doors, window frames and other openings.

3.7 CLEANING

A. Upon completion, remove surplus materials, rubbish, tools and equipment.

END OF SECTION

SECTION 04 21 00

BRICK MASONRY

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Section Includes:
 - 1. Brick Veneer Masonry
 - 2. Common Brick
- B. See Section 04 00 00 Masonry

1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 530.1/ASCE 6 Building Code Requirements and Specification for Masonry Structures
- B. ASTM International:
 - 1. ASTM C34 Standard Specification for Structural Clay Load-Bearing Wall Tile
 - 2. ASTM C56 Standard Specification for Structural Clay Nonloadbearing Tile
 - 3. ASTM C62 Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
 - 4. ASTM C67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
 - 5. ASTM C126 Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
 - 6. ASTM C216 Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
 - 7. ASTM C652 Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
 - 8. ASTM C1088 Standard Specification for Thin Veneer Brick Units Made from Clay or Shale

1.3 QUALITY ASSURANCE

- A. See Section 04 00 00 Masonry
- B. Qualifications:
 - Manufacturer:
 - a. Having 5 years' experience manufacturing components similar to or exceeding requirements of project.
 - b. Having sufficient capacity to produce and deliver required materials without causing delay in work.
 - c. Capable of providing field service representation during construction.
 - 2. Installer:
 - a. Acceptable to the manufacturer and experienced in performing work of this section and has specialized in installation of work similar to that required for this project.

1.4 SUBMITTAL

- A. Submittal Procedures: Section 01 33 00.
- B. Product Data: Submit specified products as follows:
 - 1. Manufacturer's product data, including manufacturer's product sheet.

C. Test and Evaluation Reports:

- 1. Provide certified test reports showing compliance with specified performance characteristics and physical properties.
- Certificates shall indicate that materials supplied comply with specification requirements.
 Certificates shall be signed by brick manufacturer and shall state quantities and dates shipped.
- 3. Submit test reports on fire retardant units for different classes of units furnished for the project.

D. Source Quality Control:

1. Submit documentation verifying that components and materials specified in this Section are from single manufacturer.

E. Oualification Statements:

- 1. Submit letter of verification for Manufacturer's Qualifications.
- 2. Submit letter of verification for Installer's Qualifications.
- 3. Masonry Samples:
 - a. For facing brick: submit five (5) actual bricks indicating range of color, texture, and size to be expected in finished work.
 - b. Submit samples of masonry units prior to constructing a mock-up sample wall.
 - c. Existing Construction: For bidding purposes, brick used by the Contractor shall match or be similar (in the opinion of the Owner) to the existing brick used in other buildings on site or the fence around the site (for perimeter fence brick piers).
 - 1) Brick masonry used in the existing fence columns is #301-W White as manufactured by Taylor Clay Products, Inc., Salisbury, N.C.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

- 1. Deliver material in accordance with Section 01 60 00 Product Requirements and in accordance with manufacturer's written instructions.
- 2. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.

B. Storage Requirements:

- 1. Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.
- 2. Masonry units shall be stacked on platforms.
- 3. Cover and store units in a manner that will protect them from contact with soil, and from weather exposure.
- 4. Do not use materials with stained faces in exposed work

1.6 RELATED DOCUMENTS

- A. Specifications sections:
 - 1. 04 01 00 Maintenance of Masonry
 - 2. 04 05 13 Masonry Mortaring
 - 3. 04 05 16 Masonry Grouting
 - 4. 04 05 19 Masonry Anchorage & Reinforcing
 - 5. 04 05 23 Masonry Accessories
 - 6. 04 22 00 Concrete Unit Masonry
 - 7. 07 11 00 Dampproofing
 - 8. 07 19 00 Water Repellent
 - 9. 07 62 00 Sheet Metal Flashing and Trim
 - 10. 07 65 00 Wall Flashing

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide clay or shale masonry units that conform to ASTM C34, C56, C62, C126, C212, C216, C652, or C1088 as specified.
 - 1. ASTM C34: Load-bearing wall tile
 - 2. ASTM C56: Non-load-bearing wall tile
 - 3. ASTM C62: Building brick (solid)
 - 4. ASTM C126: Ceramic glazed units
 - 5. ASTM C212: Structural facing tile
 - 6. ASTM C216: Facing brick (solid)
 - 7. ASTM C652: Hollow brick
 - 8. ASTM C1088: Thin veneer brick
- B. Colors and textures:
 - 1. Owner shall select colors and textures.
 - 2. Match existing buildings, as approved by Engineer and Owner.
- C. Brick masonry shall be of modular dimensions and of special shapes and sizes to complete the work as indicated.
 - 1. Unless noted otherwise on the Drawings, the units shall have a face dimension of, 2-1/4" X 3 5/8" X 7 5/8".
 - 2. Special shapes and sizes shall be furnished as needed.
 - a. Including, but not limited to, specially fabricated lip bricks, watertables, arches and solid units of same quality, color and texture as face brick.
- D. Units shall be of the same appearance and shall be cured by the same process delivered to the project site in an air-dry condition.

2.2 MANUFACTURER

- A. For purposes of designating type and quality for the work under this section, Drawings and Specifications are based on products manufactured or furnished by Taylor Clay Products, Inc.
- B. Acceptable manufacturers:

- 1. Hanson/Richtex Brick,
- 2. Holcim, Inc,

2.3 EXTERIOR FACING BRICK

A. Facing brick shall comply with ASTM C216, Grade SW, Type FBS.

2.4 COMMON BRICK

- A. Solid masonry units made from clay or shale.
- B. Common brick shall comply with ASTM C62, Grade SW.
- C. Brick shall be of nominal size to bond with other masonry units with which they will be constructed.
- D. Mortar drainage net: Refer to Specifications Section 04 05 23 Masonry Accessories.

2.5 DAMPPROOFING

A. Multi wythe walls shall be dampproofed, see Specifications Section 07 11 00.

2.6 WATER REPELLENT

A. Exterior masonry shall be coated with water repellant, see Specifications Section 07 19 00

PART 3 EXECUTION

3.1 MASONRY EXECUTION REQUIREMENTS

A. See Specifications Section 04 00 00.

3.2 BRICK MASONRY

- A. Do not install cracked, broken or chipped units.
- B. Provide solid brick units free of cores or frogs where such characteristics would be exposed in the finished work.
- C. Unless otherwise detailed or specified, lay facing brick in running bond with vertical joints located over center of masonry within course below. Keep mortar off the faces of masonry.
- D. For CMU/Brick veneer walls, three courses of brick in height shall be equivalent to one course of CMU. Joints at equivalent course heights shall be kept in line with each other.
- E. Headers, soldiers, borders, and other bonds shall be as shown on shop drawings, or as required for the proper installation of the brick.

- F. Lay brick with joints filled with mortar with no voids. Spread mortar beds smooth. Butter ends of brick with sufficient mortar to fill end joint completely. Prevent excess mortar from falling into cavity between brick and CMU.
- G. Do not furrow bed joints (this can cause voids to form in mortar).
- H. Partitions abutting concrete walls or columns shall be anchored to concrete by corrugated metal anchors spaced 16" apart vertically and set in dovetail anchor slots previously cast into walls and columns.
- I. Expansion/Control Joints:
 - 1. Unless other spacing is indicated, provide expansion joints in brick masonry unit partitions and walls spaced not over 30'-0" apart in walls and partitions, and at all intersections of partitions with other walls and partitions, and where partitions abut columns.
 - 2. In CMU/Brick veneer walls: At bricks and CMU control joints shall be coordinated so that they are at the same location.

3.3 BRICK EXPANSION JOINT:

- A. Install materials in accord with Masonry Accessories section. Joint size shall be same width as mortar joints.
- B. Space pressure-relieving pads at expansion joints indicated on drawings.
- C. Coordinate location of expansion joints in brick work with control joints in unit masonry backup.
- D. Joints in brick masonry shall be $\frac{1}{2}$ " wide in face joint and as follows:
 - 1. In running wall, control joints shall be made with square-end masonry unit having sash groove and synthetic rubber filler. All mortar shall be omitted from joint.
 - 2. At intersecting walls, provide control joint between the two walls and omit all mortar from face joint. Anchor the intersecting walls with corrugated metal ties 16" on center vertically in same bed joint in which the horizontal joint reinforcement occurs.
 - 3. At structural columns, provide ½" wide control joints with all mortar omitted between masonry unit and column. Anchor wall to column with anchors as detailed 16" on center vertically in same bed joint in which the horizontal joint reinforcement occurs.
 - 4. At top joint, between brick and structural slabs or beams, omit all mortar.

END OF SECTION

CONCRETE MASONRY UNIT

SECTION 04 22 00

CONCRETE MASONRY UNIT

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Sections Includes:
 - 1. Concrete masonry units (CMU)
- B. See Section 04 00 00 Masonry

1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
 - 1. ACI 530.1/ASCE 6 Building Code Requirements and Specification for Masonry Structures
- B. ASTM International:
 - 1. ASTM C55 Standard Specification for Concrete Building Brick
 - 2. ASTM C73 Standard Specification for Calcium Silicate Brick (Sand-Lime Brick)
 - 3. ASTM C90 Standard Specification for Loadbearing Concrete Masonry Units
 - 4. ASTM C129 Standard Specification for Nonloadbearing Concrete Masonry Units
 - 5. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
 - 6. ASTM C331 Standard Specification for Lightweight Aggregates for Concrete Masonry Units
 - 7. ASTM C744 Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units

1.3 QUALITY ASSURANCE

- A. See Section 04 00 00 Masonry
- B. Qualifications:
 - 1. Manufacturer:
 - a. Having 5 years' experience manufacturing components similar to or exceeding requirements of project.
 - b. Having sufficient capacity to produce and deliver required materials without causing delay in work.
 - c. Capable of providing field service representation during construction.
 - 2. Installer:
 - a. Acceptable to the manufacturer and experienced in performing work of this section and has specialized in installation of work similar to that required for this project.

1.4 SUBMITTAL

- A. Submittal Procedures: Section 01 33 00.
- B. Product Data: Submit specified products as follows:

CONCRETE MASONRY UNIT

1. Manufacturer's product data, including manufacturer's product sheet.

C. Test and Evaluation Reports:

- 1. Provide certified test reports showing compliance with specified performance characteristics and physical properties.
- Certificates shall indicate that materials supplied comply with specification requirements. Certificates shall be signed by masonry manufacturer and shall state quantities and dates shipped.
- 3. Submit test reports on fire retardant units for different classes of units furnished for the project.

D. Source Quality Control:

1. Submit documentation verifying that components and materials specified in this Section are from single manufacturer.

E. Qualification Statements:

- 1. Submit letter of verification for Manufacturer's Qualifications.
- 2. Submit letter of verification for Installer's Qualifications.
- 3. Masonry Samples:
 - a. Submit two (2) samples of masonry units indicating range of color, texture, and size to be expected in finished work.
 - b. Submit samples of masonry units prior to constructing a mock-up sample wall.
 - c. Existing Construction: For bidding purposes, CMU used by the Contractor shall match or be similar (in the opinion of the Owner) to the existing CMU used in other buildings on site.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

- 1. Deliver material in accordance with Section 01 60 00 Product Requirements and in accordance with manufacturer's written instructions.
- 2. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.

B. Storage Requirements:

- 1. Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.
- 2. Masonry units shall be stacked on platforms.
- 3. Cover and store units in a manner that will protect them from contact with soil, and from weather exposure.
- 4. Do not use materials with stained faces in exposed work

1.6 RELATED DOCUMENTS

A. Specifications sections:

- 1. 04 00 00 Masonry
- 2. 04 01 00 Maintenance of Masonry
- 3. 04 05 13 Masonry Mortaring
- 4. 04 05 16 Masonry Grouting
- 5. 04 05 19 Masonry Anchorage & Reinforcing
- 6. 04 05 23 Masonry Accessories

CONCRETE MASONRY UNIT

- 7. 04 21 13 Brick Masonry
- 8. 07 11 00 Dampproofing
- 9. 07 19 00 Water Repellent
- 10. 07 62 00 Sheet Metal Flashing and Trim
- 11. 07 65 00 Wall Flashing

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide concrete masonry units that conform to ASTM C55, C73, C90, C129, or C744 as specified.
 - 1. ASTM C55: Concrete brick
 - 2. ASTM C73: Sand-lime brick
 - 3. ASTM C90: Load-bearing units
 - 4. ASTM C129: Non-load-bearing units
 - 5. ASTM C744: Prefaced units

B. Colors and textures:

- 1. Owner shall select colors and textures.
- 2. Match existing buildings, as approved by Engineer and Owner.
- C. CMU shall be of modular dimensions and of special shapes and sizes to complete the work as indicated.
 - 1. Unless noted otherwise on the Drawings, the units shall have a face dimension of 7-5/8" X 15-5/8" (8" X 16" nominal) and a depth of 7-5/8" (8" nominal).
 - 2. Provide half special shapes and sizes required by the Drawings or to meet project conditions.
 - a. Provide bullnose corners at all interior corners at of walls, and openings for doors, windows, etc.

D. Uniformity:

- 1. All units shall be obtained from the same batch run of the manufacturer for each structure in which they are to be used.
- 2. Units shall be of the same appearance and shall be cured by the same process delivered to the project site in an air-dry condition.

E. Density:

- 1. The densities specified below are required for all types of CMU to be used.
 - a. This includes standard, split face, split rib, ground faced, etc.
- 2. Normal-Weight: for CMU with unit weight equal to or greater than 125 pounds per cubic foot, and shall be used for;
 - a. Fences
 - b. Cantilevered walls
 - c. Below grade walls supporting earth/soil loads
- 3. Medium-Weight: for CMU with unit weight less than 125, but equal to or greater than 105 pounds per cubic foot and shall be used for;
 - a. Load bearing walls
 - b. Shear walls
 - c. Exterior building walls
 - d. All applications not specified to use normal weight or light weight CMU.

- 4. Light-Weight: for CMU with unit weight less than 105 pounds per cubic foot and shall be used for:
 - a. Interior non-load bearing walls (e.g. partition walls)
- F. Lightweight aggregates shall conform to ASTM C331.
- G. Compressive Strength
 - 1. Net area compressive strength of concrete masonry units shall be a minimum of 1,900 psi when tested in accordance with ASTM C140.

H. MANUFACTURER

- 1. Oldcastle
- 2. LafargeHolcim
- 3. Cemex
- 4. Substitutions: Section 01 60 00 Product Requirements

2.2 CONCRETE MASONRY UNITS (CMU)

A. Unless otherwise specified, all CMU shall conform to ASTM C90.

2.3 SPLIT FACE MASONRY UNITS

- A. Units shall be of the hollow or solid type, with split-face exterior finish on one side and smooth (normal) face on interior side.
- B. Corners:
 - 1. Corners shall be constructed using either all full returns or all half returns.

2.4 SCORED SPLIT FACE MASONRY UNITS

- A. Scored Split Face Masonry Units shall be of similar requirements as Split Face Masonry Units with the following exceptions:
 - 1. Units shall have a single score.
 - 2. Units shall be laid in half running bond pattern.
 - 3. Joints shall be deep concave or raked to give the appearance of individual nominal 8" by 8" square blocks.

2.5 GROUND FACE MASONRY UNITS

- A. Ground Face Masonry Units
 - 1. Units shall be of the hollow type, with ground-face interior finish on one side and smooth (normal) face on exterior side on the other.

2.6 CMU INSULATION

- A. Exterior masonry walls shall be insulated with Core-Fill 500.
 - 1. "Core-Fill 500TM" as manufactured by Tailored Chemical Products, P.O. Box 4186, Hickory, N.C. 28603, (800) 627-1687.

2.7 DAMPPROOFING

A. Multi wythe walls shall be dampproofed, see Specifications Section 07 11 00.

2.8 WATER REPELLENT

- A. Exterior masonry shall be coated with water repellant, see Specifications Section 07 19 00
- B. Units shall be manufactured with a water repellant admixture. Units shall be manufactured and produced using "Dry-Block System" admixtures for water-repellent CMU.
 - 1. Admixture shall be "Dry-Block" Block Admixture by W.R. Grace or equal.
- C. The water repellant admixtures shall be added in amounts recommended by the Manufacturer to form a tight and water repellant wall.
- D. Mortar for use with split faced CMU shall contain a water repellant admixture.
 - 1. Admixture shall be "Dry-Block" Mortar Admixture by W.R. Grace or equal
- E. Block manufacturer shall submit a mix design for the block that has been approved by the admix manufacturer.

PART 3 EXECUTION

3.1 MASONRY EXECUTION REQUIREMENTS

A. See Specifications Section 04 00 00.

3.2 CONCRETE MASONRY UNITS

- A. Do not install cracked, broken or chipped units.
- B. Unless otherwise detailed or specified, lay concrete masonry units in running bond with vertical joints located over center of masonry within course below. Keep mortar off the faces of masonry.
- C. Lay units with mortar applied to the face shells of the units. Butter the vertical face of the block previously laid as well as the block to be laid to ensure wellfilled joints. At doorframes, fill cells of units on each side of opening with grout, from floor to ceiling, and for a distance of 1½ units from jamb.
- D. Partitions abutting concrete walls or columns shall be anchored to concrete by corrugated metal anchors spaced 16" apart vertically and set in dovetail anchor slots previously cast into walls and columns.
- E. Where interior partitions intersect exterior walls, they shall not be tied together in a masonry bond. Partitions shall terminate at face of exterior walls with a control joint.
- F. Unless other spacing is indicated, provide control joints in concrete masonry unit partitions and walls spaced not over 24'0" apart in walls and partitions, and at all intersections of partitions with other walls and partitions, and where partitions abut columns. Control joints shall be formed as hereinafter specified.

- G. Unless otherwise indicated, concrete lintels shall match the texture of the concrete block where exposed and shall be formed with bond beam units reinforced as indicated.
- H. Partitions shall be of height indicated

3.3 CMU INSULATION

- A. Install insulation in all exterior CMU walls.
 - 1. Insulation is required in all cells not filled with grout
 - 2. CMU insulation is not required on walls where solid insulation is detailed on the Drawings.
- B. Install according to manufacturer's printed instructions.
- C. For Core-Fill 500 insulating material:
 - 1. Fill all open cells and voids in concrete masonry walls.
 - 2. The foam insulation shall be pressure injected through a series of 5/8" to 7/8" holes drilled into every vertical column of block cells (every 8" on center) beginning at an approximate height of four (4) feet from finished floor level.
 - 3. Repeat this procedure at an approximate height of ten (10) feet above the first horizontal row of holes (or as needed) until the void is completely filled.
 - 4. Patch holes with mortar and score to resemble existing surface

END OF SECTION

POST INSTALLED CONCRETE ANCHORS

SECTION 05 05 19

POST INSTALLED CONCRETE ANCHORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Drilled in anchors for concrete
- B. The Engineer shall approve each application of drilled in place anchor bolts.
- C. Use stainless steel anchors/rods unless otherwise specifically noted.
- D. The use of chemical anchors in tension is discouraged.
- E. Each individual chemical anchor used in tension shall be field tested at maximum working strength.
- F. Wedge type anchor bolts shall not be allowed.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product specifications with recommended design values and physical characteristics for epoxy dowels, expansion and undercut anchors.
- C. Samples: Representative length and diameters of each type anchor shown on the Drawings.
- D. Manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Drilled-in anchors shall be installed by a person that has been trained within at least three years to the install the type of anchors to be installed.
- B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the personnel on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:
 - 1. hole drilling procedure
 - 2. hole preparation & cleaning technique
 - 3. adhesive injection technique & dispenser training / maintenance
 - 4. rebar dowel preparation and installation

1.4 DELIVERY, STORAGE AND HANDLING

A. Store anchors and adhesives in accordance with manufacturer's recommendations.

POST INSTALLED CONCRETE ANCHORS

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fasteners and Anchors
 - 1. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.
 - 2. Stainless Steel Nuts: ASTM F594.
 - 3. Reinforcing Dowels: ASTM A615 Grade 60

2.2 DRILLED-IN ANCHORS

- A. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings.
- B. Unless otherwise indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener.
- C. Avoid installing stainless steel anchors in contact with galvanic or dissimilar metals.
- D. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
 - 1. Hilti HAS threaded rods with HIT-HY 200 Safe Set System or equal for anchorage to concrete
 - Hilti HAS threaded rods with HIT-HY 70 Safe Set System or equal for anchorage into masonry. When anchoring into hollow CMU or Brick, use HIT-SC composite sleeves or equal.
 - 3. Hilti HAS threaded rods with HIT-RE 500 Safe Set System or equal for anchorage to concrete when longer working (gel) times are required.
 - 4. Hilti HAS threaded rods with HIT-RE 500-SD Safe Set System or equal for anchorage to cracked concrete.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Drilled-In Anchors:
 - 1. Perform anchor installation in accordance with manufacturer instructions.
 - 2. Drill holes with rotary impact hammer drills using carbide-tipped bits, hollow drill bit system, and or core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
 - a. Cored Holes: Holes may be cored only when specifically permitted by the Design Engineer. Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions.
 - b. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes or coring for anchors. Exercise care in coring or drilling to avoid

POST INSTALLED CONCRETE ANCHORS

damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. It is not acceptable to cut or core thru any existing reinforcing, prestressing tendons, electrical and telecommunications conduit.

c. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Cartridge Injection Adhesive Anchors:

a. Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

4. Capsule Anchors:

- a. Perform drilling and setting operations in accordance with manufacturer instructions.
- b. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a manner as to achieve a surface dry condition. Capsule anchors shall be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

B. REPAIR OF DEFECTIVE WORK

- 1. Remove and replace misplaced or malfunctioning anchors.
- 2. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout.
- 3. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

C. FIELD OUALITY CONTROL

- 1. Testing: 25% of each type and size of drilled-in anchor shall be proof loaded by an independent testing laboratory.
- 2. Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Engineer. If any of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the manufacturer to the required working loadings as determined by the Design Engineer, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Engineer.
- 3. Tension testing should be performed in accordance with ASTM E488.
- 4. Torque shall be applied with a calibrated torque wrench.
- 5. Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at proof load shall not exceed D/10, where D is the nominal anchor diameter
- 6. Minimum anchor embedment, proof loads and torques shall be as shown on the Drawings.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUMMARY

A. The work covered by this section consists of furnishing all materials and equipment and performing all labor necessary for furnishing and installing all structural steel and appurtenances as indicated on the Drawings, as specified, and as required for completion of all work under this Contract.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop drawings shall include details, for metal fabrications covering structural steel work showing details of fabrication and erection of structural steel including connections.
- C. If requested by the Engineer, design calculations shall be provided for connections and members designed and detailed by the Contractor or fabricator.
- D. No manufacture or fabrication shall commence until such drawings have been reviewed.
- E. The Contractor shall prepare and submit shop and erection plans covering all structural steel and related items. All dimensions for checking of structural steel details shall be shown.
- F. The Contractor shall be responsible for the conformation of all steel details to the typical and special details shown on the Drawings and for all details, notes and schedules appearing on the Drawings.
- G. The Contractor shall be responsible for giving information for the fabrication and erection of the structural steel. Related items shall be shown on the erection or shop drawings.
- H. Drawings shall include all shop and erection details including cuts, copes, connections, holes, bolts and welds.
- I. For bolted connections, the type, size and length of bolts including washers shall be shown.
- J. All shop and field welds shall be indicated by standard welding symbols as noted by AWS D1.1. Drawings shall show the size, length and type of each weld.
- K. The Contractor shall prepare and submit a detailed erection procedure with the shop and erection drawings. The procedure shall include the sequence of erection with temporary staying and bracing. No copies of such procedure will be returned.

1.3 REFERENCES

- A. American Institute of Steel Construction:
 - 1. Manual of Steel Construction, Thirteenth Edition (Allowable Stress Design) Specification for the Design, Fabrication and Erection of Structural Steel.
 - 2. American Institute of Steel Construction Publications.
 - 3. Code of Standard Practice for Steel Buildings and Bridges.
 - 4. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings with commentary.
 - 5. Specifications for Structural Joints using ASTM A 325 or A 490 bolts.
- B. American Welding Society:
 - 1. AWS D1.1 American Welding Society: Structural Welding Code Steel.
- C. American Society of Testing and Materials:
 - 1. ASTM A 36 Standard Specification for Structural Steel.
 - 2. A 500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 3. A 992 Specification for Steel Structural Shapes for Use in Building Framing.
 - 4. A 572 Specifications for High-Strength Low Alloy Columbium-Vanadium Steels for Structural Quality.
 - 5. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 6. A 325 Specifications for High-Strength Steel Bolts for Structural Steel Joints, Including Suitable Nuts and Bolts and Washers.
 - 7. A 490 Specifications for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
 - 8. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts
 - 9. E 329 Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction.
 - 10. F 436 Specification for Hardened Steel Washers.
 - 11. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- D. SSPC: The Society for Protective Coatings:
 - 1. SSPC Steel Structures Painting Manual.

1.4 DESIGN REQUIREMENTS

A. Unless otherwise indicated on the Drawings or in the Specifications for the design, the publication "Fabrication and Erection of Structural Steel for Buildings of the American Institute of Steel Construction", hereafter designated AISC, shall govern structural steel work. Welding shall be in accordance with American Welding Society Standard Code D1.1. Certain steel materials may be indicated on the drawings, which are not referred to in this specification but are included in ASTM or AISC specifications.

1.5 SUBSTITUTIONS OF SECTIONS

A. Substitutions of sections or modifications of details, or both and the reasons for such substitutions or modifications shall be submitted with the shop drawings for approval. Approved substitutions, modifications, and/or changes in related portions of the work shall be coordinated by the Contractor and shall be accomplished at no additional cost to the Owner.

1.6 RESPONSIBILITY FOR ERRORS

A. The Contractor shall be responsible for all errors of detailing, fabrication, and for the correct fitting of the structural members. The Contractor shall make all measurements in the field to verify or supplement dimensions shown on the Drawings and shall assume responsibility for fitting new work to existing work.

1.7 TEMPLATES

A. The fabricator shall furnish templates, with instructions for the setting of anchors and anchor bolts, and bearing plates for the job. The Contractor shall ascertain that the items are set during the progress of the work.

1.8 QUALIFICATIONS

- A. Experience of Fabricator:
 - 1. Fabrication Shop and Erector shall have fabricated and erected projects of similar size and complexity for at least ten years.
- B. Experience of Welders and Welding Operators:
 - 1. Welders and Welding Operators, shop and field, shall be qualified by an independent laboratory using test procedures covered in AWS D1.1, and shall have been employed as a Welder/Welding Operator using the positions for which he/she is qualified during the previous 90 days.
 - 2. The following information for welders is required;
 - a. The Contractor shall provide the Engineer and laboratory inspector with the names of Welders and/or Welding Operators to be employed in the shop and field.
 - b. Certification for the position to be welded.
 - c. Date of the last qualification test.
 - d. Give the name of the qualifying laboratory.
 - e. Welders will be required to submit a valid and current government issued photo-ID, such as a driver's licenses, prior to performing any shop or field welds. A copy of the photo-ID shall be submitted along with the welder certification.
 - 3. All welders employed in the shop on the fabrication of the steelwork shall be qualified for the most difficult welding position during shop fabrication.
 - 4. All welders employed in the field on the erection of the steelwork shall be qualified for the most difficult welding position during field erection.
 - 5. The Contractor shall require any welder to retake the test, when, in the opinion of the Engineer, the work of the welder creates a reasonable doubt as to the proficiency of the welder. Re-certification of the welder shall be made to the Engineer only after the welder has taken and passed the specified test. The Engineer may require radiographic or ultrasonic testing or may require coupons to be cut from any location in any joint for testing.

- 6. Should any two radiographic or ultrasonic tests or coupons cut from the work of any welder show strengths or under tests less than that of the base metal, it will be considered evidence of negligence or incompetence and such welder shall be removed from the work.
- 7. When coupons are removed from any part of a structure, the members cut shall be repaired at no additional cost to the Owner in a neat and workmanlike manner.
- 8. Costs of all qualifications, tests and retest shall be borne by the Contractor.

1.9 JOINTS

- A. Joints shall be as indicated on the Drawings. The fabricator shall design joints not indicated on the Drawings. Unless indicated otherwise joints will be of a type to develop the full strength of the members.
- B. Joints will be cut with peening to relieve residual stress.
- C. All sections of welds found defective shall be chipped or cut out to base metal and rewelded before proceeding with the work.
- D. All joints shall comply with AWS D1.1.

1.10 INSPECTION AND TESTING

- A. Inspections and tests shall comply with ASTM E 329 and shall be performed by an independent laboratory. The testing laboratory shall be directed by the Engineer. All material to be furnished shall be subject to inspections and tests in the shop and field.
- B. Shop inspections and tests shall include fit-up, preparation of surfaces and welding.
- C. Field inspections and tests shall include fit-up, preparations of surfaces, welding and bolting.
- D. The laboratory shall make reports of shop and field inspections and testing on a weekly basis. One copy of each shop and field inspection report shall be submitted directly to each of the following: Engineer, Resident Engineer, Inspector, Contractor, Fabricator and Erector.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:

- 1. Materials shall be of domestic manufacture, within trade tolerances, new, undamaged and without splices.
- 2. Structural material, plain or fabricated, shall be stored above the ground upon platforms, skids or supports.
- 3. Materials shall be kept free of dirt, grease and foreign matter and shall be protected from corrosion.

B. Structural Steel:

- 1. Structural steel, such as wide flange sections and I beams, shapes shall comply with ASTM A 992/A 572 Grade 50 unless indicated otherwise on the Drawings.
- 2. Members such as angles and channels shall have a minimum yield stress of 36 ksi and comply with ASTM A 36 or A 572/A 992.
- 3. Hollow structural shapes shall comply with ASTM A 500 Grade B.
- 4. The Contractor shall furnish two copies of all mill reports covering the chemical and physical properties of the steel used.

C. Welding Electrodes and Flux:

- 1. Electrodes and flux used for submerged arc welding shall be of the same manufacturer. The flux shall be free of the contamination of dirt, mill scale and foreign material. Fused flux used in welding shall not be reused. Bare electrodes and flux used in combination shall conform to the requirements of AWS D1.1.
- 2. Electrodes for manual shielded metal arc welding shall conform to AWS D1.1.

D. Welding Equipment:

1. Welding equipment shall be capable of providing the welding required by the Drawings and/or Specifications and in compliance with the requirements of joint qualification in AWS D1.1.

2.2 FASTENERS

A. Bolts, Nuts and Washers:

- 1. All bolts, nuts, and washers shall comply with ASTM A 325 or A 490 unless otherwise indicated on the drawings.
- 2. ASTM A 325 and A 490 bolts shall be used for connections as indicated on the Drawings.

B. Anchor Rods and Anchor Bolts:

- 1. Anchor rods and anchor bolts for structural steel shall be ASTM A 307 unless otherwise indicated on the drawings.
- 2. Anchor rods and anchor bolts shall be cast in place.

C. Drilled In Place Anchors:

1. Unless indicated otherwise on the Drawings, or specifically authorized by the Engineer, drilled in place anchor bolts shall not be used. When specified, anchors shall be of the chemical type. The Engineer shall approve each application of drilled in place anchor bolts. Wedge and expansion type anchor bolts shall not be allowed.

D. Load Indicator Washers:

- 1. All bolted connections shall have load indicator washers.
- 2. Load indicator washers shall be Cornet Load Indicator by Cooper + Turner, Inc. or equal.

E. Hardened Washers:

1. Hardened washers shall conform to ASTM F436.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive Work

3.2 FABRICATION

A. General:

1. Structural material shall be fabricated and assembled in the shop. Assembled pieces shall be taken apart for the removal of burrs, and shavings produced by the reaming operation. Parts not shop connected shall be secured by bolts to prevent damage in shipment and handling.

B. Connections:

- 1. Connections shall be as shown on the Drawings.
- 2. Connections not shown shall be made to conform to the AISC Specification.
- 3. One-sided or other types of eccentric connections will not be permitted.
- 4. Surfaces of joints for welded and bolted connections shall be clean bright metal.
- 5. Fit up of the parts shall be inspected and approved by the laboratory inspector prior to making final connection.

C. Fabricator Connections:

- 1. Fabricator Designed Connections:
 - a. Connections indicated on the drawings to be designed and detailed by the fabricator shall be stamped by a P.E. licensed in the state where the project is located.
 - b. If requested the design calculations shall be provided to the Engineer for review.

D. Contractor Proposed Splices:

- 1. Splices not shown on the Contract Drawings, but proposed by the Contractor shall be designed by the fabricator.
- 2. Proposed locations for splices shall be indicated on the shop drawing submittal and shall be accompanied by design calculations stamped by a P.E. licensed in the state where the project is located.

E. Connections Not Shown on the Drawings:

- 1. Connections not shown or indicated on the drawings but required for the proper execution of the work shall be designed and detailed by the fabricator.
- 2. The minimum design connection shall be as required by AISC and other applicable codes.
- 3. Design calculations shall be supplied with the submittal and shall be stamped by a P.E. licensed in the state where the project is located.

F. Holes:

- 1. Holes shall be cut, drilled or punched at right angles to the surface of the metal and shall not be made or enlarged by burning.
- 2. Holes in base or bearing plates shall be drilled.
- 3. Holes shall be clean-cut without torn or ragged edges.
- 4. Outside burrs resulting from drilling or reaming operation shall be removed.

5. Holes for bolts shall be 1/16 inch larger than the diameter of the bolt, except as noted on the drawing.

G. Welding:

- 1. Welded connections will be permitted only where indicated on the Drawings.
- 2. Welded construction shall conform to the AISC and AWS Specifications.

H. Bolted Connections:

- 1. Bolted connections using ASTM A 325 or A 490 bolts shall conform to the Specifications for Structural joints using ASTM A 325 or A 490 bolts.
- 2. Load indicator washers and hardened washers shall be used to show that bolts are properly tightened.
- 3. Bolt threads shall be excluded from the shear planes of the contact surfaces between the connected parts.
- I. Milled surfaces shall comply with the AISC Specification and the Drawings.
- J. Allowance shall be made for draw in all tension bracing.

3.3 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Accept structural steel on site with identification tags/markings as shown on shop drawings. Inspect for damage.
- C. Protect steel coatings from damage and store above ground to avoid soil contamination to primer and interference with field top coatings.

3.4 ERECTION

A. Splices and Field Connections:

- 1. Splices and field connections shall be made as shown or noted on the Drawings.
- 2. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the assembly and fitting of parts shall be reported immediately to the Engineer for directions as to the method of correction.
- 3. Corrections shall be made at no additional cost to the Owner.

B. Leveling Plates and Leveling Nuts:

- 1. Leveling plates and leveling nuts can be used at the option of the Contractor.
- 2. All base plates shall be fully grouted such that the base plate is fully seated on the grout and no air gaps exist between the base plate and grout.

C. Anchor Rods and Anchor Bolts:

- 1. Anchor rods, anchor bolts and anchors shall be located and built into connecting work. Bolts and anchors shall be preset by the use of templates to locate the anchors and anchor bolts.
- 2. Unless noted otherwise on the drawings, anchor bolts shall be tightened to 70% of their allowable tension load. Tension load shall be based on Allowable Stress Design (ASD) with

- an allowable axial tensile stress (F_t) of 20.0 ksi for ASTM A307 material. Tension area of the bolt shall be based on the nominal diameter of the bolt.
- 3. The services of an independent testing lab shall be used to check tension on the bolts.

D. Turnbuckles:

1. Threaded rods used for bracing shall be connected and tightened using turnbuckles.

E. Column Bases and Bearing Plates:

- 1. Column bases and bearing plates may be attached or loose as approved on the shop drawings.
- 2. Plates shall be supported and aligned on steel wedges or shim. After the supported members have been plumbed and positioned, the entire bearing area under the plate shall be dry packed solidly with no shrink grout, and the anchor nuts tightened. Wedges and shims shall be cut off flush with the edge of the column base and bearing plates, and shall be left in place.

F. Drift Pins:

1. Drift pins may be used only to bring several parts together, and shall not be used in such manner as to distort or damage the metal.

G. Gas Torch:

1. The use of a gas-cutting torch in the field for correcting fabrication errors is prohibited unless the Engineer has specifically approved such procedure for each case individually in writing.

3.5 ALIGNMENT AND ASSEMBLY

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. After assembly, the various members forming parts of a completed frame or structure shall be aligned and adjusted before being fastened.
- C. Tolerance shall conform to AISC.
- D. Fastening of splices of compression members shall be done after the abutting surfaces have been brought completely into contact.
- E. Bearing surfaces and surfaces that will be in permanent contact shall be cleaned before the members are assembled.
- F. As erection progresses, the work shall be fastened to take care of all dead load, wind and erection stresses.
- G. Splices will be permitted only where indicated on the Drawings.
- H. Erection bolts used in welded construction shall be tightened and left in place.
- I. Welding for redrilling will not be permitted.

3.6 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story or for every 12 ft in height whichever is greater, non-cumulative.
- B. Maximum Offset From Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

3.7 PAINTING

- A. Painting shall be as set forth in the painting section of the specifications.
- B. Care shall be taken to ensure that shop primer and finish coat paint are made by the same manufacturer and are compatible with each other.

END OF SECTION

SECTION 05 60 00

MISCELLANEOUS METALS

PART 1 GENERAL

1.1 SUMMARY

A. The work covered by this section consists of furnishing all materials and equipment and performing all labor necessary for furnishing and installing all miscellaneous metals, such as aluminum handrail, grating, stairs, raised platforms, stair nosings, aluminum weir plates, iron castings, etc. and appurtenances as indicated on the Drawings, as specified, and as required for completion of all work under this Contract.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop drawings shall include details, for metal fabrications covering aluminum work showing details of fabrication and erection of structural aluminum including connections.
- C. If requested by the Engineer, design calculations shall be provided for connections and members designed and detailed by the Contractor or fabricator.
- D. No manufacture or fabrication shall commence until such drawings have been reviewed.
- E. The Contractor shall prepare and submit shop and erection plans covering all aluminum and related items. All dimensions for checking of structural aluminum details shall be shown.
- F. The Contractor shall be responsible for the conformation of all aluminum details to the typical and special details shown on the Drawings and for all details, notes and schedules appearing on the Drawings.
- G. The Contractor shall be responsible for giving information for the fabrication and erection of the aluminum work. Related items shall be shown on the erection or shop drawings.
- H. Drawings shall include all shop and erection details including cuts, copes, connections, holes, bolts and welds.
- I. For bolted connections, the type, size and length of bolts including washers shall be shown.
- J. All shop and field welds shall be indicated by standard welding symbols as noted by AWS D1.1. Drawings shall show the size, length and type of each weld.
- K. If requested by the Engineer, samples of all aluminum handrail components, bases, toe plates and pipe shall be submitted for approval. No fabrication, erection or installation of work shall commence until drawings and details covering such work have been reviewed by the Engineer.

L. Test Data:

1. The manufacturer of aluminum grating, floor plates, handrails, and ladders shall submit calculations and/or test data by an independent laboratory which meet the testing requirements of the Aluminum Association.

1.3 REFERENCES

A. ASTM International:

- 1. ASTM A36/A36M Standard Specification for Carbon Structural Steel.
- 2. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- 3. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- 4. ASTM A666 Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- 5. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- ASTM B211 Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
- 7. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- 8. ASTM B429 Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

B. American Welding Society:

- 1. AWS A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- 2. AWS D1.1 Structural Welding Code Steel.
- 3. AWS D1.2 Structural Welding Code Aluminum.

C. Green Seal:

- 1. GC-03 Anti-Corrosive Paints.
- D. National Association of Architectural Metal Manufacturers:
 - 1. NAAMM MBG 531 Metal Bar Grating Manual.
 - 2. NAAMM MBG 532 Heavy Duty Metal Bar Grating Manual.

E. SSPC: The Society for Protective Coatings:

- 1. SSPC Steel Structures Painting Manual.
- 2. SSPC SP 1 Solvent Cleaning.
- 3. SSPC SP 10 Near-White Blast Cleaning.
- 4. SSPC Paint 15 Steel Joist Shop Paint.
- 5. SSPC Paint 20 Zinc-Rich Primers (Type I Inorganic and Type II Organic).

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Handrail, Ladder and Structural Aluminum:

- 1. Handrail, ladder, structural aluminum and associated items shall be manufactured by Thompson Fabricating Company, or equal.
- 2. Substitutions: Section 01 60 00 Product Requirements.

B. Grating:

- 1. Grating shall be manufactured by IKG Borden, Thompson Fabricating or equal.
- 2. Substitutions: Section 01 60 00 Product Requirements.

C. Stair Nosings for Concrete Treads:

- Nosings of all concrete steps, interior, and exterior, shall be 3" width and shall be Wooster Type 231BF Supergrit or equal abrasive safety treads, securely anchored to concrete. The color of the nosings shall be safety yellow.
- 2. Substitutions: Section 01 60 00 Product Requirements.

2.2 MATERIALS

A. Stainless Steel:

 Unless otherwise specified, all fabricated work indicated on the Drawings and/or specified to be stainless steel shall be Type 316 for non-welded and Type 316L for welded, in accordance with ASTM A 276 as amended to date.

B. Bolts, Nuts and Screws:

- 1. All hardware to connect structural aluminum shall be Type 304, or 316 stainless steel.
- 2. Anchor rods or anchor bolts, unless shown otherwise on the Contract Drawings, shall be placed in forms prior to placing concrete. All anchor rods/bolts for aluminum or stainless steel or fiberglass members shall be Type 304, or 316 stainless steel.
- 3. Aluminum Nuts and Bolts: Alloy 2024-T4 with #205 aluminum finish.
- 4. Aluminum weir plates, aluminum railing, miscellaneous aluminum, and stainless steel jointing shall be fastened with Type 302 or 304 stainless steel bolts, nuts, washers, and screws as required.
- 5. When drilled in place anchor bolts are to be used, they shall be the type as specified in Section 05 05 19.
 - a. Use stainless steel anchors/rods.
 - b. The Engineer shall approve each application of drilled in place anchor bolts.
 - c. The use of chemical anchors is in tension is discouraged.
 - d. Each individual chemical anchor used in tension shall be field tested at maximum working strength.
 - e. Wedge type anchor bolts shall not be allowed.

C. Supports:

- 1. All supports for small water and process piping (4" and less) and electrical devices including control panels shall be stainless steel or aluminum.
- 2. This requirement should include unistrut, straps, anchor bolts, nuts, washers, framing and any other metals used to support the pipe or device.

3. The General Contractor is responsible for coordinating this requirement with all subcontractors and suppliers.

D. Ferrous Metals:

- 1. Gray-Iron Castings shall be ASTM A-48 (Manhole and step castings shall be the Owner's Standard unless otherwise specified).
- 2. Malleable Castings shall be ASTM A-47.

E. Aluminum Metals:

- 1. Aluminum surfaces in contact with concrete, grout or dissimilar metals shall be protected with a coat of asphaltic paint, mylar isolators or other approved material.
 - a. Aluminum Sheet or Plate: Alloy 6061-T6.
 - b. Aluminum Structural or Rolled Shapes: Alloy 6061-T6.
 - c. Aluminum Extruded Shapes: Alloy 6061-T6.
 - d. Aluminum Tubing or Pipe: Alloy 6061-T6, 6063-T6 or 6105-T5 as specified by ASTM B 429 or ASTM B 221.

F. Aluminum Stair Treads:

- 1. When aluminum stairs are detailed on the drawings, aluminum stair treads shall be I-bar grating type treads and shall be furnished with extruded aluminum corrugated nosing.
- 2. Aluminum carrier angles shall be bolted/welded to the ends of stair treads. Minimum depth of grating at treads shall be 1-1/4 inches.

2.3 IRON CASTINGS

A. General:

The Contractor shall furnish all miscellaneous iron castings, including catch basins, manhole
frames and covers, steps, floor drains, bolt inserts, brackets, supports and such other iron
castings as are shown on the Drawings in accordance with the applicable ASTM
Specifications, as amended to date.

B. Quality:

- 1. All castings shall be tough, close-grained and smooth, and free from blow holes, blisters, shrinkage stains, cracks, cold shots, and like defects.
- 2. No plugging of defective castings will be permitted.

C. Workmanship:

- 1. All castings shall be made accurately to dimensions shown on the Drawings or ordered and shall be planed or ground where necessary, whether marked or not, to secure perfectly flat bearing surfaces.
- 2. Allowance shall be made in the patterns so that the specified thickness of metal will not be reduced.

D. Weights:

1. No castings will be accepted, the weight of which is less than the theoretical weight, based on required dimensions, by more than five (5%) percent.

E. Cleaning and Painting:

1. All castings shall be thoroughly cleaned and painted before rusting begins.

- 2. All castings except those to be embedded in concrete, shall be cleaned and given a priming coat of paint in the shop.
- 3. Castings which will be exposed in buildings shall be painted in accordance with the painting section.

2.4 ALUMINUM GRATING, FLOOR PLATES, HANDRAILS, AND LADDERS

A. General:

1. All aluminum grating, floor plates, handrails and ladders shall be as shown on the Drawings and comply with applicable OSHA regulations.

B. Handrails:

- 1. Handrails shall be fabricated of minimum size 1-1/2 inches Schedule 40 aluminum pipe.
- 2. Minimum size of rails shall be Schedule 40 and posts shall be Schedule 80.
- 3. Railing may be shop fabricated and or assembled using components that utilize the internal type method of connection for field erection.
- 4. Components that are glued or use pop-rivets are not acceptable.
- 5. Handrail shall have a clear anodized finish in accordance with Aluminum Association M10-C22-A41.
- 6. Handrail pipe shall be plastic wrapped.
- 7. Plastic wrap shall be removed after installation.
- 8. Welding shall be by inert gas shielded arc method with all welds ground smooth.
- 9. Handrails and stair rails shall be designed, and tested, to withstand a 200 pound concentrated load applied in any direction at any point on the top rail.
- 10. In addition, handrails shall be designed, and tested, to withstand a simultaneous loading of a vertical 100 pounds per foot and a horizontal 50 pounds per foot applied at the top rail.
- 11. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations.
- 12. If requested by the Engineer, design calculations and samples of all components (including bases, toe plates, rails, posts, fittings, etc.) shall be submitted for approval.
- 13. The top surface of the top railing shall not be interrupted by projecting fittings.
- 14. Toe plates shall be provided on all handrail.
- 15. For no reduction in pull out strength, anchor bolts shall meet the minimum requirements for spacing and edge distance as required by the anchor bolt manufacturer. A safety factor of 4 shall be used on anchor bolt pullout values published by the manufacturer.
- 16. Except as otherwise shown on the Drawings, handrail denoted to be "removable" shall generally be of the same fabrication process and subject to the design and testing requirements as the "non-removable" handrail.
- 17. Shop drawings shall clearly indicate the removable sections and show details that allow for the removal of the handrail.

C. Grating:

- 1. Grating shall be fabricated of 6063-T6 I-shaped bars with swaged cross bars spaced 4 inches on center and bearing bars spaced 1-3/16 inches on center.
- 2. If alternative bearing bar spacing is used, provide design calculations that meet the design criteria as stated below.
- 3. Grating shall be striated for skid resistance, minimum depth 1-1/4 inches, and shall support a uniform load of 200 pounds per square foot with a deflection of not more than 1/4-inch and a maximum fiber stress less than that allowed by the Aluminum Association.

- 4. The ends and cutouts of all grating shall be banded.
- 5. Exposed welds and welding beads on the exposed top surface of end plates and bands are not acceptable.
- 6. Seat angles or shelf angles shall be a minimum 1/4-inch thick continuous aluminum angle sized to accommodate the depth of the grating and shall have welded on anchors when shown installed prior to concrete placement or Type 304 stainless steel anchor bolts.
- 7. Maximum size of aluminum grating shall facilitate removal by a single plant operator. Submit details for approval during shop drawing review.
- 8. Aluminum grating shall be fastened with a minimum of four (4) fasteners (if rectangular or square) and six (6) fasteners (if more than four sides) per grating section.
- 9. Provide details on grating fasteners/hold down clips in the submittal.

D. Floor Plates:

- 1. Checkered floor plates shall be aluminum with raised diamond pattern on the upper surface.
- 2. Floor plate shall be 1/4-inch thick and designed to support a uniform load of 200 pounds per square foot with a deflection of not more than 1/4-inch.
- 3. Maximum fiber stress shall not exceed that allowed by the Aluminum Association.
- 4. Reinforcing rib size, depth and spacing is to be determined by the floor plate fabricator.
- 5. The fabricator of the floor plate shall submit calculations to the Engineer for approval.
- 6. Calculations shall show reinforcing rib size, spacing and welding if calculations show that ribs are required.

E. Ladders:

- 1. Aluminum ladders shall meet the requirements of ANSI-A14.3.
- 2. Side rails shall have a minimum diameter of 1-1/2 inches, Schedule 40 (minimum), and alloy 6061-T6 or 6105-T5 conforming to ASTM-B-429 or ASTM-B-221.
- 3. The rung shall be a flat 1-inch wide serrated top surface and straight side semicircular bottom with striations.
- 4. The rung shall be a 6063-T6 aluminum extrusion of sufficient section modulus and moment of inertia to withstand a concentrated load of 250 pounds plus 30% impact with a maximum deflection of L/360.
- 5. Side rails shall be designed, and tested, for a minimum live load of 250-pound plus 30% impact concentrated between any two consecutive attachments.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

A. Verify field measurements prior to ordering and fabrication.

3.2 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with other trades. For example, confirm pump size and hatch opening prior to submitting aluminum floor hatch. Coordinate placement of frames and tolerances for placed frames and openings

3.3 INSTALLATION

- A. Place frames in correct position, plumb and level.
- B. Mechanically cut finish surfaces. Do not flame cut.
- C. Set perimeter closure flush with top of grating and surrounding construction.
- D. Secure to prevent movement.

E. Iron Castings:

1. All materials furnished shall be installed in a good workmanlike manner.

F. Aluminum Grating:

- Standard installation clearances and tolerances shall conform to the requirements of the current Metal Bar Grating Manual published by the National Association of Architectural Metal Manufacturers.
- 2. Install aluminum clamps or clips to anchor grating and planking to supports.
- 3. A minimum of four fasteners per panel is required unless otherwise noted on the Contract Drawings.
- 4. Clips shall not protrude above the top of the grating.
- 5. Self-tapping screws shall not be used to secure grating to supports.

G. Toe Plates:

1. Toe plates shall be a minimum of 4 inches high, set 1/4-inch above the walking surface attached to the posts with clamps allowing for expansion and contraction.

H. Bolts, Nuts, and Screws:

- 1. Steel bolts and nuts for jointing miscellaneous steel shall conform to ASTM A 325 or A 490 and shall be American National Standard dimensions.
- 2. Anchor bolts, unless shown otherwise on the contract drawings, shall be placed in forms prior to placing concrete.
- 3. All anchor bolts for "non-structural steel" members shall be Type 302, 304, or 316 stainless steel.
- 4. Steel and aluminum weir plates, aluminum railing, miscellaneous aluminum, galvanized steel and stainless steel jointing shall be fastened with Type 302 or 304 stainless steel bolts, nuts, washers, and screws as required.
- 5. The use of chemical anchors in tension is discouraged.
- 6. Each individual chemical anchor used in tension shall be field tested at maximum working strength.

I. Stainless Steel:

1. Unless otherwise specified, all fabricated work indicated on the Drawings and/or specified to be stainless steel shall be Type 316, in accordance with ASTM A 276 as amended to date.

J. Handrail and Ladders:

- 1. Handrail and Ladders shall be attached to concrete with stainless steel anchor bolts as specified and as shown on the Contract Drawings.
- 2. Anchor bolts shall be supplied by the handrail manufacturer.

3.4 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Clean welds and damaged coatings and apply two coats of touch-up primer.

END OF SECTION

WATER REPELLENT

SECTION 07 19 00

WATER REPELLENT

PART 1 GENERAL

1.1 SUMMARY

A. Liquid water repellent shall be applied to all exterior masonry (including brick and block). Water repellent for split face and scored split face masonry units (i.e., non-common CMU) shall be as specified in Section 04 20 00.

1.2 QUALITY ASSURANCE

A. Installer:

1. Applicator shall be approved by the liquid water-repellent manufacturer for application of product on each surface receiving liquid water repellent.

B. Field Test:

- 1. Field test prior to application.
- 2. Apply liquid water repellent to one (1) square foot of each material to be treated in accordance with manufacturers printed instructions, and field test to ascertain water absorption within tolerance of that specified in MATERIALS sub-paragraph below.

1.3 SUBMITTALS

A. Shop Drawings:

- 1. The Contractor shall furnish to the Engineer for review (see section 01 33 00 for number of copies required) manufacturer's literature covering material and installation directions and procedure for the product.
- 2. No installation of work shall commence until details covering such work have been reviewed by the Engineer.

B. MATERIAL HANDLING

- 1. Delivery:
 - a. Deliver materials in sealed containers clearly marked with manufacturer's identification including the type of materials, and with manufacturer's numbered seal intact.
- 2. Storing:
 - a. Store materials in area protected from rain or standing water, where temperatures are not less than -10°F or over 100°F, with adequate ventilation, unless otherwise authorized by the material manufacturer.

1.4 JOB CONDITIONS

A. Environmental Requirements:

- 1. Temperature:
 - a. Do not proceed with application of materials if ambient temperature is below 40°F or if ice or frost is covering the substrate.

WATER REPELLENT

b. Do not proceed with application if ambient temperature or surface temperature exceeds 100°F.

2. Moisture:

- a. Do not proceed with application of materials in rainy conditions or if heavy rain is anticipated within 2 hours after application.
- b. Material may be applied to damp but absorbent substrates, but not over standing water.
- c. The surface should be sufficiently dry to observe the spray pattern during application.

B. PROTECTION

C. Plants and Vegetation:

1. Protect plants and vegetation from over spray.

D. Asphalt-based Materials:

1. Protect asphalt-based materials such as roofing, caulking and joint fillers.

1.5 MANUFACTURER

A. The product shall be as manufactured by Sonneborn, or equal.

1.6 WARRANTY

A. Manufacturer will issue its standard ten- (10) year warranty for labor and materials covering the application.

PART 2 PRODUCTS

2.1 MATERIALS

A. Components:

1. Liquid water repellent shall be 40% (wt/wt) alkyl trialkoxy silane, 60% (wt/wt) ethyl alcohol, a water miscible, colorless liquid.

B. Viscosity:

1. At 20°C viscosity should be 1.0mPA-s max.

2.2 WATER REPELLANT

A. Liquid water repellent shall be a water miscible, colorless, penetrating water repellent treatment, which shall conform to the following requirements:

B. Absorption:

1. Water absorption values for treated concrete surfaces shall not exceed 1% moisture after 48 hour submersion in water, when compared to similar untreated concrete surfaces with approximately 4.8% moisture after 48-hour submersion in water, according to ASTM C 642 testing procedure. The treated specimen shall not exceed 1.3% moisture by weight when submerged in boiling water for 24 hours following the 48 hour soak in accordance with ASTM C 642 test procedure.

WATER REPELLENT

C. Permeability:

- 1. The treatment must allow treated substrates to retain vapor permeability.
- 2. Application must be compatible with damp substrate surfaces.
- 3. Verification of this property will be demonstrated by the following procedure:
 - a. Treat the sample specimen in a water saturated condition at the time of application; dry the treated sample to a constant weight; and then perform ASTM C 642 testing procedure with the treated sample gaining no more than 1% of its weight when submerged for 24 hours.
 - b. No staining, discoloration, darkening or texture change of the surface shall occur as a result of the treatment used.
 - c. The treatment must be able to resist salt penetration as measured by AASHTO T-259 and T-260. After 90 days of salt ponding, the treated samples shall absorb less than 1.5 lbs. chloride per cubic yard at a depth of 1/16-inch to 1/2-inch and no more than 0.75 lbs. chloride per cubic yard at a depth of 1/2-inch to 1-inch. This sample shall be compared to an untreated sample with 6 lbs/yd³ and 3.5 lbs/yd³ respectively.

PART 3 EXECUTION

3.1 Installation

A. Surface Preparation:

- 1. Examination:
 - a. Examine surfaces to receive water repellent treatment to assure that conditions are satisfactory for application of materials.
- 2. Verify Joints:
 - a. Verify that masonry joints found to be unsound, hollow, or otherwise defective, have been raked out to a depth of 1/2-inch and pointed with mortar.
 - b. Allow mortar to cure according to the manufacturer's instructions.
- 3. Pointing:
 - a. Verify that cracks widths exceeding 5/32-inch have been filled with pointing mortar.
 - b. Allow mortar to cure according to the manufacturer's instructions.
- 4. Curing:
 - a. Verify that all new masonry has reached 28-day cure strength.
- Clean Surfaces:
 - a. Clean surfaces, with high-pressure water, to remove dust, dirt, oil, wax, other coatings, efflorescence and other foreign materials.

B. Application:

- 1. The liquid water repellent shall be applied as supplied by the manufacturer without any dilution or alteration.
- 2. Coverage:
 - a. Apply water repellent with low-pressure airless fan spray coarse nozzle, flooding surface to obtain uniform coverage according to manufacturer's recommendation.
- 3. Rate of Coverage:
 - a. Apply water repellent materials at a coverage rate according to manufacturer's recommendation.

END OF SECTION

SECTION 07 40 00 ARCHITECTURAL METAL ROOF

PART 1 GENERAL

1.1 SUMMARY

- A. The work included in this Section consists of furnishing all labor, materials, equipment and services necessary for installing the light gauge metal roof trusses, metal decking, insulation board, vapor barrier and standing seam architectural metal roofs as shown on the Contract Drawings.
- B. Include ridge vent, soffit vent, metal fascia, soffits, gutters, downspouts and splash blocks as shown on the Contract Drawings and as required for a complete system. The gutters and downspouts color shall match the metal roof panels.

1.2 DESIGN CRITERIA

- A. The manufacturer shall design the architectural metal roof and light gauge metal roof truss support systems.
- B. All building codes referenced shall be per the latest adopted versions of the codes.
- C. The wind load for the structure shall be determined in accordance with IBC/ASCE provisions for wind loads with a minimum wind load of 20 pounds per square foot or as required by National Association of Architectural Metal Manufacturers (NAAMM).
- D. Vertical live loads shall be in addition to the applicable dead loads and shall be applied to the horizontal projection of the roof.
- E. Roof panels shall be designed for either 50 psf (minimum) uniform, distributed or a 200 pound (minimum) concentrated (point) load (over a 1' x 1' area) located at center of maximum roofing panel span. The most severe conditions shall govern.
- F. Dead load applied to the roof shall include 10 psf uniformly distributed over the roof area in addition to the self-weight of the structure.
- G. The maximum deflection criteria shall be L/240 unless specified otherwise.
- H. Systems shall conform to Factory Mutual I-90 guidelines.
- I. Design shall include all pertinent load combinations of the ASCE & IBC.
- J. Load combinations used shall include the effects of dead, live, wind, snow and seismic loading.
- K. Minimum ground snow load shall be as required by IBC/ASCE for the particular location of the project.
- L. Lateral stability and the effects of temperature shall be taken into account during the design of the roof systems. Panels shall not warp or buckle due to thermal effects and temperature variations.

1.3 SUBMITTALS

- A. Shop Drawing submittals and samples shall be submitted for review as required by Section 01 33 00 of these Specifications.
- B. Submit detailed drawings showing layout of roof trusses, metal decking (used as sheathing), rigid polyiso-core insulation board, vapor barrier (roofing paper underlayment), metal fascia, roof panels, anchoring details, fasteners, joint details, trim, flashing, and accessories. Show details of weatherproofing, terminations, and penetrations of metal work. Include details on ridge vent, soffit vent, gutter and downspouts.
- C. Submit detailed drawings of the roof truss system. Drawings shall indicate size of members, anchoring details, bracing details (lateral stability) and all means of attachment include weld length/size and bolt/fastener dimensions.
- D. Submit a sample of each type of panel (roof, ceiling, etc.) complete with factory finish.
- E. Submit results indicating compliance with minimum requirements of the following performance tests:
- F. Air and Water Infiltration: ASTM E283, current edition.
- G. Water Infiltration: ASTM E331, current edition.
- H. Air and Moisture Testing: ASTM E1646, current edition.
- I. Air and Moisture Testing: ASTM E1680, current edition.
- J. Uplift as required by ASTM E1592, current edition.
- K. Wind Uplift: U.L. Class 90.
- L. Submit manufacturer's specifications and installation instructions for each proposed item together with shop drawings. Include manufacturer's certification as may be required to show compliance with these Specifications.
- M. Submit all proposed items pertaining to the roof system together at one time in one submittal to ensure coordination.
- N. Submit structural design calculations, with an engineer's seal who is registered in the State of where the project is located, verifying design compliance of all members and that the entire system is in compliance with these Specifications and all pertinent design Codes. If calculations are done by a computer program, provide inputs and outputs for the calculations.
- O. Provide erection drawings. State whether the trusses/joists will be fabricated onsite or offsite. State how trusses will be transported, if in pieces or whole. State how trusses will be spliced together onsite (only if splicing trusses in field). Provide details how trusses will be connected to one another.
- P. Provide O&M manuals, including roof system warranty. Include in submittal (or manual) the repair procedures of metal roof panels.

1.4 STORAGE AND PROTECTION

A. Panels should be stored in a clean, dry place. One end should be elevated to allow moisture to run off.

- B. Panels with strippable film must not be stored in the open, exposed to the sun.
- C. Stack all materials to prevent damage and to allow for adequate ventilation.
- D. All materials shall be stored and protected in accordance with the requirements of Section 01 60 00 of these Specifications.

1.5 QUALITY ASSURANCE

- A. The manufacturing company shall have specialized in Architectural Sheet Metal Products with 10 years minimum documented experience.
- B. The applicator shall be licensed by the manufacturer and shall have installed an application of this roofing system on a minimum of ten (10) projects within the past three years.
- C. The manufacturer shall provide written certification to the Engineer that all materials furnished comply with all applicable requirements of these Specifications.
- D. The joist or truss manufacturing company shall be specialized in the manufacture of steel joists and truss products with a minimum of 10 years documented experience.

1.6 WARRANTY

- A. Paint finish shall have a 20-year warranty against cracking, peeling, and fade.
- B. The applicator/installer shall furnish a warranty covering water tightness of the roofing system for the period of three years.
- C. The manufacturer shall furnish a warranty covering water-tightness of the roofing system for the period of 20 years.
- D. These warranties shall include all costs associated with making the repairs, including, but not limited to, parts, labor, travel, lodging, expenses.

PART 2 PRODUCTS

2.3 ACCEPTABLE MANUFACTURERS

- A. Metal Panels:
 - 1. Specified Manufacturer: Berridge Manufacturing Company.
 - 2. Acceptable Manufacturer: Englert, Inc., or MBCI.
 - 3. Substitutions: Section 01 33 00 Shop Drawings, Product Data and Samples.
- B. Roof Support System/ Trusses:
 - 1. Specified Manufacturers: Alpine TruSteel
 - 2. Acceptable Manufacturer: Trinity Framing System.
 - 3. Substitutions: Section 01 33 00 Shop Drawings, Product Data and Samples.

2.4 SHEET MATERIALS

A. Prefinished metal shall be minimum 24 gauge, hot-dipped, galvanized steel, Grade C, G-90 coating, in accordance with ASTM A653-latest edition and A924-latest edition or 24 gauge galvalume.

- B. Finish shall be full strength Kynar 500 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to
- C. 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500 finish supplier.
- D. The Owner shall choose the colors of roof panels, soffit panels, metal fascia, ridge vent, gutters and downspouts. Provide 6 original color copies of the expanded color charts with available colors in order for the Owner to review and select the colors.
- E. Strippable film shall be liquid applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. This strippable film must be removed before installation.

2.5 ACCESSORY MATERIALS

- A. Fasteners: All fasteners shall be stainless steel, whether or not exposed.
- B. Sealant: Shall be "Tremco 1" or Dow 790 or equal as determined by roofing manufacturer.

2.6 FLASHING

- A. All exposed adjacent flashing and items formed from flatstock shall be of the same material and finish as the standing seam roof panels.
- B. Hem all exposed edges of flashing on underside, ½ inch.

2.7 METAL ROOF PANELS and EXTERIOR WALL PANELS

- A. Panels shall be standing seam "CEE-LOCK" panels.
- B. Panels shall have 16-1/2-inches on-center seam spacing with a seam height of 1-3/8 inch.
- C. Snap-on seams shall be 1-inch in height and shall contain manufacturer's factory applied Extruded Vinyl Weather Seal Insert to prevent siphoning of moisture through the standing seam.
- D. Concealed anchor clips shall be spaced as required to meet uplift loads (maximum of 24-inches on center).
- E. Panel assembly shall bear Underwriter's Laboratories Label UL90, pursuant to Construction Number 296 and applicable Fire Ratings.
- F. Certification shall be submitted, based on independent testing laboratory, indicating no measurable water penetration or air leakage through the system when tested in accordance with ASTM E331 current edition and E283 current edition.

2.8 METAL CEILING AND INTERIOR WALL PANELS

- A. Panels shall be standing seam "TEE-PANELS".
- B. Panels shall have 12-3/4-inches on-center seam spacing with a seam height of 1-inch.
- C. Snap-on seam covers shall be installed on all seams.
- D. Concealed anchor clips shall be spaced as required to adequately secure panels in place.
- E. Panels shall be as specified in Paragraph 2.2 above.

2.9 SOFFIT PANELS

- A. Panels shall be flush seam as specified in Paragraph 2.2 above.
- B. Panels shall be factory formed to 40' maximum.
- C. Panels shall have flat, 3-7/8-inches wide, embossed textured face; ½-inch depth; interlocking male-female side lap; and utilize concealed stainless steel fasteners.
- D. Attached to metal supports with stainless steel screws as required per the design calculations.
- E. Soffits with vents shall be continuous perforated type to get maximum ventilation in the attic space.

2.10 LIGHT GAUGE METAL FRAMING

- A. All light gauge metal framing supporting roof panels, wall panels, ceiling panels and soffit panels shall be designed, furnished and installed by the architectural metal roofer.
- B. Light gauge metal framing shall include clips, purlins, C-channels, metal studs, metal track, hat channels, angles, anchors, fasteners and other items as required for a complete system.
- C. Metal studs and track shall be 20 gauge minimum, galvanized.
- D. All other members shall be 16 gauge minimum, galvanized, unless noted otherwise.

2.11 VAPOR BARRIER (underlayment)

A. Vapor Barrier shall be 30# roofing paper or as required by roof manufacturer.

2.12 METAL DECKING (sheathing)

- A. Metal decking shall be installed attached to the roof trusses.
- B. Decking shall be corrugated and a minimum 20 gauge thickness or as required by the design of the roof manufacturer.
- C. Sheet steel shall conform to ASTM A653 Structural Quality grade 33.
- D. Galvanizing shall conform to ASTM A924 with a minimum coating class of G90 as defined in ASTM A653.
- E. Decking shall be fastened to the trusses with stainless steel fasteners as required by the design of the roof manufacturer.

2.13 INSULATION BOARD

A. Insulation board shall be 1.5 inches thick rigid poly-iso core board.

2.14 GUTTERS AND DOWNSPOUTS

- A. Provide gutters and downspouts as shown on the Contract Drawings.
- B. Gutters shall be 6 inches by 6 inches and shall be 24-gauge galvanized steel with Kynar finish to match roof panel color chosen by the Owner.
- C. Gutters shall be properly secured on maximum 30-inch centers.
- D. Provide gutter end closures and seal watertight with sealant.
- E. Gutters shall be one piece, if possible. If not, sections shall be as long as possible to

- minimize joints. Join sections with riveted and soldered or lapped and sealed joints.
- F. Downspouts shall be 4 inches by 5 inches and shall be 24 gauge galvanized steel with Kynar finish to match roof panel color chosen by the Owner.
- G. Downsport supports shall be installed on a maximum of 10 foot centers. Provide a minimum of 3 supports per downsport run.
- H. Downspouts shall be configured per the SMACNA Figure 1-32B.
- I. Downspout hanger design shall be configured per the SMACNA Figure 1-35A.
- J. Join downspout sections with 1-1/2 inch telescoping joints. Provide fasteners to hold downspouts securely 1 inch away from walls.
- K. Include elbows at base of downspouts to direct water away from building.
- L. Furnish and install concrete 12" wide x 30" long splash block at the base of each downspouts.

2.15 RIDGE VENT

- A. Ridge vent shall be continuous along the ridge.
- B. Ridge vent shall be designed to get the maximum ventilation in the attic space.
- C. Ridge vent shall be Cor-A-Vent or equal.

2.16 SNOW GUARDS

- A. Provide metal snow guards on the roof panels.
- B. Install snow guards with screws and sealants as recommended by the roof manufacturer.
- C. Snow guards shall be a color as selected by the Owner. Provide six color copies of the color charts.

PART 3 EXECUTION

3.3 ERECTION

- A. Comply with manufacturer's standard instructions and conform to standards set forth in the Architectural Sheet Metal Manual published by SMACNA, in order to achieve a watertight installation.
- B. Install panels in such a manner that horizontal lines are true and level and vertical lines are plumb.
- C. Install starter and edge trim before installing roof panels if required by roof manufacturer.
- D. Remove protective strippable film prior to installation of roof panels.
- E. All trim, flashings and closures to be fabricated from the same material, finish and color as its adjacent metal panels.
- F. The lengths of all metal roofing panels and the sizes of its trim and flashings shall be manufactured based on actual field verified dimensions.
- G. Erection Tolerances: Shim and align metal roof panel units within installed tolerance of \(^{1}\)4

- inch in 20 feet on slope and location lines as indicated within 1/8 inch offset of adjoining faces and alignment of matching profiles.
- H. Remove and replace panels where inspections indicate that they do not comply with specified requirements or unsatisfactory to the Owner.
- I. Additional inspections, at the Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- J. Attach panels using manufacturer's standard clips and fasteners, spaced in accordance with approved shop drawings.
- K. Install sealant for preformed roofing panels as approved on shop drawings.
- L. Do not allow panels or trim to come into contact with dissimilar materials.
- M. Do not allow traffic on completed roof. If required, provide cushioned walk boards.
- N. Protect installed panels and trim from damage caused by adjacent construction until completion of installation.
- O. Remove and replace any panels or components which are damaged beyond successful repair.
- P. Applicator shall cut mortar joints in masonry and install step flashing as required.
- Q. Install soffit panels that are adjacent to fascias perpendicular to fascias.
- R. Joist or truss spacing shall be as determined by the joist or truss manufacturer except that the maximum spacing shall be 6 feet.

3.4 CERTIFICATION

A. The roof manufacturer shall make periodic inspections as required and conduct an inspection of the completely installed roofing system in order to provide a certificate to the Owner that the roofing system, including all components submitted in the shop drawings has been installed according to the Contract Documents, the manufacturer's design and all applicable codes. This certification will be required prior to providing the roof warranty.

3.5 CLEANING

- A. Clean any grease, finger marks or stains from the panels per manufacturer's recommendations.
- B. Maintain roof system in a clean condition during construction.
- C. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touch up or similar minor repair procedures.
- D. Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with the requirements of Section 01 70 00 of these Specifications.

SHEET METAL FLASHING AND TRIM

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

- A. The workmanship and methods employed for forming, anchoring, and cleating for the expansion and contraction of sheet metal work shall conform to applicable details and description as indicated in the current edition of the Architectural Sheet Metal Manual.
 - 1. This manual is published by the Sheet Metal and Air Conditioning Contractors National Association, Inc. and hereinafter referred to as "The SMACNA Manual", unless otherwise noted on the Contract Drawings or specified herein.

1.2 SCOPE

A. The work covered by this section consists of furnishing all materials and equipment and performing all labor necessary for furnishing and installing all sheet metal flashing and trim, and appurtenances as indicated on the Drawings, as specified, and as required for completion of all work under this Contract.

1.3 SUBMITTALS

A. Shop Drawings:

- 1. The Contractor shall furnish to the Owner for review (see Section 01 33 00 for number of copies required) drawings and details for metal fabrications and fasteners.
- 2. Details and layout shall show weight, gauge, or thickness of sheet metal, jointing, expansion joint spacing, and procedure to be followed during installation.
- 3. Indicate bolt size and spacing, nailers or blocking required for securing work of this section.
- 4. No fabrication, erection or installation of work shall commence until drawings and details covering such work have been reviewed by the Engineer.

B. Catalog Cuts:

1. Submit catalog cuts for standard manufactured items, for checking and approval by the Engineer.

1.4 Product Handling

A. Handling and Storage:

1. Sheet metal items shall be carefully handled to prevent damage to the surfaces, edges, and ends, and shall be stored at the site above ground in a covered dry location.

B. Replacement:

1. Damaged items that cannot be restored to like new condition shall be removed and replaced at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sheet Metal:

- 1. Type and Location:
 - a. The type and location of the various kinds, gauge, thickness and finish of sheet metal to be used is specified hereinafter under the individual items.
 - b. However, where sheet metal is indicated on Drawings and kind or type of metal is not definitely specified or noted, it shall be aluminum, size as specified in The SMACNA Manual for the particular function.

2. Aluminum Sheets:

- Aluminum sheets shall conform to ASTM B 209 gauge and finish specified for the item.
 - 1) Gauges:
 - a) The gauges for the following items are the minimum.
 - b) Where size of item requires heavier materials, gauge shall be in accordance with The SMACNA Manual.
 - (1) Exposed Flashing:
 - (a) Cap or counter 0.050".
 - (b) Base 0.050".
 - (c) Sill 0.050".
 - (2) Roof Trim:
 - (a) Fascia 0.050".
 - (b) Finishing edge strips 0.050".
 - (3) Roof Penetration Flashing:
 - (a) Equipment supporting caps 0.050".
 - (4) Conductor heads, downspouts and fasteners 0.050".

B. Accessories:

- 1. All accessories or other items essential to the completeness of the sheet metal installation, though not specifically shown or specified, shall be provided.
- 2. All such items shall be of the same material or compatible to the base material to which applied and the gauges shall conform to The SMACNA Manual recommendations.

C. Fasteners:

- 1. All nails, screws, bolts, rivets and other fastenings for sheet metal, unless otherwise noted, shall be Type 304 or 305 stainless steel, and of size and type suitable for the intended use.
- 2. Nails shall be minimum gauge, flat head annular-thread type, and of sufficient length to penetrate backing at least 3/4 inch.

D. Sealant:

1. Sealing and caulking materials shall conform to the JOINT SEALANTS Section 07 90 00.

PART 3 EXECUTION

3.1 Installation Of Sheet Metal

A. Condition of Surfaces:

1. Proper Surfaces:

- a. Surfaces to which sheet metal is applied shall be even smooth, sound, thoroughly clean and dry and free from projecting nail heads or other defects that would affect the application.
- b. Prior to the installation of sheet metal, defects in surfaces or materials shall be corrected by the trades involved.

2. Other Work:

a. Installation of other work that will be covered by or pass through sheet metal work shall be completed and approved before sheet metal work begins in that area.

B. Installation:

1. Workmanship:

- a. Fabricate and install sheet metal with lines, arises, and angles sharpened true, and plane surfaces free from waves, warps, or buckles.
- b. Exposed edges of sheet metal shall be folded back to form 1/2-inch wide hem on the side concealed from view.
- c. Finished work shall be free from water leakage under all weather conditions.

2. Expansion Joints:

- a. Provisions for expansion and contraction shall be provided in sheet metal work at intervals not exceeding thirty (30) feet or as recommended by the metal manufacturer.
- b. Where the continuous run of sheet metal exceeds the interval by more than 16 feet, an additional joint shall be provided.
- c. Where the run is less than the interval specified and more than 16 feet, one joint shall be provided at the center of the run.
- d. Joints shall be evenly spaced.
- e. Expansion and contraction joints shall be slip type, loose locked, and fabricated as indicated or in accordance with applicable details in The SMACNA Manual.

3. Sealing:

a. Except where other methods of jointing are indicated or specified, all joint seams and connections of sheet metal work shall be sealed.

4. Fastenings:

- a. Unless otherwise indicated or specified, all fastenings shall be concealed.
- b. Nails where used to attach sheet metal shall be spaced on 6-inch centers unless otherwise specified herein or approved.

5. Continuous Edge Strips:

- a. Provide continuous edge strips at eaves and other locations indicated for attaching exposed terminating edge of fascia and other sheet metal work.
- b. Fabricate edge strips from the same material and gauge as the units attached to, in lengths of 8 or 10 feet.
- c. Edge strips shall be not less than 2 inches wide.
- d. Set edge strips straight and true and secure in place with nails or screws of proper size and type.
- e. Space fasteners not more than 6 inches apart.

3.2 Fascia

A. Shape

1. Form fascia to sizes and details indicated from one-piece material of width and standard stock lengths not less than 8 feet long and not greater than 10 feet unless otherwise approved or noted.

SHEET METAL FLASHING AND TRIM

B. Corners:

1. Form corner sections by mitering and spot welding or riveting the flange and sealing with solder or sealant, or by a continuous weld on back side.

C. Jointing:

- 1. Unless otherwise indicated, the joints between the units shall be made with a 3/16" minimum expansion joint between sheets and 6 inch wide cover plates formed to exact profile of fascia
- 2. Fill space between plates with sealant and nail plates to wood nailer at the 3/16" expansion joint.

D. Fastening:

Extend flanges out on top not less than 3-1/2"; secure flange to wood nailers with No. 12 flat head, annular thread, stainless steel nails, 1" long, space nails 6" on center.

3.3 Cap and Counter Flashing

A. Shape and Locations:

- Provide cap and/or counter flashing in locations indicated on the Drawings or as required for proper execution of the work.
- 2. Form flashing in 8 or 10-foot lengths, except where shorter pieces are required.

B. Jointing:

- 1. Lap end joints a minimum of 3".
- 2. Do not solder or weld joints.
- 3. Stagger joints with relation to base flashing joints.
- 4. Make flashing continuous at angles.

C. Width:

- 1. Cap and counter flashing shall overlap base flashing a minimum of 4".
- 2. Bottom edge of flashing shall be folded back 1/2" on underside.

3.4 Miscellaneous Flashing

A. Location:

1. Provide where indicated or required for the proper execution of the work.

B. Forming:

 The forming and installation of flashing shall be as indicated on the Drawings and as required by applicable portion of The SMACNA Manual as referred to under "PRODUCTS".

SECTION 07 65 00

WALL FLASHING

PART 1 GENERAL

1.1 SUMMARY

A. The work covered by this section consists of furnishing all materials and equipment and performing all labor necessary for furnishing and installing all wall flashing as indicated on the Drawings, as specified, and as required for completion of all work under this Contract.

1.2 QUALITY ASSURANCE

- A. Qualifications of Manufacturers: For purposes of designating type and quality of the work under this Section, Drawings and Specifications are based on products manufactured or furnished by the manufacturers listed herein below.
- B. Single Source: Products for use on this project shall be of one manufacturer unless specified otherwise herein.

1.3 SUBMITTALS

A. Submit manufacturer's technical specifications, application instructions and material safety data sheet per the requirements of these specifications.

1.4 MATERIAL HANDLING

- A. Delivery: Materials shall be delivered to the project site in manufacturer's original, unopened containers with manufacturer's brand name clearly marked thereon.
- B. Storing: Store containers of mastic, primer, and adhesive on end on wood or other clean, rigid pad to prevent adherence of foreign material. Roll goods shall be stored on end in unopened packages. Cover and protect from weather and moisture.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Fabric Wall Flashing: Fabric flashing shall be fabric-covered copper flashing; Copper Armored Sisalkraft as manufactured by Sisalkraft Division, St. Regis Paper Company, AFCO Copper Fabric as manufactured by AFCO Products, Inc., or equal.
- B. Copper: Copper shall be 2 ounces per square foot.
- C. Covering: Covering shall be asphalt impregnated fiberglass fabric.

WALL FLASHING

D. Mastic:

- 1. Trowel Mastic: Trowel mastic shall be Carey Flashing Cement or Grace Bituthene Mastic.
- 2. Asphalt Primer: Asphalt primer shall be cut-back solvent type conforming to ASTM D 41.
- E. Joint Mastic: Mastic for sealing joints in membrane shall be brush applied. Type shall be as recommended by membrane manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Environmental Conditions: No fabric shall be applied in wet weather, nor when the threat of rain exists within 12 hours, unless fabric can be covered before rain.
- B. Inspection: Before beginning work, Contractor shall inspect surfaces to receive the wall flashing specified. He shall have trades involved correct any serious defects or conditions that will interfere with, or prevent, a satisfactory installation. Installation of other work passing through or concealed by wall flashing shall be complete and approved before starting work.

C. Installation:

- 1. Locations: Wall flashing shall be installed under masonry sills, over lintels in exterior walls, and as indicated on the Drawings.
- 2. Priming: Concrete and masonry surfaces shall be primed with asphalt primer prior to receiving any trowel mastic.
- 3. Bedding Fabric: Fabric shall be bedded in a coat of mastic 1/16" thick, troweled over all surfaces of concrete, masonry or steel to be treated.
- 4. Jointing and Embedment: Fabric shall be tightly pressed into center with mastic, without voids or air bubbles, and shall be bent sharply and fitted closely into re-entrant angles, so that masonry laid on complete treatment shall neither puncture the fabric nor disengage its upper edge from reglet or flashing receiver. Cross-joints in fabric shall be lapped 4" with lap bedded in mastic.
- 5. Lengths: Fabric flashing at floor lines, continuous lintels or sash angles, continuous sills, or other running members shall be continuous. Discontinuous treatment at sills and lintels of isolated openings shall extend 6" beyond jambs and turned up at ends to form a pan.
- 6. Width: Unless detailed otherwise, fabric shall extend substantially to outside face of wall and to within 1" of interior side of wall turning back 1/2" to form water stop.
- 7. Special Treatment: Where continuous treatments are pierced by columns, reinforcing angles formed of flashing shall be installed; they shall be sealed carefully to column faces and to fabric flashing both above and below treatment to insure water tightness.

D. Patching:

- 1. Holes: Holes shall be covered with flashing 4" in diameter larger than the hole, and set in and covered with mastic.
- 2. Tears: Tears shall be covered with 4" wide strip of flashing covered with mastic.

SECTION 07 90 00

SEALANTS AND CAULKING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes sealants and joint backing, precompressed foam sealers, hollow gaskets, and accessories.

1.2 SCOPE

A. The work covered by this section consists of furnishing all materials and equipment and performing all labor necessary for furnishing and installing all sealants and caulking as specified or shown on the Contract Drawings.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM C834 Standard Specification for Latex Sealants.
 - 2. ASTM C919 Standard Practice for Use of Sealants in Acoustical Applications.
 - 3. ASTM C920 Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM C1193 Standard Guide for Use of Joint Sealants.
 - 5. ASTM D1056 Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber
 - 6. ASTM D1667 Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
 - 7. ASTM D2628 Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- B. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1168 Adhesive and Sealant Applications.

1.4 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this section.

1.5 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Samples: Submit two samples, 6-inches in size illustrating sealant colors for selection.

- D. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.
- E. Warranty: Include coverage for installed sealants and accessories failing to achieve airtight seal, watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure. The Contractor shall furnish to the Owner for review (see Section 01 33 00 for number of copies required) Shop Drawings that include manufacture's literature and catalogue cuts of the products to be used and where each will be used.
- F. If requested by the Engineer samples of the materials to be used shall be submitted for approval. No installation of work shall commence until drawings and details covering such work have been reviewed by the Engineer.

G. Handling and Storing

- 1. Handling and storing shall be accomplished in a manner, which will prevent damage. Products shall be stored inside a building and off the floor.
- 2. Packages shall not be opened until they are in the area to be sealed and caulked.

H. Scheduling

- 1. Scheduling and coordinating of work specified in this Section with that specified in other Sections shall be the responsibility of the Contractor.
- 2. Delivery of products shall coincide with the construction schedule to eliminate long term storage.
- 3. Painting shall be completed before sealants are installed.
- 4. Sealant manufacturer shall advise if sealant will adhere to painted surfaces.

I. Identifying

1. Wrapping, marking and shipping shall be accomplished in a manner, which will prevent damage and clearly identify the products.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements.
- B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with sections referencing this section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sealant:

- 1. The Owner shall select all colors for the Sealant.
- 2. Sealant shall be of the types described below for their respective applications:
 - a. Joints in Vertical Surfaces above grade:
 - 1) Sealant for joints in vertical surfaces above grade shall be Sikaflex 1a, Sonneborn NP-1, or equal.
 - b. Joints in Horizontal Surfaces above grade:
 - 1) Sealant for joints in horizontal surfaces above grade shall be Sikaflex-15LM SL Grade, or equal.
 - c. Horizontal Joints Submerged:
 - 1) Sealant for submerged joints in horizontal surfaces shall be polyurea as furnished by Barton Southern, Sikaflex 1a with primer, Sonolastic Two Part with primer or equal.
 - d. Vertical Submerged Joints:
 - 1) Sealant for vertical submerged joints shall be Sikaflex 1a with primer, Sonolastic Two Part with primer or equal.
 - e. Horizontal Overhead Joints with High Humidity:
 - 1) Sealant for overhead joints shall be Sikaflex 1a, Sonneborn NP 1 or equal.
 - f. Horizontal Overhead Joints For Dry Building:
 - 1) Sealant for overhead joints shall be Sikaflex 1a, Sonneborn NP 1 or equal.
 - g. Vertical Joints Below Grade:
 - 1) Sealant for vertical joints below grade shall be Sikaflex 1a, Sonneborn NP 1 or equal.
 - h. Horizontal Joints Below Grade:
 - 1) Sealant for horizontal joints below grade shall be Sikaflex 1a, Sonneborn NP 1 or equal.
 - i. Joints in Harsh Environments (Chlorine over 2ppm, acid containment, and etc.):
 - 1) Sealant for Joints in Areas of Harsh Environment shall be Pelseal 2077, Sikadur Combiflex, or equal.
 - j. Joints larger than ³/₄ of an inch:
 - Sealant for joints larger than ³/₄ inch shall be Sikadur Combiflex, or Sonneborn NP-2, or equal.

B. Caulking:

1. Caulking shall be non-absorbent, non-staining, and non-petroleum based material of the type recommended by the caulking manufacturer.

C. Masking Tape:

- 1. Masking tape, primer, and bond breaker shall be of the type recommended by the sealant manufacturer.
- D. Joint Packing:

- 1. Joint packing shall be installed in all joints to receive sealant.
- 2. Packing shall be sized to require 20% to 50% compression upon insertion and shall be a synthetic material that will not react with sealant and shall be non-oily.
- 3. Use no asphalt or bitumen-impregnated fiber with sealants or the surfaces to which they will adhere
- 4. Packing characteristics shall conform to the additional requirements at the following conditions:
 - a. Non-traffic Packing:
 - 1) Closed-cell expanded polyethylene cord or square rod conforming to ASTM D1752, or closed-cell vinyl conforming to ASTM D1667, Grade VE-41.
 - b. Traffic Packing:
 - 1) Closed-cell neoprene chord or square rod conforming to ASTM C509-T with a minimum shore "A" hardness of 45.

E. Color:

1. Color(s) of all sealants and caulking shall be as selected by the Owner.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify substrate surfaces and joint openings are ready to receive work.
- C. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

A. Joint Depth:

- 1. Joint depth shall be ½ the joint width.
- 2. Joint depth shall be controlled with backer rod.
- 3. No joint shall be more than $\frac{1}{2}$ " deep.
- 4. If the joint is more than 1" wide, contact manufacturer of material to be used for recommendations for depth of joint.

B. Primer:

- 1. Contractor shall follow manufacturer's recommendation concerning priming substrates before installing sealants.
- 2. All submerged joints to receive sealants shall be primed as per manufacturer's recommendation.

C. Preliminary Work:

- 1. Sealant and caulking products shall be inspected for damage.
- 2. Damaged products shall not be installed.
- 3. Joints in which the products will be placed shall be inspected for completeness.
- 4. Joints shall be dry, cured, free from loose material, and generally in a condition as described by the sealant and caulking manufacturer.

D. Precautions:

- 1. Sealant and caulking shall not be installed when the temperature of the surrounding air is colder than 40°F.
- 2. Do not touch masking tape to cleaned and/or primed joint surfaces.
- 3. Masking shall be removed immediately after the sealing is complete.
- 4. Do not saturate sealant with smoothing solvent.

3.3 Installation

A. Surface Preparation:

- 1. Surfaces shall be prepared and cleaned in accordance with the sealant and caulking manufacturer's printed instructions.
- 2. Surfaces to receive sealants and caulking shall exhibit no loose particles, grease, and dampness whether solid or liquid.
- 3. Remove all foreign matter impairing adhesion of sealant.
- 4. Concrete, plaster, and masonry surfaces shall show no laitance; metal surfaces shall exhibit no areas of oxidation; and wood surfaces shall show no splinters.
- 5. Perform preparation in accordance with ASTM C1193.
- 6. Protect elements surrounding Work of this section from damage or disfiguration.

B. Bond Breaker:

- 1. Install bond breaker where joint backing is not used.
- 2. Bond breaker shall be applied to the rear surface of joints that have no sealant or caulking.
- 3. Breaker shall totally cover the rear surface, and shall be applied in a manner that will prevent its flowing onto the sides of the joint.

C. Primer:

1. Primer shall be applied to those joint surfaces to which the sealant must adhere, and shall be allowed to become tack-free before the masking tape is applied.

D. Masking Tape:

- 1. Masking tape shall be applied along each side of the joint in a manner that will prevent the adhesive from touching the surface to receive the sealant.
- 2. The tape shall be removed after the sealant has been applied, and before the sealant's surface skin has started to form.

E. Sealant:

- 1. Perform installation in accordance with ASTM C1193.
- 2. Perform acoustical sealant application work in accordance with ASTM C919.
- 3. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- 4. Sealant shall be placed into the joint in a manner that will fill the joint completely as the work progresses, and shall form a uniformly smooth surface.
- 5. Gun and knife grade sealant, which cannot be made smooth surfaced during initial sealing, shall be made uniformly smooth with a tool moistened with water or solvent.
- 6. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- 7. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

SEALANTS AND CAULKING

- 8. Tool joints concave.
- F. Locations of Caulking:
 - 1. Caulking shall be installed where shown, and in voids where sealant is recommended by the caulking manufacturer.
 - 2. The space that will receive the caulking shall have dimensions no larger than the dimensions recommended by the caulking manufacturer.
 - 3. Caulking shall be placed in joint locations as follows:
- G. All joints and projections in structures to receive exterior special coatings shall be sealed with caulking approved by the special coatings manufacturer. Color shall match that of the coating.

3.4 CLEAN UP

- A. Smears, and other surface soiling, resulting from sealing and caulking operations shall be removed with cleaners in a manner recommended by the sealant and caulking manufacturer.
- B. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- C. Clean adjacent soiled surfaces.

3.5 PROTECTING PRODUCTS

- A. Protecting of products shall be the responsibility of the Contractor until the Owner has accepted the project.
- B. Damaged products shall be removed and replaced with new products by the Contractor at no additional expense to the Owner.
- C. Section 01 70 00 Execution and Closeout Requirements: Protecting installed construction.
- D. Protect sealants until cured.

OVERHEAD COILING DOORS

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. The Contractor shall furnish and install overhead coiling doors at the locations detailed on the drawings.
- B. The overhead coiling door shall be as manufactured by
 - 1. The Cookson Company.
 - 2. Cornell Iron Works
 - 3. The Overhead Door Corporation.
 - 4. Substitutions are allowed: Section 01 60 00 Product Requirements
- C. Furnished materials shall include all curtains, bottom bars, guides, brackets, hoods, operating mechanisms, hardware, seals and any special features for a complete and operating door system.

1.2 Quality Assurance

- A. Exterior rolling service doors shall be designed to withstand at least a twenty (20) pounds per square foot windload. Provide windlocks on doors over 8'1" wide.
- B. All rolling service doors shall be designed to a standard maximum of 25 cycles per day and an overall maximum of 50,000 operating cycles for the life of the door.

PART 2 PRODUCTS

2.1 Materials

- A. The door shall be type FC by the The Cookson Company, Inc with face of wall guides.
 - 1. Guides (Type No.1) shall be anchored to the masonry wall with proper size anchors, embedment depth and spacing according to the door manufacturer.

B. Curtain:

- 1. Slats: No. 6, 12 gauge, .80 aluminum.
- 2. Bottom Bar: Two 2x2x3/16 inch (50x50x4.8 mm) aluminum angles.
- 3. Fabricate interlocking sections with high strength malleable steel endlocks on alternate slats each secured with rivets. Provide windlocks as required to meet specified wind load.
- 4. Slat Finish:
 - a. Aluminum: Mill finish, or Clear anodized, or Bronze anodized. The finish shall be selected by the Owner and shall be chosen from the door manufacturer's custom color selection.
- 5. Curtain Configuration:
 - a. Standard Curtain configuration.
- 6. Bottom Bar Finish:

a. Aluminum: Mill finish, or Clear anodized, or Bronze anodized. The finish shall be selected by the Owner and shall be chosen from the door manufacturer's custom color selection.

C. Guides:

- 1. Fabricate with aluminum angles bolted together with 3/8" fasteners to form a channel for the curtain to travel.
- 2. The wall angle portion shall be continuous and fastened to the masonry structure with a minimum 1/2" fasteners on 36" centers.
- 3. Provide windlock bars of same material when windlocks are required to meet specified wind load.
- 4. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides.
- 5. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.
- Finish
 - a. Aluminum: Mill finish, or Clear anodized, or Bronze anodized. The finish shall be selected by the Owner and shall be chosen from the door manufacturer's custom color selection.
- 7. Guide Configuration:
 - a. Standard Guide Configuration.

D. Counterbalance Shaft Assembly:

- 1. Barrel:
 - a. Steel pipe of not less than 4" in diameter capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.
 - b. The finish on the barrel shall be one (1) coat of bronze rust-inhibiting prime paint.
- 2. Spring Balance:
 - a. Oil-tempered torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 30 lbs.
 - b. Provide wheel for applying and adjusting spring torque.

E. Brackets:

- 1. Fabricate from minimum 1/4 inch steel plate and shall be bolted to the wall angle with minimum 1/2" fasteners.
- 2. Finish:
 - a. Steel: Factory applied thermosetting powder coat.
 - b. The finish shall be the same Cookson ColorCote finish as indicated in the curtain section.

F. Hood:

- 1. 0.040 inch aluminum with reinforced top and bottom edges.
- 2. Provide minimum 1/4 inch steel intermediate support brackets as required to prevent excessive sag.
- 3. Finish:
 - a. Aluminum: Mill finish, or Clear anodized, or Bronze anodized. The finish shall be selected by the Owner and shall be chosen from the door manufacturer's custom color selection.

G. Weatherstripping:

- 1. Bottom Bar:
 - a. Replaceable, bulb-style, compressible EDPM gasket extending into guides.
- 2. Guides:
 - a. Vinyl strip sealing against fascia side of curtain.
- 3. Hood:
 - a. Neoprene/rayon baffle to impede air flow above coil.
- 4. Lintel Seal:
 - a. Nylon brush seal fitted at door header to impede air flow.

2.2 Operation

A. Primary Electrical Control

- 1. Supply Cookson Model SG Electric Motor Operator, continuous duty, UL listed, Totally Enclosed Fan Cooled gear head operator(s) rated (1/2) to (7 1/2) hp as recommended by door manufacture for size and type of door, 480 Volts, 3 Phase.
- 2. Provide complete with electric motor and factory pre-wired motor control terminals, maintenance free solenoid actuated brake, emergency manual chain hoist provided up to 2 hp and control station(s).
- 3. Motor shall be high starting torque, industrial type, with overload protection. Primary speed reduction shall be heavy-duty gears running in grease or oil bath with mechanical braking to hold the door in any position.
- 4. The emergency manual chain hoist assembly shall automatically disengage when motor is energized.
- 5. A disconnect chain shall not be required to engage or release the manual chain hoist.
- 6. Operator drive and door driven sprockets shall be provided with minimum #50 roller chain.
- 7. Operator shall be capable of driving the door at a speed of 8 to 9 inches per second (20 to 23 cm/sec).
- 8. Fully adjustable, driven linear screw type cam limit switch mechanism shall synchronize the operator with the door.
- 9. The motor shall be removable without affecting the limit switch settings.
- 10. The contractor shall mount the control station(s) and supply the appropriate disconnect switch, all conduit and wiring per the overhead door wiring instructions.

B. Control Station

- 1. Surface mounted, "Open/Close/Stop," push buttons with keyed lock-out, not masterkeyable; NEMA 4X
- C. Entrapment Protection: Provide the following primary entrapment protection device to enable momentary contact close operation
 - 1. Provide a continuously monitored, wireless sensing edge / weather edge seal extending the full width of door bottom bar. Contact before door fully closes shall cause door to immediately stop downward travel and reverse direction to the fully opened position

D. Back-up Manual Control

OVERHEAD COILING DOORS

- 1. Provide Manual Chain Hoist as backup: Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide
- 2. Provide chain of sufficient length to operate the door.
- 3. Chain shall extend down to within three (3) feet of the floor.
- 4. Provide a means to hold the chain against the wall during normal use.

2.3 Accessories

A. Locking:

1. Masterkeyable cylinder operable from both sides]of bottom bar. Provide interlock switches on motor operated units.

B. Operator and Bracket Mechanism Cover:

- 1. Provide c sheet metal cover to provide weather resistances and to enclose exposed moving operating components at coil area of the unit.
- 2. Finish to match door hood.

PART 3 EXECUTION

3.1 Examination

A. Examine substrates upon which work will be installed and verify conditions are in accordance with Contract Drawings and approved shop drawings.

3.2 Installation

A. All coiling service doors shall be installed, checked out and started by an authorized and certified technician of the manufacturer.

B. General:

- Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports
- C. Follow manufacturer's installation instructions.

D. Adjusting

1. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion.

E. Cleaning

- 1. Clean surfaces soiled by work as recommended by manufacturer.
- 2. Remove surplus materials and debris from the site.

F. Demonstration

- 1. Demonstrate proper operation to Owner's Representative.
- 2. Instruct Owner's Representative in maintenance procedures.

OVERHEAD COILING DOORS

3.3 Warranty

A. All rolling service doors shall be warranted against defects in workmanship and materials for a period of 2 years.

SECTION 08 41 13

ALUMINUM ENTRANCE DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. The Contractor shall furnish and install the aluminum entrance rated exterior doors at the locations detailed on the Contract Drawings.
- B. The door schedule is included on the Contract Drawings.
- C. The doors shall be installed complete with hardware as specified herein and as shown on the Contract Drawings.
- D. All doors shall be insulated.
- E. All doors shall have a 10-inch x 10-inch lite.
- F. The finish, texture and colors on all doors shall be as selected by the Owner.
- G. Doors shall be keyed to match the Owner's keying system. A key will be made available to insure that the correct cylinder is ordered.

1.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed window system shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Aluminum-Framed Entrance Performance Requirements:
 - 1. Design Wind Loads for Exterior Doors:
 - a. Determine design wind loads applicable to the Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - 1) Basic Wind Speed: 120 MPH
 - 2) Importance Factor: III
 - 3) Exposure Category: C
 - 2. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283.
 - 3. Uniform Load: The test specimen shall be tested in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
 - 4. Thermal Transmittance (U-factor): When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than:
 - a. Aluminum-Framed Flush Entrance Doors with glass lites 0.48.

- 5. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than:
 - Aluminum-Framed Flush Entrance Doors with glass liltes CRF(frame) 48, CRF(glass) 55.
- 6. Indoor Air Quality (IAQ): When tested to ASTM D 6670, achieves GREENGUARD environmental institute certification including GREENGUARD for Children and School Certification

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, and fabrication methods, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum-framed flush entrance doors indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.
- C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.
- D. Samples for Verification: For aluminum-framed flush entrance doors and components required.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, class, grade, and size of aluminum-framed flush entrance doors. Test results based on use of downsized test units will not be accepted.
- F. Warranty: Special warranty specified in this Section.
- G. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed flush entrance doors, made from minimum 8" (203 mm) lengths of full-size components and showing details of the following:
 - 1. Joinery, including welds.
 - 2. Anchorage.
 - 3. Glazing.

H. Other Action Submittals:

 Aluminum-Framed Flush Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.

- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum-framed flush entrance doors and storefronts that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports and calculations.
- C. Source Limitations: Obtain aluminum-framed flush entrance doors through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum-framed flush entrance doors and are based on the specific system indicated.
 - 1. Do not modify size and dimensional requirements.
 - 2. Do not modify intended aesthetic effects, as judged solely by Engineer and Owner. If modifications are proposed, submit comprehensive explanatory data to Engineer for review.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings

1.6 DELIVERY, STORAGE AND HANDLING

A. Store windows in accordance with manufacturer's recommendations.

1.7 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
 - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product
 - 1. Kawneer Company Inc.
 - 2. The door stile and rail face dimensions of the Flushline® entrance door will be as follows
 - a. Door: Flushline
 - b. Vertical Stile: 2-7/16"
 - c. Top Rail: 2-5/16"
 - d. Bottom Rail: 2-5/16"
 - 3. The door face sheet shall be 5005 alloy aluminum sheet 0.062" thick embossed, vertical ribbed or plain unpatterned.
 - a. Provide samples of each type for Owner to select face sheet type.
 - 4. Vision Lites, if required, shall be aluminum framed vision lite
 - 5. Glass for vision lites shall be 1" insulated clear tempered glass
 - 6. Major portions of the door members to be 0.125" nominal in thickness and glazing molding to be 0.05" thick
 - 7. Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer

B. Finishes:

- Exposed surfaces of aluminum storefront members shall have an architectural Class 1 hard coat color finish conforming to Aluminum Association Standard finishes as scheduled below.
- 2. All finish thicknesses shall be 0.007-inch minimum.
- 3. Color shall be as selected by Owner.

| COLOR | ALUMINUM ASSOCIATION NO. | KAWNEER DESIGNATION |
|-----------------|-----------------------------|------------------------|
| Clear | AA-M12C22A41 | 14 Anodized |
| Light Bronze | AA-M12C22A44 | 26 Permanodic |
| Medium Bronze | AA-M12C22A44 | 28 Permanodic |
| Dark Bronze | AA-M12C22A44 | 40 Permanodic |
| Statuary Bronze | AA-M12C22A44 | 42 Permanodic |
| Black | AA-M12C22A44 | 29 Permanodic |

2.2 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum-framed flush entrance doors manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.090" wall thickness at any location for the main frame and sash members.
- B. Aluminum-Framed Flush Entrance Door Core: Shall be froth-in-place urethane foam at 5.0 lb./cu.ft. density, R-value: minimum 9; U-value = 0.11 and shall have "0" O.D.P. = "Zero" Ozone Depletion Potential and contains no Chlorofluorocarbons (CFC's) or Hydrochlorofluorocarbons (HCFC's).
- C. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum-framed flush entrance door members, trim hardware, anchors, and other components.
- D. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- E. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated

2.3 STOREFRONT FRAMING SYSTEM

A. Storefront Entrance Framing Thermal (Trifab® 451T or Trifab® 451UT):

- 1. Thermally Broken Entrance Framing Kawneer IsoLock® Thermal Break with a 1/4" (6.4 mm) separation consisting of a two-part chemically curing, high-density urethane, which is mechanically and adhesively joined to aluminum storefront sections.
 - a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.
- B. Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- E. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- F. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.4 GLAZING

- A. Glass and Glazing Materials: Refer to Specifications Section 08 80 00 GLAZING for glass units and glazing requirements applicable to glazed aluminum window units.
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type

2.5 Finish Hardware:

- A. General Work Included:
 - 1. Hardware for interior and exterior doors;
 - 2. Thresholds; and
 - 3. Weatherstripping for exterior doors.

B. Quality Assurance:

- 1. The company furnishing hardware under this section shall be regularly engaged in the sale and distribution of finish hardware for commercial aluminum door projects and if not established and known in the area may be required to post bond to insure performance.
- 2. Manufacturers of hardware furnished, if different from those specified in the Acceptable Manufacturers sub-paragraph of this Paragraph, may be required to post bond to insure performance.

- 3. The person responsible for scheduling, detailing, ordering and coordinating hardware for this project shall be an experienced hardware consultant. Consultant membership in the Door and Hardware Institute is acceptable as indication of required experience.
- 4. Hardware furnished shall comply with the requirements of the Standards and Codes listed in the References sub-paragraph of this Paragraph.
- 5. Standards:

| a. | BUMA 1301-1982 | Materials and Finishes | |
|----|---|--|--|
| b. | ANSI A156.1-1981 | Butts and Hinges | |
| c. | ANSI A156.2-1976 | Locks and Lock Trim | |
| d. | ANSI A156.3-1978 | Exit Devices | |
| e. | ANSI A156.4-1980 | Door Controls (Closers) | |
| f. | ANSI A156.5-1978 | Auxiliary Locks and Associated Products | |
| g. | ANSI A156.6-1979 | Architectural Door Trim | |
| h. | ANSI A156.7-1981 | Template Hinge Dimensions | |
| i. | ANSI A156.8-1982 | Door Controls (Overhead Holders) | |
| j. | ANSI A156.15-1981 | Closer Holder Release Devices | |
| k. | ANSI A156.17-1981 | Self-Closing Hinges and Pivots | |
| 1. | ANSI A115.1-1982 | Standard Steel Door and Frame Preparations for Mortise | |
| | Locks | | |
| m. | ANSI A117.1-1980 | Specification for Making Buildings and Facilities | |
| | Accessible to and Usable by Physically Handicapped People | | |

6. Codes:

- a. ANSI/NFPA 101-1981 Life Safety Code
- b. International Building Code,

7. Submittals:

- a. Specification:
 - Within thirty days of award of purchase order, submit to the Engineer for review a complete vertical format hardware specification. Furnish six (6) copies of complete submittal.
 - 2) Schedule and Details:
 - Submittal shall include manufacturer's name, type, finish and location for each item.
 - b) Title page shall indicate Project, Engineer, Owner, and Contractor and shall include address and phone number of each.
 - c) There shall also be included a table of contents, glossary of terms, abbreviations, and symbols used in the Hardware Schedule.
 - d) Also include a cross reference of all product numbers used within the Schedule that deviate from those specified.
 - e) Column 1 shall state specified item and manufacturer and Column 2 shall state prior approved substitute item and its manufacturer.
 - f) Mounting heights for all items of hardware and hands of doors shall be included in the hardware schedule.

b. Samples:

- 1) Submit a sample of each item of hardware that differs from the specification herein.
- 2) If requested, supply a sample of each hardware item required to be retained by the Engineer for comparison with the hardware furnished on the project.
- 3) Samples will be returned in time for installation on the project.

ALUMINUM ENTRANCE DOORS

- 4) Tag samples for opening identification.
- c. Catalogue Data:
 - 1) Furnish six (6) copies of catalogue data of all products that differ from the requirements of these Specifications.
- d. Templates:
 - 1) After approval of hardware schedule, furnish templates to other trades who have hardware applied to their products.
 - 2) All templates shall be clearly marked as to their respective heading number and shall give full information with regard to fasteners, dimensions and other pertinent details affecting their installation and operation.
- e. Delivery, Storing and Handling:
 - 1) Delivery:
 - a) Hardware shall be delivered to the job site in the manufacturers' original packages.
 - b) Each item shall be clearly marked with the opening number and hardware heading to identify correct location.
- f. Storing:
 - 1) Locked storage space complete with shelving for unpacking crates and sorting out hardware shall be furnished.
 - 2) The space shall be maintained clean and dry for protection of hardware.
- g. Sequencing and Scheduling:
 - 1) Work Coordination:
 - a) Coordinate hardware with related trades such as entrance, steel and wood doors, frames, millwork, electrical, etc.
- h. Delivery Scheduling:
 - a) Hardware shall be ordered so that it will be available on time for job requirements.

C. Warranties:

- 1. All hardware items, except door closers, shall be guaranteed for a period of one year from final acceptance of the project.
- 2. Door closers shall guaranteed for a period of five year from final acceptance of the project.
- D. Acceptable Manufacturers:
 - 1. A specified manufacturer is shown for each hardware item to establish a standard of quality and minimum functional requirements.
 - 2. The product numbers of these manufacturers are found in the hardware schedule.
 - 3. Approved manufacturers designate manufacturers whose products may be acceptable on the project, if in the opinion of the Engineer the products meet the intent of the specifications in terms of design, function, material and quality of workmanship.
 - 4. Hinges:
 - a. All ball bearing hinges shall be equipped with non-rising alloy stainless steel pins. Furnish non-removable pins on all outswing exterior doors and where noted "NRP" in the hardware sets. Unless otherwise indicated, hinge size shall be 4-1/2" x 4-1/2".
 - b. Specified manufacturer:
 - 1) Lawrence
 - 2) Acceptable alternate manufacturers: Hager, McKinney, Stanley

- 5. Locksets, Latches and Deadbolts:
 - a. Specified manufacturer:
 - 1) Corbin/Russwin (Non-Ferrous Parts)
 - 2) Acceptable alternate manufacturers: Sargent, Schlage.
 - 3) The lockset shall have a lock cylinder to match the Owner's keying system. First determine Owner's key and keying system before preparing submittal.
- 6. Continuous Gear Hinges:
 - a. The specified manufacturer is Rotan.
 - b. Substitutions: Section 01 60 00 Product Requirements
- 7. Door Closers:
 - a. The specified manufacturer is LCN Closer.
 - b. Substitutions: Section 01 60 00 Product Requirements
- 8. Pushes, Pulls, Stops, Plates, Trim, Flush Bolts, and Cane Bolts:
 - a. Kickplates, mop plates, and armor plates shall be furnished 8", 4" and 36" high, respectively, and 2" less than door width when applied to the push side of the door and 1" less than door width when applied to the pull side of the door or to pairs of doors.
 - b. Specified manufacturer:
 - 1) Quality Hardware
 - 2) Acceptable alternate manufacturers: Baldwin, Burns, Ives
- 9. Overhead Stops and Holders:
 - a. Specified manufacturer:
 - 1) Glynn Johnson
 - b. Acceptable alternate manufacturers: Corbin/Russwin, Sargent
- 10. Weatherstrip, Threshold, Astragal and Soundseal:
 - a. Specified manufacturer:
 - 1) National Guard Products
 - b. Acceptable alternate manufacturers: Pemko, Zero
- 11. Silencers:
 - a. Supply three silencers for single opening and two silencers for double openings.
 - b. Specified manufacturer:
 - 1) Quality Hardware
 - c. Acceptable alternate manufacturers: Ives, Glynn Johnson
- 12. Storefront Entry Door Locksets:
 - a. Specified manufacturer:
 - 1) Adams Rite
 - b. Acceptable alternate manufacturers:
 - 1) ASSA "Halt"
- 13. Footbolts and Chainbolts:
 - a. Specified manufacturer:
 - 1) Lawrence Brothers
 - b. Acceptable alternate manufacturers:
 - 1) Stanley, Hager.
- 14. Crossbar Exit Devices:
 - a. Aluminum Storefront Doors:
 - 1) Pairs of Doors
 - a) Specified manufacturer is Kawneer Panic Guard (concealed rod device for pairs of doors).
 - 2) Single Doors

- a) Specified manufacturer is Door-O-Matic (concealed rod device).
- 15. Other Storefront Entry Hardware:
 - a. By storefront entry manufacturer and as scheduled.

E. Single Source:

1. All items of a particular hardware category (e.g., hinges, locksets, and closers) shall be of the same manufacturer.

F. Keying:

- 1. Final keying requirements shall be coordinated with the Owner and Engineer.
- 2. Keys:
 - a. Integrate keying the new doors into the existing key system.
 - b. Stamp all keys and key blanks with "Do Not Duplicate" and with the room number.
 - c. All new door cylinders shall match the Owner's key system.
- 3. Construction Master Keys:
 - a. All locksets shall be controlled by a Construction Master Key System during the construction period.
 - b. A total of two (2) construction master keys shall be furnished to the Owner.
 - c. Construction master key system shall be voided at the project completion.
- 4. Supplied Key Requirements:
 - a. Furnish two (2) change keys for each lock cylinder and three (3) master keys.
- 5. Final Keying Requirements:
 - a. Final keying requirements shall be coordinated with the Owner.

2.6 Material and Finishes:

- A. Hinges:
 - 1. Provide samples for Owner to select.
- B. Continuous hinges:
 - 1. Provide samples for Owner to select.
- C. Locksets:
 - 1. Provide samples for Owner to select.
- D. Door closers:
 - 1. Provide samples for Owner to select.
- E. Overhead stops/holders:
 - 1. Provide samples for Owner to select
- F. Storefront entry door hardware:
 - 1. Unless otherwise scheduled or noted, hardware finish and color shall match that of storefront or as select by Owner.
- 2.7 Inspection Prior to Hardware Installation:
 - A. Condition of opening size shall be verified as door frames being plumb and of correct tolerance to receive doors and hardware.

B. Hardware Installation:

- 1. All hardware shall be installed by carpenter mechanics skilled in the application of institutional grade hardware.
- 2. Installation shall be in accordance with the approved hardware schedule.

C. Adjusting:

- 1. Correct Operation:
 - a. Hardware shall be adjusted for correct operation.
 - b. Coordinate correction prior to date of satisfactory completion of the project.
 - c. After installation of hardware and before the building is accepted, inspect the installation and certify that the hardware is correctly installed in accordance with the manufacturer's recommendations.
 - d. If doors are to be field painted or finished, hardware shall be protected after the hardware is certified for correct installation.

D. Lock and Cylinder Inspection:

- 1. After installation of all hardware and before acceptance of the building, check each locked door against the key schedule to make certain that correct locks and cylinders are on proper doors.
- 2. Any incorrectly located cylinder shall be tagged and relocated to proper location.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight installation.
 - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 - 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
 - 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed flush entrance doors, hardware, accessories, and other components.
- B. Install aluminum-framed flush entrance doors level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

ALUMINUM ENTRANCE DOORS

- C. Set sill threshold in bed of sealant, as indicated, for weather tight construction.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean aluminum surfaces immediately after installing aluminum-framed flush entrance doors and storefronts. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period

SECTION 08 51 13.11

FIXED ALUMINUM WINDOWS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes Aluminum Windows including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of window units.
 - 1. Types of aluminum windows include:
 - a. Kawneer Series AATM6400/6500/6600 Windows (or approved equal)
 - b. 5" AATM6400 frame depth,
 - c. AW-PG70-FW
 - 2. Locations or Rooms
 - a. See contract drawings for required fixed aluminum window locations.

1.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed window system shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Design Wind Loads for Exterior Windows:
 - a. Determine design wind loads applicable to the Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - 1) Basic Wind Speed: 120 MPH
 - 2) Importance Factor: III
 - 3) Exposure Category: C
- B. Window Framing System Performance Requirements:
 - 1. Provide aluminum windows of performance indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS).
 - a. Performance Class and Grade: AW-PG70-FW
 - 2. 2. Wind loads:
 - a. Provide window system; include anchorage, capable of withstanding wind load design pressures as determined using IBC 2012 for inward and outward pressures.
 - 3. Air Infiltration:
 - a. The test specimen shall be tested in accordance with ASTM E283 at a minimum size of 60" x 99" (1524 x 2515). Air infiltration rate shall not exceed 0.10 cfm/ft2 at a static air pressure differential of 6.24 psf (300 Pa). The test specimen shall meet the Fixed rating of less than 0.25 (m3/h)/m at 75 Pa when tested in accordance with CAN/CSA-A440-00 Windows.
 - 4. Water Resistance:
 - a. The test specimen shall be tested in accordance with ASTM E547 and ASTM E331 at a minimum size of 60" x 99" (1524 x 2515). There shall be no leakage as defined in the test method at a static air pressure differential of 15 psf (720 Pa). The test specimen shall meet the B7 rating with no water leakage at 15 psf (720 Pa) when tested in accordance with CAN/CSA-A440-00 Windows.
 - 5. Uniform Load Deflection:

- a. A minimum static air pressure difference of 70 psf (3352 Pa) shall be applied in the positive and negative direction in accordance with ASTM E330. There shall be no deflection in excess of L/175 of the span of any framing member. The test specimen shall meet the C5 rating when tested in accordance with CAN/CSA-A440-00 Windows.
- 6. Uniform Load Structural:
 - a. A minimum static air pressure difference of 105 psf (5028 Pa) shall be applied in the positive and negative direction in accordance with ASTM E330. The unit shall be evaluated after each load with permanent set not to exceed 0.2% of span length.
- 7. Component Testing:
 - a. Window components shall be tested in accordance with procedures described in AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS) and AAMA 910.
- 8. Thermal Transmittance (U-Factor):
 - a. When tested to AAMA Specification 1503, AAMA Specification 507 or NFRC 100 the thermal transmittance (U-Factor) shall not be more than;
 - 1" insulating glass: U-Factor not more than .31 BTU/hr/ft2/°F per AAMA 1503 with exterior 1/4" low-e glass, 1/2" Technoform TGI spacer, and interior 1/4" clear glass
- 9. Condensation Resistance Factor (CRF):
 - a. Provide aluminum windows tested for thermal performance according to AAMA 1503, with a CRF not less than 77 (frame) and 72 (glass).
- 10. Temperature Index (I):
 - a. Provide aluminum windows tested for thermal performance according to CSA-A440 with a Temperature Index (I) not less than 73 (frame) and 66 (glass) for AA6400 and 70 (frame) and 67 (glass) for AA6500.
- 11. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC):
 - a. When tested in accordance with AAMA Specification 1801, the STC and OITC shall not be less than;
 - 1) 1" insulating glass made with exterior 3/16" clear glass, 3/8" aluminum spacer, and interior 7/16" laminated clear glass:
 - a) STC not less than 38; OITC not less than 32.
- 12. Forced Entry Resistance: All windows shall conform to ASTM F588, Grade 10
- 13. Thermal Barrier Test: Thermal break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, operating instructions for each type of aluminum window indicated, and the manufacturer's installation instructions.
- C. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances and installation details.
- D. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.
- E. Samples for Verification: For aluminum windows and components required.
- F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. An installer which has had successful experiences with installation of the same or similar units required for this project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated.
 - 1. Do not modify size and dimensional requirements.
 - 2. Do not modify intended aesthetic effects, as judged solely by Engineer and Owner. If modifications are proposed, submit comprehensive explanatory data to Engineer for review.

E. Mockups:

- 1. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
- 2. Build mockup for type(s) of window(s) indicated, in location(s) shown on Drawings.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings

1.6 DELIVERY, STORAGE AND HANDLING

A. Store windows in accordance with manufacturer's recommendations.

1.7 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
 - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Kawneer Series AATM6400/6500/6600 Windows Fixed
- B. Substitutions: Section 01 60 00 Product Requirements.

2.2 MATERIALS

A. Aluminum Extrusions:

1. Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" (1.8) wall thickness at any location for the main frame and sash members.

B. Thermal Barrier:

1. The thermal barrier shall be Kawneer consisting of two parallel glass fiber-reinforced nylon strips installed continuously and mechanically bonded to the aluminum.

C. Fasteners:

 Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

D. Anchors, Clips, and Accessories:

1. Aluminum, nonmagnetic stainless steel; provide sufficient strength to withstand design pressure indicated.

E. Reinforcing Members:

 Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

F. Sealant:

 For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

2.3 GLAZING

- A. Glass and Glazing Materials: Refer to Specifications Section 08 80 00 GLAZING for glass units and glazing requirements applicable to glazed aluminum window units.
- B. Glazing System: Glazing method shall be a dry type in accordance with manufacturer's standards. Exterior glazing shall be TPE gasket. Interior glazing shall be snap-in type glazing beads with an interior TPE gasket in accordance with AAMA 702 or ASTM C864

2.4 HARDWARE

A. General: None required for fixed windows.

2.5 Accessories

A. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, non-migrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.

- B. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.
- C. Sealants and joint fillers for joints at perimeter of window system as specified in Division 7 Section "Joint Sealants".
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action
- E. Interior Trims: Extruded aluminum, 6063-T6 alloy and temper, extruded to profiles and details indicated.
 - 1. The interior face trim minimum wall thickness shall be 0.062" (1.57 mm).
 - 2. The face trim shall snap-fit onto concealed mounting clip. Exposed fasteners shall not be accepted.
 - 3. The mounting clip shall be extruded aluminum of 6063-T6 alloy and temper.
 - 4. The minimum wall thickness shall be 0.062" (1.57 mm).
 - 5. The trim clips shall be provided in 4" (101.6 mm) lengths and spaced a maximum of 18" (45,72 cm) center to center.
- F. Coupling Mullions: Shall be extruded aluminum of 6063-T6 alloy and temper of profile and dimensions indicated on drawings. Mullions shall provide structural properties to resist wind pressure required by performance criteria and standards

2.6 FABRICATION

- A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fit joints; make joints flush, hairline and weatherproof.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- B. Window Framing: Fabricate components for assembly using manufacture's standard installation instructions.
- C. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- D. Thermally Improved Construction: Fabricate aluminum window framing with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact. Thermal barriers shall be designed in accordance with AAMA TIR A8.
 - 1. Thermal Barrier: The thermal barrier shall be Kawneer consisting of two parallel glass fiber-reinforced nylon strips installed continuously and mechanically bonded to the aluminum.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Provide samples for color selection by Owner

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight window installation.
 - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris
 - 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
 - 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install aluminum framed window system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.
- D. Install aluminum framed window system and components to drain condensation, water penetrating joints, and moisture migrating within system to the exterior.
- E. Separate aluminum from dissimilar materials to prevent corrosion or electrolytic action at points of contact.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weather tight closure. Lubricate hardware and moving parts.
- B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

FIXED ALUMINUM WINDOWS

- C. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes Glass and glazing required throughout Project and not specified as a part of other Sections.
- B. Glass and glazing is specified with the following components. Unless otherwise noted, glass and glazing specified elsewhere shall conform to materials and glazing requirements and procedures specified in this Section.

1.2 REFERENCES

- A. "Glazing Manual" published by Flat Glass Marketing Assn.
- B. "Safety Standard for Architectural Glazing Materials (16 CFR 1201) CI and CII issued by the Consumer Product Safety Commission.
- C. ANSI Z 97.1, "Safety Glass Test Requirements".
- D. ASTM International.
 - 1. ASTM C864 Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
 - 2. ASTM C1036 Standard Specification for Flat Glass
 - 3. ASTM C1048 Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass
 - 4. ASTM E774 Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units. (This standard is withdrawn and no replacement has been issued).
- E. DD-G-1403.
- F. Sealed Insulating Glass Manufacturers Association (SIGMA) Recommendations.
- G. BAAQMD Regulation 8-51 Adhesive and Sealant Products

1.3 SYSTEM DESCRIPTION

- A. Install each piece of glass watertight and airtight. Each installation shall withstand local, normal temperature changes, wind loading, impact loading (for operating sash and doors) without failure of any kind, including loss or breakage of glass, failure of sealants or gaskets to remain watertight, deterioration of glazing materials, and other defects of work.
- B. Where no thickness of glass is given in the glass schedule, it shall be determined by glass manufacturer for the wind loads specified and/or determine using the applicable local building codes.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product Data: Manufacturer's product data, material safety data sheets, and specifications for installations indicated, listing specific materials proposed. Indicate completely, recommendations for use of primers, joint preparation and sealant dimensions, and shall state shelf life (from date of shipment by manufacturer to expiration date for use on a project) for the material. Provide necessary information required to translate batch number code into date of manufacture and to thereby determine the latest date of usage from manufacturer's shelf life requirements.

C. Samples:

- 1. Each glass type required, minimum size 12 by 12 inches (300 by 300 mm).
- 2. Each type of glazing material and available colors, and accessories.

D. Certifications:

- 1. Certification that all insulating units furnished comply with Class CBA of ASTM E774 and the performance specified.
- 2. Certification that all sealants are fully compatible with the surfaces and finishes with which they are in contact.
- E. Closeout Submittals: Material Safety Data: Sealant and adhesive quantity use for in accordance with requirements of BAAQMD Regulation 8-51.

F. LEED Submittals (If required):

1. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

- 1. An installer which has had successful experiences with installation of the same or similar units required for this project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain through one source from a single manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Package and deliver glass in manufacturer's sealed unopened containers, fully identified, and each pane clearly labeled with manufacturer's name and product designation.
- B. Protect glass from damage and store in accordance with manufacturer's recommendations. Keep handling to a minimum. Protect edges of laminated and insulated glass from damage.

C. Glazing Sealants:

1. Deliver sealants and related accessories to the job site in factory sealed, unopened containers bearing manufacturer's name, product designation and batch number.

- 2. Store in unopened containers. Follow manufacturer's recommendations for storage temperatures and shelf life (see "Submittals" above).
- 3. Follow manufacturer's recommendations for handling products containing toxic materials. Keep flammable material away from heat, sparks and open flame. Use recommended solvents and cleaning agents for cleaning tools, equipment and skin.

1.7 ENVIRONMENTAL CONDITIONS

A. Perform no glazing operations when ambient temperature is at or below 40 deg F.

1.8 WARRANTY

- A. Insulating Glass Units: Warrant for 10 years from date of acceptance of Project to be free from delamination and failure of seals and not to develop material obstruction of vision as a result of dust, moisture or film formation on internal glass surfaces.
- B. Low-E Glass: Warrant for 10 years from date of acceptance of Project to be free of peeling or other deterioration of the Low-E coating.
- C. Laminated Glass: Warrant for 10 years from date of acceptance of Project to be free from delamination and discoloration.
- D. Glazing Sealant:s Warrant for 10 years per sealant manufacturer's standard warranty of merchantable quality. Warranty shall certify that cured sealants:
 - 1. Will perform as a watertight weatherseal.
 - 2. Will not become brittle or crack due to weathering or normal expansion and contraction of adjacent surfaces.
 - 3. Will not harden beyond a Shore A durometer of 50, nor soften below a durometer of 10.
 - 4. Will not change color when used with compatible back-up materials.
 - 5. Will not bleed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. PPG Industries
- B. Pilkington
- C. Guardian Industries
- D. Ford Glass
- E. Hordis Brothers Inc.
- F. Substitutions: Section 01 60 00 Product Requirements.
- G. Provide all tinted and Low-E glass from the same manufacturer for the entire project

2.2 MATERIALS

- A. Glass types, thicknesses and fabricated assemblies are scheduled in the Glass Schedule included in PART 3. EXECUTION of this Section. Where no thickness is given, it shall be determined by glass manufacturer as specified in Article 1.04 System Description of this Section. Adjacent tinted and Low-E glass shall have the same light transmittance.
 - 1. Clear Annealed Float Glass: Clear float glass conforming to ASTM C 1036, Type I, Class 1, quality q3.
 - 2. Heat Strengthened Clear Float Glass: As specified for clear annealed float glass except heat strengthened to conform to ASTM C 1048, Kind HS.
 - 3. Tempered Clear Float Glass: As specified for clear annealed float glass except fully tempered to conform to ASTM C 1048, Kind FT.
 - 4. Annealed Tinted Float Glass: Glare reducing float glass conforming to ASTM C 1036, Type I, Class 2, quality q3, 1/4 inch (6 mm) thick.
 - a. PPG "Solex", green color, or equal.
 - b. LOF "Blue-Green ", blue-green color, or equal.
 - c. PPG "Azurelite", blue color, no substitutions.
 - d. PPG "Solargray", gray color, or equal.
 - e. PPG "Solarbronze", bronze color, or equal.
 - 5. Heat Strengthened Tinted Float Glass: As specified for annealed tinted float glass except heat strengthened to conform to ASTM C 1048, Kind HS.
 - 6. Tempered Tinted Float Glass: As specified for annealed tinted float glass except fully tempered to conform to ASTM C 1048, Kind FT.
 - 7. Clear Wire Glass: 1/4 inch (6 mm) thick, clear rolled glass conforming to ASTM C-1036, Type II (flat), Class I, Form 1 (wired and polished both faces), wired with welded polished wires, 1/2 inch (13 mm) x 1/2 inch (13 mm) square pattern, smooth wires vertical, manufactured by Hordis Bros., Sierracin/Transtech, or equal.
 - 8. Annealed Obscure Glass: Conforming to ASTM C 1036, Type II, Class I, Form 3, Finish 1, pattern p3 "hammered" texture glass.
 - 9. Tempered Obscure Glass: As specified for annealed obscure glass except conforming to ASTM C 1048, kind FT.
 - 10. Obscure Wire Glass: As specified for Clear Wire Glass, except Form 3, Finish 1, pattern p3 "hammered" texture glass.
 - 11. Clear Fire Rated Tempered Safety Glass, 20 Minute Rated: "Pyroswiss", no known equal, with UL or Warnock-Hersey label, manufactured by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products, 2425 Carillon Point, Kirkland, WA 98003, Tel. 1-800-426-0279.
 - 12. Clear Fire Rated Safety Glass Ceramic, 20 90 Minute Rated: "Firelite Plus", no known equal, with UL or Warnock-Hersey label, manufactured by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products, 2425 Carillon Point, Kirkland, WA 98003, Tel. 1-800-426-0279.
 - 13. Annealed Low-E Clear Float Glass: PPG "Sungate 500(2)", or equal, clear float glass with transparent reflective coating on inboard (No. 2) surface, conforming to ASTM C 1036, Type I, Class 2, quality q3.
 - 14. Tempered Low-E Clear Float Glass: PPG "Sungate 500(2)", or equal, [clear][tinted] float glass with transparent reflective coating on inboard (No. 2) surface, tempered to conform to ASTM C 1048, Kind FT.
 - 15. Annealed Low-E Tinted Float Glass: PPG "Sungate 500(2)", or equal, clear float glass with transparent reflective coating on inboard (No. 2) surface, conforming to ASTM C 1036, Type I, Class 2, quality q3.

- 16. Heat Strengthened Low-E Tinted Float Glass: PPG "Sungate 500(2)", or equal, tinted float glass with transparent reflective coating on inboard (No. 2) surface, heat strengthened to conform to ASTM C 1048, Kind HS.
- 17. Tempered Low-E Tinted Float Glass: PPG "Sungate 500(2)", or equal, [clear][tinted] float glass with transparent reflective coating on inboard (No. 2) surface, tempered to conform to ASTM C 1048, Kind FT.
- 18. Heat Strengthened Low-E Tinted Float Glass: PPG "Sungate 1000(2)", or equal, tinted float glass with transparent reflective coating on inboard (No. 2) surface, heat strengthened to conform to ASTM C 1048, Kind HS.
- 19. Tempered Low-E Tinted Float Glass: PPG "Sungate 1000(2)", or equal, tinted float glass with transparent reflective coating on inboard (No. 2) surface, tempered to conform to ASTM C 1048, Kind FT.
- 20. Spandrel Glass: Tempered spandrel glass conforming with DD-G-1403, Grade B, Style II, color as shown or selected by University.
- 21. Insulating Glass:
 - a. Manufacturer And Unit Fabrication: By a member of the Sealed Insulating Glass Manufacturers Assn. (SIGMA) and fabricated in accordance with SIGMA recommendations, except where more stringent requirements are indicated.
 - b. Class: "CBA" and certified as such by the Insulating Glass Certification Council (IGCC).
 - c. Construction: ASTM E 774 organic elastomeric sealed edge (no metal edges permitted) consisting of a polyisobutylene primary seal and a silicone secondary seal, with the interior air space hermetically sealed and provided with a concealed desiccant agent. Secondary seals other than silicone shall not be used.
 - d. Where visible through the glass, the exposed surface of the metal spacer tube shall be painted with thermosetting, siliconized acrylic paint, or equal, color to match the color of aluminum frame at the interior of the building.
 - e. Configuration: As per Glass Schedule.
- 22. Laminated Glass: Fabricated using heat and pressure with Monsanto, or approved equal, clear polyvinyl butyral sheet interlayer, configuration of assembly as per Glass Schedule. Laminated glass shall conform to requirements of Reference Standard 1.2.B.
- 23. Glazing Materials and Accessories: Glazing materials and accessories shall be fully compatible with the materials and finishes with which they are in contact. Neoprene and EPDM materials shall not come in contact with silicone sealant materials. Silicone rubber spacers, setting and edge blocks and gaskets shall be either Type I (designed to prevent adhesion) or Type II (designed for adhesion) as per glazing system manufacturer's recommendations for each condition of use.
 - a. Glazing Tapes: Preformed, preshimmed polyisobutylene-butyl tape, 1/2 inch (13 mm) wide x thickness to suit proper face clearance of glass, black color; "Pecora BB-50 Extru-Seal", PTI "606", Tremco Preshimmed #440, or "Polyshim" ("Polyshim" only where glass lites exceed 150 united inches), or equal.
 - b. Glazing Sealants: One component, silicone based sealant, black color; Dow-Corning "795" or General Electric "Silpruf 2000", or equal. Sealants shall be recommended by the manufacturer for the particular condition of use.
 - c. Glazing Sealants (Butt Glazing And Steel Windows): One component, silicone based sealant, black color except clear color at butt glazing; Dow-Corning "795" or "999-A", or General Electric "Gesil N 2600", "SCS 100" or "SCS 1200", or equal, as per manufacturer's recommendations for the particular condition of use.
 - d. Primers (If Required For Sealants): Non-staining and non-etching type as recommended by sealant manufacturer.

- e. Setting Blocks: Neoprene, EPDM or silicone rubber conforming to ASTM C 864, 80-90 Shore A durometer hardness, and which will permit permanent mounting. Blocks shall be 0.1 inch (2.5 mm) long for each square foot of glass area (but no less than 4 inches (100 mm)) x 1/16 inches (1.6 mm) less than full channel width and of thickness to provide proper bite and minimum edge clearance for glass. Where length of block may become excessive, lead blocks having a length of 0.05" for each square foot of glass (4 inches (100 mm) minimum) may be used. Do not use lead blocks for insulating, laminated or wire glass.
- f. Edge Blocks: Neoprene, EPDM or silicone rubber conforming to ASTM C 864, 60-70 Shore A durometer hardness, and which will permit permanent mounting. Blocks shall be 3 inches (75 mm) minimum length x full channel width and of thickness or configuration to provide 1/8 inch (3 m) (nom.) clearance between block and glass edge.
- g. Glazing Spacers: Neoprene, EPDM or silicone rubber conforming to ASTM C 864, 60-70 Shore A durometer hardness, size as required by glazing conditions, continuous (do not use intermittent spacers).
- h. Insulation (Glass Spandrels): Owens-Corning Fiberglas "CW 225-FSK", or approved equal, fiberglass, semi-rigid, friction fit board with integral aluminum foil vapor barrier, "R" value as indicated on Drawings. Include galvanized steel mounting channels as required by job conditions

2.3 FABRICATION

- A. Cut glass to full fit and play, consistent with glass and glazing material manufacturers' recommendations and the requirements of the Drawings and References, Codes and Standards Article.
- B. Follow code requirements and glass manufacturer's recommendations for minimum bite and edge and face clearances.
- C. Cut lights to smooth straight edges, clean, free of nicks and flares; nipping not permitted. Follow glass manufacturer's directions exactly for tinted and Low-E glass.
- D. Where glass edges (including cut openings) are required to be exposed, grind smooth and polish.
- E. Tempered and heat strengthened glass shall be horizontally treated only. Fabrication and treatment shall, where at all possible, be such that roller distortion lines (where they may occur) will run horizontally (parallel to sill and head) after installation.

F. Glass Identification:

- 1. Tempered and heat strengthened glass shall bear the manufacturer's identification as to type and thickness.
- 2. Glazing in fire rated doors and fire rated windows shall bear UL classification marking in accordance with UL 9.
- 3. Manufacturer's and UL identifications for glazing shall be permanently etched so as to be visible after glass has been set in place and glazed.
- 4. Glass other than tempered, heat strengthened and UL-marked glass shall not have labels

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspect surfaces to receive glazing materials and report defects which might adversely affect the glazing work. Commencing work implies acceptance of surfaces as satisfactory.
- B. Weep systems shall be open.
- C. Surfaces shall be free of condensation and moisture.
- D. Steel surfaces shall be primed and dry

3.2 PRPARATION

- A. Clean rebates and glazing reveals free of foreign matter, special coatings, dust, grease, projections and irregularities prior to setting glass. Solvents used for cleaning shall not etch or damage glass or metal surfaces.
- B. Wipe glass free of dust and oil.

3.3 INSTALLATION

- A. Conform to recommendations of glass manufacturer where such covers points not shown on Drawings or specified herein.
- B. Remove "loose" stops furnished with the units and reinstall as a part of the glazing operation.
- C. Handle to prevent nicks and flares on glass edges.
- D. Install glass exceeding 1/8" thickness on identical setting blocks permanently mounted and centered at 1/4 points. If necessary to reduce deflection of horizontal supporting member, blocks may be placed at 1/8 points or with the nearest end 6" (whichever is greater) from edge of glass unit. Ensure that blocks are equidistant from centerline of glass. Do not obstruct weep holes.
- E. Provide permanently mounted edge blocks at head and jambs of dry-glazed lights to prevent damage to glass edges during installation and lateral shifting of glass due to thermal and seismic loads and vibrations. Follow recommendations of Flat Glass Marketing Assn. Glazing Manual.
- F. Set glass to maintain bite, edge and face clearance stipulated by code and the glass manufacturer.
- G. Take special precautions to protect laminated glass edges from deterioration of vinyl interlayer by moisture.
- H. Glaze dry-glazed aluminum doors and frames as per manufacturer's directions using glazing gaskets and seals furnished with the units.
- I. Miter gaskets at corners, and install so as to prevent pulling away at corners. Gaskets with gaps or other visible irregularities on door and window units shall be corrected by manufacturer or fabricator at no additional cost to University.

- J. Set interior non-wired glass in fixed stops with glazing tape one face.
- K. Wire glass installed in metal frames and stops shall be embedded in metal sash putty, and all exposed joints between the metal and the glass struck and pointed.
- L. Aluminum or Steel Windows:
 - 1. Clean surfaces to receive glazing materials.
 - 2. Apply glazing tape against fixed stops with corners butted tightly (do not overlap). Install head and sill tape first and extend full width of opening. Tape shall be straight without dips and so placed that it will finish flush with top of stop after glass is installed.
 - 3. Set glass on glazing blocks at 1/4 points (if required by size) and properly position glass in opening. Remove paper backing from tape and press glass against tape to ensure full contact.
 - 4. Snap stops in place making sure that exterior glazing sealant reveal is maintained all around.
 - 5. Apply glazing sealant in exterior reveal all four sides. Tool to uniform, smooth bead with 1/16" watershed surface.
- M. Where butted glass without mullions is required, seal with silicone sealant in strict accord with sealant and glass manufacturer's directions. Set glass so that joint is plumb and glass edges are aligned to provide for a uniform joint width of 3/8" (max.). Mask edges of glass to confine sealant to joints and to avoid contact with either face. Use primers where so required. Neatly tool joints to slightly concave surface using recommended tooling agent. Remove masking from glass and clean glass surfaces completely free of sealant material.
- N. Set pattern glass with smooth side to exterior, and to room side of corridors.
- O. Insulation (Spandrel Glass): Attach mounting channels for insulation to aluminum framing members in accord with glass manufacturer's recommendations and so as to maintain a minimum distance of l" between glass surface and insulation face. Cut insulation to fit tightly. Orient foil vapor barrier to the interior. Seal edges, joints, penetrations, tears and holes with compatible adhesive foil tape.
- P. Close and tightly seal all partly used sealant containers, and store protected in well-ventilated area at temperature recommended by sealant manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Conduct field check (test) of glazing in exterior for water leakage in accordance with AAMA 501.2.
- B. After substantial cure of exterior glazing sealants which are exposed to the weather, test for water leaks. Flood the joint exposure with water directed from a 3/4 inch (38 mm) garden hose held perpendicular to the wall face, 24 inches (600 mm) from the joint, connected to a water system with 43 psf minimum static water pressure. Move stream of water along joint at an approximate rate of 20 feet (6 m) per minute.
- C. Test approximately 5 percent of total glazing system in locations which are typical of every joint condition and which can be inspected easily for leakage on opposite face. Conduct tests in presence of the Project Manager, who will determine actual percentage of joints to be tested and the actual period of exposure to water from hose, based upon extent of observed leakage or lack thereof.

- D. Repair glazing installation at leaks or, where leakage is excessive, replace glazing sealants.
- E. Where nature of observed leakage indicates possibility of inadequate glazing joint bond strength, the Project Manager may direct that additional testing be performed at a time when joints have been fully cured, followed by natural exposure through both extreme temperatures, and returned to range of temperature in which it is feasible to conduct testing. Repair or replace work as required for permanent elimination of leakage

3.5 CLEANING

- A. Initial cleaning of glass surfaces is a part of this Section. Follow glass manufacturer's directions exactly for cleaning tinted and Low-E glass.
- B. Do not use abrasive cleaners or sharp instruments.

3.6 PROTECTION

- A. Protect installed glass from damage due to subsequent construction operations.
- B. Identification or caution markers shall not be applied to glass surfaces nor shall they be applied to metal surfaces in any way which would damage or stain the metal.
- C. Replace glass broken or damaged prior to final acceptance.

END OF SECTION

SECTION 09 70 00

SEAMLESS EPOXY FLOOR COATINGS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. The work includes the application of seamless epoxy floor coating systems to items and surfaces as scheduled on the drawings.
 - 1. Coatings to be resinous flooring, including surface preparation, prime coats, and top-coats as specified herein and as indicated on the drawings.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Design Data: Submit manufacturer's latest published literature including installation instructions and maintenance instructions.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum three years documented experience and approved by coating manufacturer.
 - 1. The proposed applicator shall submit a list of a minimum of five (5) completed projects of similar size and complexity to this Work.
 - 2. Include the following for each project:
 - a. Project name and location
 - b. Name of Owner
 - c. Name of Contractor
 - d. Name of Architect/Engineer
 - e. Name and type of Coating System Applied
 - f. Approximate area of coatings applied
 - g. Date of completion

1.4 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene a pre-installation meeting one (1) week before start of surface preparation/application of coating systems covered under this Section. Require attendance of parties directly affecting work of this Section, including Contractor, the Owner, Engineer, Architect, applicator subcontractor and epoxy resin manufacturer's representative to review the work to be performed under this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
 - 1. Deliver materials in original, sealed containers of the manufacturer with labels legible and intact.
 - 2. Each container shall be clearly marked or labeled to show coating identification, date of manufacture, batch number, analysis or contents, identification of all toxic substances and special instructions
- C. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing, thinning or reducing, safety and storage information.

D. Coating Materials:

- 1. Store in well ventilated area, as required by manufacturer's instructions.
- 2. Store material in a suitable location and in such a manner as to comply with all safety requirements including any applicable federal, state and local rules and requirements.
- 3. Storage shall also be in accordance with the instructions of the coating manufacturer and the requirements of the insurance underwriters.
- 4. Flammable coatings, thinners, solvents and materials shall be stored to conform to the applicable City, County, State and Federal safety codes for flammable materials.
- 5. Restrict storage area to coating materials and related equipment.
- E. Any material that has been determined to have exceeded the manufacturer's recommended shelf life shall be removed from the project and shall not be utilized in the completion of the work.
- F. No materials other than those formally submitted and approved shall be brought onto or stored on the project site.
- 1. Store only acceptable Project materials on the Project site.
- G. Place any materials that may constitute a fire hazard in closed metal containers and remove daily from the Project site.

1.6 SEQUENCING

- A. Sequence application to the following:
 - 1. Concrete surfaces and masonry surfaces shall be properly cured and aged according to coating manufacturer's written requirements.
 - 2. Do not apply coatings over sealants, unless coating manufacturer's written instructions allow or require it.

1.7 SAFETY

- A. Work shall be performed in a safe manner in accordance with all applicable federal, state and local codes.
- B. The Contractor shall provide all individual air supplies, air filtration or respiration equipment, protective clothing, safety showers or other supplies and equipment necessary to ensure that a safe working environment is maintained.
- C. Ventilation: The Contractor shall provide and maintain adequate ventilation during surface preparation, coating application and curing phases of the work to adequately remove dust and

fumes to prevent injury to workmen, accumulation of volatile gases, or damage to existing or new equipment.

- 1. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured
- 2. It shall be the sole responsibility of the Contractor to ascertain and provide the prescribed ventilation requirements.
- D. Equipment: The Contractor shall provide explosion proof lighting, fans, pumps, sprayers, flashlights, and other required equipment in all coating and curing areas. Equipment shall be properly maintained and in good working order.
- E. Illumination: The contractor shall provide adequate illumination while work is in progress.
- F. Personal Protection Equipment: The Contractor shall provide personnel with safety clothing, climbing devices, scaffolding, work stages, respiratory equipment, and eye and face protection as required for the work.
- G. Confined Space: All work shall be performed in compliance with OSHA rules and regulations for confined space entry and comply with any State and/or local requirements, which are more restrictive than the Federal requirements.

1.8 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. Warranty period shall be for one year after completion of the project as a whole.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufacturers: All approved manufacturers and approved products shall be limited to those listed below. Only those products as listed approved herein and composing pre-approved samples, on file with Architect/Engineer (A/E), will be allowed.
 - 1. Approved Manufacturer: Products:
 - a. Stonehard
 - b. Substitutions: Section 01 60 00 Product Requirements
 - 2. Products (Refer to finish tables for locations of epoxy resin):
 - a. Stoneshield HRI. Unless other systems are specifically identified below Stoneshield HRI Resinous coating shall be used for all epoxy floor applications. Install with Stoneproof ME7 membrane and SL/Standard Primer on all elevated slab applications. Other HRI applications shall use Standard Primer.
 - b. Stongard MD Decorative to be used in the showers/bathrooms. *Install with SL/Standard Primer on all applications*.
- B. Installers: All installers shall have completed a minimum of ten (10) epoxy floor applications within the past three (3) years of similar size and scope as specified herein and indicated on drawings. The proposed applicator shall submit a list of a minimum of five (5) completed projects of similar size and complexity to this Work. Include the following for each project:

- 1. Project name and location
- 2. Name of Owner
- 3. Name of Contractor
- 4. Name of Engineer
- 5. Name and type of Coating System Applied
- 6. Approximate area of coatings applied
- 7. Date of completion
- C. Colors: All colors to be selected by Owner.
 - 1. For each product specified, submit two complete sets of color chips representing manufacturer's full range of available or custom colors.
 - 2. For each product selected, submit two samples that represent actual product, color, and texture
- D. Materials: Only first quality material as manufactured by the approved manufacturers respectively shall be used.
- E. Delivery and Storage: Deliver materials to the project site at the time of installation. Do not store materials at site more than the time needed for installation. All primary system materials shall be delivered in the manufacturer's undamaged, and unopened containers. Each container shall be clearly marked with the product name, manufacturer, component designation, and the ratio of component mixture. Store all materials in accordance with manufacturer's instructions with all seals and labels intact. Maintain 60 to 90 degrees F, unless required otherwise by the manufacturer.
- F. Pre-Installation Conference: Prior to the installation of the epoxy floor coatings, the installer, epoxy flooring manufacturer's representative, installers of related work and other entities concerned with the performance of the epoxy floor topping, including (where applicable) insurer, test agencies, government authorities, and Owner shall meet at a predetermined location.
- G. A technical representative of the manufacturer shall be present to supervise the execution of the work to the extent deemed necessary by the manufacturer to assure that all work is carried out in strict accordance with the Manufacturers recommended practices and this specification. As a minimum, the manufacturer's technical representative shall be present to review the conditions and methods prior to the start of the work, during surface preparation and a final inspection shall be performed upon substantial completion of the work. The cost for these services shall be the Contractor's responsibility.
- H. Warranty: The installer, jointly with the manufacturer, shall furnish a standard guarantee of the epoxy floor coatings for a period of one (1) year from the completion of the project as a whole.

2.2 SUBMITTALS

- A. Submit the manufacturer's specification literature, listing all components, mixing directions, storage instructions, and application instructions.
- B. Submit the manufacturer's bill of lading and packing list indicating manufacturer, name and location of project, and quantities of materials.

- C. Submit physical samples of selected color.
- D. Submit complete maintenance instructions for each type epoxy floor system applied.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The work will be performed at a Water Treatment Plant in the vicinity of active treatment processes, which must remain in service during the surface preparation and coating application. The operation of the plant must not be impacted or jeopardized by the work specified herein.
- B. Inspect areas to receive seamless epoxy flooring for conditions which might be detrimental to a first-class installation and report discrepancies to the general contractor. Do not install epoxy floor coating until all unsatisfactory conditions (including floor slopes and uniform grades) have been corrected. The installing contractor will be wholly responsible for the floor coating application and finished product.
- C Substrate Preparation: Prepare concrete to "open" the surface pores by mechanical means of vacuum blasting or scarifier, removing all contamination or bond breaking substances including, but not limited to dust, latency, curing compounds, coatings, sealers, oil or grease. Only self-contained blasting units equipped with necessary HEPA vacuum attachments will be allowed. Exhaust system shall be of sufficient strength and power to contain any dust and debris generated by the blast cleaning. Any oil or grease not removed by vacuum blasting or etching, must be chemically removed. All spalled or deteriorated concrete should be removed by scrabbling or chipping hammers, then patched with an epoxy patching material as recommended by the manufacturer.
- D. Epoxy Floor Coatings shall consist of:
 - 1. Stoneshield HRI Resinous coating shall be a minimum thickness of 3/16" and consist of:
 - a. Standard primer
 - b. A membrane with primer, elevated slabs only
 - b. A mortar system consisting of 100 % solids by volume epoxy resins, curing agents, and fine silica sands troweled onto mortar system.
 - c. A two (2) component epoxy undercoat, colored quartz fine aggregate broadcast and a two (2) component, high performance clear epoxy sealer.
 - Stongard MD-Decorative 1/8" nominal broadcast aggregate waterproofing system with SL/Standard Primer.
 - 3. Stonclad GS/Stonkote GS4-1/4" nominal troweled epoxy mortar system with a 100% solid epoxy top coat, primers. Install membrane on elevated slabs only.
- E. Cove base: A 6" high, minimum 1/8" thick cove base shall be installed integral with the floor surface at all walls and raised areas in the installation area. Seal top of base to wall with silicone caulking.
- F. Chases: At all areas where the floor does not abut wall, the concrete shall be chased a minimum of 1/4" deep and 3/4" wide. This chase applies at all floor drains and cleanouts. Surface condition at drains shall not be raised so as to puddle water or prevent gravity drainage in anyway. See details on drawings.

- G Thresholds: Threshold application at all doors and walk-throughs entering the application areas are to be installed per manufacturer's standards, but in no case, will these areas be constructed as to promote or allow surface water to flow out of the epoxy coated floor area to adjacent floor areas.
- H. Joints or Cracks: Fill any joints or cracks in concrete floor with a manufacturer's approved joint filler to resist possible cracking of the finished epoxy topping. Provide joint bridging material at all cracks and joints as specified by manufacturer.
- I. Coordinating: Coordinate the installation of epoxy floor coatings with the general contractor for uninterrupted space availability, lighting, temperature control etc., prior to starting. Rope off areas to be coated during the entire installation & curing process and provide "WET PAINT" or similar signage to prevent traffic on un-cured coatings.
- J. Protection: Protect the work of other trades, whether to be coated or not, against damage from coating operations. Correct damage by cleaning, repairing or replacing, and recoating as acceptable to the General Contractor and Architect/Engineer (A/E). Leave the work in an undamaged condition. Be especially careful to prevent any material from entering floor drains. All floor drains shall be taped prior to and during application of epoxy floor coatings to prevent flooring materials from entering drains or blocking drain covers.
- K. Core Drilling Samples: If required by the A/E, the installing epoxy floor contractor shall provide core drilled samples of the finished application where directed. If core drilled samples of epoxy floor are determined not to be in compliance with the project specifications and drawings, the installing contractor shall be responsible for all costs incurred for core drillings, floor repair, and epoxy floor replacement for full compliance with specifications and drawings. If, however, core drilled samples of epoxy floor are determined to be in compliance with project specifications and drawings, the Owner will be responsible for the costs of core drilling and floor repair at drilling locations.

3.2 CLEAN UP

A. Clean up all rubbish, empty containers, rags and all other debris and remove from the site. Just prior to final inspection clean the epoxy floor coating using only manufacturer approved materials and procedures.

B. COMPLETED WORK

1. The Engineer shall have final judgment as to the acceptability of all epoxy floor installations. The installing contractor shall repair deficiencies in the work to the full satisfaction of the Owner. Repairs, which result in an uneven coloring or poor appearance, will not be acceptable.

END OF SECTION

PAINTING AND COATING

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of painting systems and coatings.
- B. The Contractor shall furnish all materials, labor and equipment required to properly furnish and install protective coating systems for the surfaces, equipment and machinery listed herein, or in other documents, or on the Contract Drawings.
- C. In general, all exposed surfaces on all material furnished, constructed or installed in this project shall be painted, whether installed inside or outside.
- D. The Contractor shall repair and/or repaint all factory finishes of equipment and machinery, not required to be painted at the job site, which is defective or has been damaged in transit and/or installation.
- E. Items not to be painted include aluminum (except for surfaces in contact with concrete), stainless steel, nameplates, tile, finish hardware, buried pipe, fittings, and valves (except manufacturer's coatings), concrete floor slabs with hardener, concrete walls required to be coated with waterproofing material, galvanized metal roof decking.
- F. Aluminum surfaces bearing on or embedded in concrete and facing surfaces of bolted aluminum joints, except anchor bars and anchor bolts, shall be given one coat of zinc chromate primer. The primer shall be allowed to dry prior to placing the aluminum in contact with concrete.
- G. Full field cleaning and priming will be performed in accordance with specification requirements for unpainted products. Maintain adequate equipment on the site to assure proper cleaning.
- H. Shop Primed Products: Manufactured products may be shop cleaned and primed. Shop cleaning must equal or exceed cleaning specified in the Painting Schedule. Clean as specified and reprime all abrasions, weld splatter, excessive weathering and other defects in the shop prime coating.
- I. Manufacturers furnishing shop primed products shall certify that cleaning was performed in accordance with specification requirements and that the specified primer was used.
- J. Fully field clean and prime any shop primed products which the Engineer determines that were not cleaned in accordance with the Specifications prior to priming, that the wrong primer was applied, that the primer was applied improperly, or has excessively weathered, or that the product is otherwise unacceptable.
- K. Finish Painted Products: Certain products such as electrical control panels and similar items may, with the approval of the Engineer, be furnished finish painted. Properly protect these products

throughout the Project to maintain a bright and new appearance. If the finish surfaces are defaced, weathered or not of the selected color, the Contractor shall repaint as required by the Owner or Engineer.

L. Existing Surfaces: Properly protect existing finish painted items and surfaces or equipment from damage throughout the Project. Repair any damage to existing coatings, surfaces or equipment to the full satisfaction of the Owner, at no expense to the Owner.

1.2 REFERENCES

A. ASTM International:

- 1. ASTM D16 Standard Terminology for Paint, Related Coatings, Materials, and Applications.
- 2. ASTM D610 Standard Practice for Evaluating Degree or Rusting on Painted Steel Surfaces
- 3. ASTM D4138 Standard Test Method for Measurement of Dry Paint Thickness of Protective Coating Systems by Destructive Means.
- 4. ASTM D4258 Practice for Surface Cleaning Concrete for Coating.
- 5. ASTM D4259 Practice for Abrading Concrete.
- 6. ASTM D4260 Practice for Etching Concrete.
- 7. ASTM D4261 Practice for Surface Cleaning Concrete Unit Masonry for Coating.
- 8. ASTM D4262 Standard Test Method for pH of Chemically- Cleaned or Etched Concrete Surfaces.
- 9. ASTM D4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
- 10. ASTM D4285 Standard Test Methods for Indicating Oil or Water in Compressed Air.
- 11. ASTM D4414 Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
- 12. ASTM D4417, Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
- 13. ASTM D4442 Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
- 14. ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- 15. ASTM D 6237, Standard Guide for Painting Inspectors (Concrete and Masonry Substrates).
- 16. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

B. Society for Protective Coatings (SSPC):

- 1. Guide 6, Guide for Containing Debris Generated During Paint Removal Operations
- 2. SSPC-SP 1, Solvent Cleaning
- 3. SSPC-SP 2, Hand Tool Cleaning
- 4. SSPC-SP 3, Power Tool Cleaning
- 5. SSPC-SP 6, Commercial Blast Cleaning
- 6. SSPC-SP 10, Near-White Metal Blast Cleaning
- 7. SSPC-SP 11, Power Tool Cleaning to Bare Metal
- 8. SSPC SP13 (NACE 6), Surface Preparation of Concrete
- 9. SSPC-PA 2, Measurement of Dry Film Thickness with Magnetic Gages
- 10. SSPC-VIS 1, Visual Standard for Abrasive Blast Cleaned Steel
- C. Equipment and Coating Manufacturers' Published Instructions.

D. RPO188 – NACE Standard Recommended Practice Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

1.3 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on all products.

C. Samples:

- 1. Submit two paper chip samples, 2 x 2 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.
- 2. The Owner shall select all finishes, colors and textures.
- D. Manufacturer's Installation Instructions: Submit complete manufacturer's installation instructions including any special surface preparation procedures, and any substrate conditions requiring special attention. In case of conflict between this specification and the manufacturer's printed instructions, this specification shall prevail.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with client standards (if any) and in a first-class workmanlike manner.
- B. Only those systems and components which are judged acceptable by the Engineer shall be utilized in the work. No materials shall be delivered to the job site until the Engineer has evaluated their acceptability.
- C. Maintain one copy of printed manufacturer's instructions at the job site. Explain all instructions in detail to all personnel involved with the project painting. All applied coatings shall strictly adhere to these requirements.
- D. All material shall be pure and of the best quality, shall be delivered in unbroken original containers bearing the brand and manufacturer's name, manufacturer's stock number and manufacturer's application recommendations. All coatings shall be mixed in conformity with the manufacturer's specifications and directions.
- E. Thinners shall not be used in amounts exceeding labeled directions.

- F. As far as possible, paints shall be applied in alternating colors. For lighter shades, use differing tones which will permit easy detection of voids and holidays.
- G. The Contractor shall submit manufacturer's written verification that coatings for contact with potable water have been approved by current federal and state regulations and that product formulations have not changed since approval with coating submittal.
- H. Within ten days after notification, the Contractor shall submit manufacturer's written verification that coatings are for the service identified, that coatings for contact with potable water have received the appropriate ANSI/NSF 61 certification and that product formulations have not been changed since approval.
- I. The manufacturer shall also certify that all coatings are lead and chromate free with exception of specific colors approved by Engineer, such as, safety colors.

1.7 SAMPLING AND ANALYSIS OF EXISTING MATERIALS

- A. Sampling analysis of existing coatings, where available, is included in the appendix of these specifications.
- B. However, the Owner assumes no responsibility for the actual toxic metal content or toxicity of the coating system. The Contractor is responsible for conducting appropriate testing of their own and shall comply with the applicable regulations for worker safety and health, protection of the environment and management of wastes.
- C. Certified copies of the test results are to be supplied to the appropriate representative of the Owner. A representative of the Owner shall witness the required sampling

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum three years documented experience and approved by coating manufacturer.
- C. Hazardous Paint Removal: If the project scope includes removing existing coatings that contain lead or other hazardous materials, the Contractor shall follow these experience requirements:
 - 1. The coating work shall be performed by a contractor who is regularly engaged and has successfully completed work of similar scope in the past including the containment and removal of hazardous coatings. Prior to beginning cleaning and coating operations, the Contractor shall submit, in accordance with SSPC- QP 4 evidence of successfully meeting the specification requirements of hazardous paint removal jobs, using environmental controls in accordance with SSPC-Guide 6 "Guide for Containing Debris Generated During Paint Removal Operations" and in accordance with SSPC-Guide 7 "Guide for the Disposal of Lead Contaminated Surface Preparation Debris."

- 2. Submittal shall include a list of completed project names and addresses, names and addresses of Engineers and Owners, and other information specified. Contractor shall submit written documentation of the firm's qualifications with respect to items addressed in SSPC-QP 4 Section 4. These shall include the following at a minimum:
 - **a.** Experience of Contractor in operations that result in the disturbance of hazardous paint or related work.
 - **b.** Names of representatives of facility owners or prime contractors for whom work was performed, and dates of work.
 - **c.** Evidence that the Contractor has designated specific individuals as competent persons who are qualified to supervise hazardous paint removal or related work.
 - **d.** Specific training and certification of Contractor's production and support personnel in the environmental and health risks associated with disturbance of hazardous paint and in industrial hygiene.
 - e. Other evidence of effectiveness of Contractor's programs and qualifications outlined in Section 4.1 through 4.4 of SSPC-QP 4. Copies of Contractor's safety and environmental compliance programs. Copies of citations issued to the Contractor for serious or willful violation of federal, state or local regulations.
 - **f.** In addition, the Contractor shall submit a copy of their Lead Abatement Program to the Engineer for review.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Prior to ordering any of the materials covered under this Section, the Owner, Contractor, Engineer, painting subcontractor and paint manufacturer's representative shall attend a progress meeting in accordance with the requirements of Section 01 30 00 of these Specifications, and review the work to be performed under this Section.

1.10 TESTING EQUIPMENT

- A. The Contractor shall furnish and make available to the Engineer the following items of testing equipment for use in determining if the requirements of this Section are being satisfied. The specified items of equipment shall be available for the Engineer's use at all times when field painting or surface preparation is in progress:
 - 1. Wet film gauge,
 - 2. Surface thermometer,
 - 3. Keane-Tator surface profile comparator,
 - 4. Set of SSPC visual standards,
 - 5. Holiday (pin hole) detector (low voltage),
 - 6. Sling-psychrometer, used in conjunction with the U.S. Department of Commerce Weather Bureau psychometric tables.

- 7. Magnetic dry film gauge.
- 8. Tooke gage.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing, thinning or reducing, safety and storage information.
- D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 95 degrees F, in well ventilated area, and as required by manufacturer's instructions.
- E. Any material that has been determined to have exceeded the manufacturer's recommended shelf life shall be removed from the project and shall not be utilized in the completion of the work.
- F. No materials other than those formally submitted and approved will be brought onto or stored on the project site.
- G. Flammable coatings, thinners, solvents and materials shall be stored to conform to the applicable City, County, State and Federal safety codes for flammable materials.

1.12 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 – Product Requirements.

1.13 SEQUENCING

- A. Section 01 10 00 Summary: Work sequence.
- B. Sequence application to the following:
 - 1. Do not apply finish coats until paintable sealant is applied. If sealant is not paintable or sealant manufacturer recommends not painting the sealant, then apply the finish coat and let dry. The sealant can then be installed. If the sealant is a pre-mixed color chosen by the Owner, then it shall not be painted.
 - 2. Back prime wood trim before installation of trim.

1.14 SAFETY

- A. Work shall be performed in a safe manner in accordance with all applicable federal, state and local codes.
- B. The Contractor shall provide all individual air supplies, air filtration or respiration equipment, protective clothing, safety showers or other supplies and equipment necessary to ensure that a safe working environment is maintained.

- C. Ventilation: The Contractor shall provide and maintain adequate ventilation during surface preparation, coating application and curing phases of the work to adequately remove dust and fumes to prevent injury to workmen, accumulation of volatile gases, or damage to existing or new equipment.
 - 1. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
 - 2. It shall be the sole responsibility of the Contractor to ascertain and provide the prescribed ventilation requirements.
- D. Equipment: The Contractor shall provide explosion proof lighting, fans, pumps, sprayers, flashlights, and other required equipment in all painting and curing areas. Equipment shall be properly maintained and in good working order.
- E. Illumination: The contractor shall provide adequate illumination while work is in progress.
- F. Personal Protection Equipment: The Contractor shall provide personnel with safety clothing, climbing devices, scaffolding, work stages, respiratory equipment, and eye and face protection as required for the work.
- G. Confined Space: All work shall be performed in compliance with OSHA rules and regulations for confined space entry and comply with any State and/or local requirements, which are more restrictive than the Federal requirements.

1.15 WARRANTY

A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.

1.16 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish the Owner at least one gallon of each type and color of paint used for finish coats and one gallon of each type of thinner required. Containers shall be tightly sealed and clearly labeled.
- C. Label each container with color, type, texture, equipment, room locations, etc. in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

- A. Manufacturers: Paint.
 - 1. Carboline.
 - 2. Induron.
 - Tnemec.
 - 4. To the maximum extent possible, all coatings, thinners and additives shall be the products of a single manufacturer.
 - 5. Substitutions: Section 01 60 00 Product Requirements.

- B. Manufacturer: Coating "Stripper"
 - 1. Peel Away System as manufactured by Dumond Chemicals, Inc.
 - 2. Substitutions: Section 01 60 00 Product Requirements

2.2 COMPONENTS

- A. Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:
 - 1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
 - 2. For good flow and brushing properties.
 - 3. Capable of drying or curing free of streaks or sags.
- B. Application Data: All applicable data currently published by the paint manufacturer relating to surface preparation, coverage, film thickness, application technique, drying and overcoating times is included by reference as a part of this Section. It will be the responsibility of the Contractor to obtain and fully understand the appropriate data sheets for the coatings specified.
- C. Paints shall be factory mixed and delivered to the site in unbroken original packages bearing the manufacturer's label. All coatings shall be applied in strict accordance with the manufacturer's printed specifications. Two component coatings shall be mixed in accordance with manufacturer's instructions. All two component coatings, once mixed, shall be applied within the pot life recommended by the manufacturer.
- D. Unless otherwise specified, paints shall be of the best grade. All thinners, driers, varnish, etc., shall be of the best grade and shall be furnished by the coating manufacturer for use with the specified paints.
- E. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified and first class quality.
- F. Colors: The Owner will select the colors to be used on the various portions of the work. Provide color cards for the coatings proposed. Where more than one coat of paint is required, job tint the paint for each undercoat off shade to show complete coverage.

2.3 PIPE AND EQUIPMENT IDENTIFICATION

A. All pumps, valves, supports, piping and appurtenances, electrical equipment and enclosures, and equipment and appurtenances shall have coatings either manufactured applied or field applied. Different colors will be used on pumps, motors, valves, piping systems and other surfaces as required. All monorails, bridge beams and bridge crane rails shall have the load capacity stenciled every ten (10) feet or a minimum of two places. The text and colors shall be chosen by the Owner.

2.4 MIXING AND TINTING

A. When possible, all paints and other materials shall be mixed and tinted by the paint manufacturer prior to delivery to the job site.

B. When job site mixing and/or tinting is required, the manufacturer's recommendations shall be strictly adhered to. The Contractor shall be solely responsible for the proper conduct of all on-site mixing and/or tinting.

2.5 OSHA SAFETY COLOR USAGE GUIDE

A. OSHA Safety colors, in accordance with ANSI Z3.1, shall be used for marking physical hazards and safety equipment and locations. The following OSHA Safety Color Usage Guide will be used in determining the coating color and type of marking required.

B. Table 2.5B:OSHA Safety Color Usage Guide

| Safety Red | Safety Orange | Safety Yellow | Safety Green |
|--|---------------------------------------|--|--|
| | | Physical Hazard CAUTION (Generally used with Black in checks or stripes) | Safety Equipment and Locations |
| Fire protection equipment | Exposed box housings | Unguarded edges of platforms | First aid kits and stretchers |
| Fire boxes | Exposed edges of pulleys, gears, etc. | Elevator door edges | First aid signs, dispensaries and drinking water stations |
| Extinguishers | Exposed box housings | Bollards | |
| Exit signs | Safety starting buttons | Pulley Blocks | |
| Sprinkler piping | | Material handling equipment | |
| Portable containers of flammable liquids | | | |
| Emergency stop bars | | | |

2.6 COATING COMPATIBILITY

A. The Contractor shall verify with the coating manufacturer that the proposed coating is compatible with the existing coating. The Contractor shall patch test unknown existing coatings for compatibility with proposed coatings. No additional payment will be made for patch testing.

PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor shall make themselves familiar with the site and provide, install and maintain the necessary tarps, tents, covers and containment structures and shall utilize the appropriate cleaning equipment and appurtenances required to adequately contain all materials as specified herein.
- B. Cleaning operations shall not be initiated until the containment methods to be employed are in place.
- C. If the project has a lead abatement scope, then all lead related debris shall be collected at the end of each day and stored in approved containers for disposal by the Contractor. The Contractor shall set up a waste storage area designated for proper storage and handling of hazardous waste. This area shall be properly maintained and inspected.
- D. Adequately protect other surfaces from paint and damage. Furnish sufficient drop cloths, masking, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and, in particular, surfaces within storage and preparation area. Repair damage as a result of inadequate or unsuitable protection.
- E. Upon completion of the work, all paint splatters or drippings shall be removed.

3.2 PRODUCT HANDLING

- A. Deliver materials in original, sealed containers of the manufacturer with labels legible and intact. Each container shall be clearly marked or labeled to show paint identification, date of manufacture, batch number, analysis or contents, identification of all toxic substances and special instructions.
- B. Store only acceptable Project materials on the Project site.
- C. Store material in a suitable location and in such a manner as to comply with all safety requirements including any applicable federal, state and local rules and requirements. Storage shall also be in accordance with the instructions of the paint manufacturer and the requirements of the insurance underwriters.
- D. Restrict storage area to paint materials and related equipment.
- E. Place any materials that may constitute a fire hazard in closed metal containers and remove daily from the Project site.

3.3 ENVIRONMENTAL CONDITIONS

A. Environmental conditions which affect coating application include, but are not necessarily limited to, ambient air temperature, surface temperature, humidity, dew point and environmental cleanliness. Comply with the manufacturer's recommendations regarding environmental conditions under which coatings may be applied.

- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Do not apply exterior coatings during rain, snow, fog or mist or when relative humidity is outside humidity ranges as established by coating manufacturer (or exceeds 85%), or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Minimum Application Temperatures: No paint shall be applied when the ambient conditions are less than 45 degrees F; unless required otherwise by manufacturer's instructions.
- E. No paint shall be applied when the temperature of the surface to be painted is below 45° F, or when the temperature is expected to drop below 45°F within six (6) hours after application of coating, or when freezing (32 degrees F) is predicted within 24 hours of application, or when the relative humidity is above 90%.
- F. Paint shall not be applied to wet, damp or frosty surfaces.
- G. Paint shall not be applied when the substrate temperature is less than 5° F above the dew point.
- H. No material painted inside shall be moved outside in wet or freezing weather until the painted surfaces are thoroughly dry.

3.4 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify surfaces are ready to receive Work as instructed by product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application. All defects in fabrication shall be noted.
- D. The work pieces shall be inspected for the presence of oils and greases using an Underwriters Laboratories (UL)-approved ultra-violet lamp. Areas containing oil and grease shall be located and recorded and the oil or grease contamination removed by cleaning using a biodegradable cleaning solvent compatible with the specified coating.
- E. Test shop applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces. Do not apply finishes unless moisture content of surfaces is below manufacturer's recommendations.
- G. Fabrication defects noted in iron and steel materials and equipment to be coated shall be repaired. All voids, open and hollow places and irregularities shall be filled with a filler mixture suitable for the material and purpose and all laminations, scabs, rollovers and other defects of this type shall be removed by SSPC-SP2 "Hand Tool Cleaning" or SSPC-SP3, "Power Tool Cleaning".

3.5 PREPARATION

- A. All surfaces to be coated shall be prepared in accordance with the best practice. Surface preparation and coating shall be performed only by crews experienced in this work. All surfaces to be coated shall be thoroughly cleaned of all dirt, dust, weld splatter and any foreign matter before beginning surface preparation.
- B. The Contractor shall have the responsibility for containing, collecting and disposing of all paint particles, residues, dust, paint chips as well as all other debris generated during surface preparation performed in conjunction with the work specified herein.
- C. Coatings shall be applied by a subcontractor having the approval of the manufacturer and whose workmen have been instructed in the application of these coatings by the manufacturer.
- D. A representative of the paint manufacturer shall be present when work begins to instruct personnel in substrate preparation and application techniques.
- E. The Engineer will inspect the surface preparation prior to the application of coatings. If the preparation is found to be satisfactory, a written order will be given to proceed with coatings.
 - 1. Application of the first coat shall follow immediately after surface preparation and cleaning. Cleaning performed on steel substrates within one day shall be primed the same day before rust blooms occur.
 - 2. Cleaned areas which are not coated within this period shall be re-cleaned prior to the application of the first coat.
- F. The Engineer will inspect each coat prior to the application of subsequent coats. If the work is found to be satisfactory, a written order will be given to proceed.
- G. Surface Appurtenances: Remove all electrical plates, surface hardware, light fixture trim, escutcheons, fittings and fastenings prior to preparing surfaces or finishing. These items are to be carefully stored, cleaned and replaced upon completion of work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.
- H. Surfaces: Correct defects and clean surfaces capable of affecting work of this section. Remove or repair existing coatings exhibiting surface defects.
- I. Marks: Remove those which may bleed through surface finishes.
- J. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- K. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- L. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply sealer or primer.
- M. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

- N. Concrete Surfaces: All concrete shall have cured a minimum of 28 days before cleaning or coating. Remove contamination, acid etch, and rinse floors with clear water. Verify required acidalkali balance is achieved. Allow to dry.
- O. Concrete Surfaces: For all concrete surfaces, the following surface preparation shall be employed:
 - CC-1 Wash: Wash and scrub all surfaces with a solution of 1-1/2 ounces of soap
 chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Flush
 away all soap and dirt with clean water. After this washing the surface will be
 re-checked and any rough areas not suitable for painting shall be sandblasted
 smooth.
 - 2. CC-2 Acid Etch: Surface preparation for painting shall not commence until 7 days after the concrete has been pronounced cured. Wash and scrub all surfaces with a solution of 1-1/2 ounces of soap chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Flush away all soap and dirt with clean water and then etch the surface with a 15 percent or stronger solution of muriatic acid until an open-faced granular texture, similar to fine sandpaper, is obtained. Any areas that remain smooth are to be re-etched until the desired texture is achieved. Flush and scrub away with clear water all acid and loosened particles.
 - 3. CC-3 Blast Cleaning: Remove all form oil and dirt by washing the surface with a solution of 1-1/2 ounces of soap chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Blast clean all laitance and other foreign material from the surface of the concrete until an open-faced granular texture similar to fine sandpaper is achieved. These results should be accomplished with blast cleaning similar to "brush blasting" steel surfaces.
 - 4. Prior to the surface preparation noted in paragraphs 1, 2, and 3 above, all concrete surfaces to be painted shall have a rubbed stone finish in accordance with Section 03 30 00 of these Specifications.
- P. Coated Piping: For bituminous coated piping if one seal coat is insufficient to protect the priming coat, the sealing process shall be repeated until a satisfactory seal is obtained. Black pipe shall be cleaned thoroughly. Piping shall be abrasive blasted clean if no seal coat is available for the paint used.
 - 1. All interior piping, submerged piping and above grade exterior piping outlined for coating under this section shall be supplied with a factory applied primer in accordance with the enclosed painting schedule.
- Q. Machinery and Equipment: The Contractor shall identify and repair deficiencies in new factory coated surfaces prior to application of specified field coatings.
 - 1. <u>USE SPECIAL CARE TO LEAVE ALL NAMEPLATE AND NON-FERROUS FINISHED</u> TRIM UNPAINTED.
 - 2. Complete instructions as to equipment requiring painting shall be obtained from the Engineer before starting the work.
 - 3. Control centers and meter panels with a factory finish shall not be painted in the field, unless damaged in shipment or installation.

- 4. All rust, scale and other areas of obvious coating breakdown (loose mill scale, loose rust, loose paint and other detrimental foreign matter) shall be power tool cleaned to bare metal in accordance with SSPC-SP-11.
- 5. Prior to power tool cleaning, the repair areas shall be cleaned of foreign matter and oil and grease removed by biodegradable cleaning solvent compatible with the specified system to be applied.
- 6. All edges shall be feathered a minimum of three (3) inches from the center of the damaged area to the tightly adhered existing paint and the existing coating roughened with 80 grit abrasive coated paper to assure proper adhesion of the coating repair work.
- R. Copper Surfaces Scheduled for Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.
- S. Copper Surfaces Scheduled for Natural Oxidized Finish: Remove contamination by applying oxidizing solution of copper acetate and ammonium chloride in acetic acid. Rub on repeatedly for required effect. Once attained, rinse surfaces with clear water and allow to dry.
- T. Gypsum Board Surfaces: Fill minor defects with filler compound. All surfaces shall be clean, dry and free from grease, oil or other contaminants. All joint compounds shall be sanded smooth and the edges feathered to provide a smooth transition to the new dry wall. Spot prime defects after repair.
- U. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer. Conduit on interior walls or ceilings shall be painted with the same color as that selected for the walls or ceilings unless otherwise directed by the Owner or Engineer.
- V. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry. All voids, open or hollow places in masonry shall be repaired with an epoxy patching compound.
- W. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- X. Non-Submerged Uncoated Steel and Iron Surfaces: Remove grease, oil, mill scale, weld splatter, dirt, loose paint, rust and other foreign matter. To remove grease and oil, clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Where heavy coatings of mill scale or rust are evident, surface shall be cleaned in accordance with SSPC –SP6 commercial blast cleaning and have edges feathered. Spot prime paint after repairs.
- Y. Submerged Uncoated Steel and Iron Surfaces: Remove grease, oil, mill scale, weld splatter, dirt, loose paint, rust and other foreign matter. To remove grease and oil, clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Where heavy coatings of mill scale or rust are evident, surface shall be cleaned in accordance with SSPC –SP10 near white metal blast cleaning. Spot prime paint after repairs. In the event that the time for re-coat expires prior to the application of the field applied coats, the

- surfaces shall be abrasive blasted in accordance with SSPC-SP-6 "Commercial Blast Cleaning", primed and painted as specified
- Z. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
 - 1. All shop primed ferrous materials using a primer that is not compatible with finish coat or that the recoat time for primer has lapsed shall have that primer removed by abrasive blasting, and reprimed prior to final coat. Abrasive blasting, if required, shall be SSPC-6.
- AA. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections. Fill nail holes and cracks after primer has dried; sand between coats.
- BB. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.
- CC. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior paintable caulking compound after prime coat has been applied.
- DD. Exterior Wood Scheduled to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied.
- EE. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.
- FF. Precast Concrete Hardware: All metal embedded in precast concrete shall be primed and painted in accordance with the paint manufacturer's printed data and the painting schedule.
- GG. Wood Doors Scheduled for Painting: Seal wood door top and bottom edge surfaces with tinted primer.
- HH. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.
- II. Door Frames, Window Frames, and Trim: Remove all rust and loose scale with wire brush and wipe clean. Caulk around frames and trim as per manufacturer's recommendations. Primer shall be applied to damaged areas and all indentions repaired.

3.6 BLAST CLEANING

- A. There shall be no blast cleaning inside existing buildings without written consent from the Engineer.
- B. Blast cleaning equipment shall be well maintained with properly sized pots, hoses, nozzles and all support equipment required to complete the work as specified.
- C. Compressors shall be installed with the necessary oil and water separators and filters to ensure that the compressed air supply is free from moisture and oil contamination.

- D. Abrasives used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with the adhesion of the coating and shall not be reused unless approved by the Engineer.
- E. If recycled abrasives are used, appropriate equipment to clean the abrasive, including fine particle and dust removal, shall be provided.
- F. Abrasives used in blast cleaning shall be such that they will produce a 1.5 to 2.0 mil surface profile (37.5 microns to 50 microns) or as recommended by the coating manufacturer.

3.7 HAND AND POWER TOOLS

- A. Hand and Power tools shall be well maintained and in proper working order.
- B. Discs, brushes, wheels, etc shall be free from grease and oil and other materials that could contaminate the substrate and sized, when specified, to produce the required surface profile

3.8 HIGH PRESSURE WATER JETTING

- A. High pressure water jetting equipment shall be well maintained, in proper working order and sized to provide a minimum of 35,000 psi of water pressure.
- B. The equipment shall be provided with the necessary nozzles and attachments to obtain the level of cleaning required without damaging the substrate being cleaned.
- C. Water utilized in the water jetting operations shall be clean and free of contaminants.
- D. Necessary steps shall be taken to ensure that damage does not occur to existing electrical equipment and appurtenances during power washing operations.
- E. Should such equipment or appurtenances be damaged, the Contractor shall repair or replace these items to the full satisfaction of the Owner.

3.9 COATING "STRIPPER"

A. The coating stripper shall be an environmentally safe paint/coating removal system specifically designed to remove various types of coatings from varying substrates.

3.10 CONTAINMENT

- A. The Contractor shall be responsible for containing, collecting and disposing of all paint particles, residues, dust, paint chips as well as all other debris generated from the water jetting, "stripping", abrasive blasting, power tool cleaning, hand tool cleaning and other cleaning operations required in conjunction with the work specified herein.
- B. All work shall be performed in accordance with OSHA Safety and Health Standards 29 CFR 1910.1025. The Contractor shall submit the details of the proposed containment methods and equipment to be utilized to the Engineer for review prior to initiating cleaning operations.

- C. Disposal: Prior to beginning any cleaning operations, a representative sample of all existing coatings to be rehabilitated shall be removed from a designated portion of the various structures and sent to a laboratory for analysis.
 - 1. Samples obtained for coatings to be removed using abrasive blast cleaning shall include the residues of the blasting operations.
 - 2. The paint samples and blasting residues collected shall be analyzed to determine if the residues exceed the "leachable" limits for lead, arsenic, barium, cadmium, chromium, mercury, selenium and silver as determined by the EPA's Toxicity Characteristics Leaching Procedure (TCLP).
 - 3. Should the results of the analysis exceed any of the EPA's maximum limits the Contractor shall apply for an EPA identification number for a generator of hazardous waste.
 - 4. Application and disposal of debris shall be in a manner approved by the State in which the project is located.
 - 5. If the results of the certified test are less than the EPA maximum limit the Contractor shall dispose of the debris generated in an approved landfill in accordance with all applicable regulations.
- D. Monitoring: To assist in determining the suitability and efficiency of the containment systems to be employed by the Contractor to contain particles and debris generated during the various exterior cleaning processes specified, the Contractor will be required to provide, maintain and analyze various methods to assess the quantity of emissions generated. These methods are described as follows:
 - Visible Emissions:
 - a. During cleaning operations, the work area shall be monitored to provide an immediate assessment of the performance of the containment methods employed by the Contractor.
 - b. Under no circumstance shall emission extend beyond the boundaries of where the coating work is being completed into general areas of the facility.
 - c. Intermittent emissions, within the property, will be monitored and subject to adjustments as required by federal, local, or state statutes or regulations.
 - d. If it is determined through monitoring or other means by the Engineer or Owner that the containment system selected and employed by the Contractor is not suitable or capable of containing the cleaning residues, debris and other materials as required, the Contractor shall, at no cost to the Owner, make use of other containment systems, equipment or measures as may be required to ensure that all materials are contained as specified.
 - e. No further work shall proceed until the necessary improvements are in place. Any remediation which may be required as the result of improper containment shall be the responsibility of the Contractor.

3.11 PREPARATION OF EXISTING PAINTED SURFACES

- A. The Contractor shall prepare and coat existing surfaces, structural members, equipment, piping, etc. which are noted in the Painting Schedule and/or on the Drawings to be repainted in the field.
- B. All surfaces shall be prepared in accordance with the best practice. Surface preparation and coating shall be performed only by crews experienced in this work.

- C. Coatings shall be applied by a subcontractor having the approval of the manufacturer and whose workmen have been instructed in the application of these coatings by the manufacturer.
- D. A representative of the paint manufacturer shall be present when work begins to instruct personnel in substrate preparation and application techniques.
- E. Extend existing paint and coatings installations using materials and methods compatible with existing installations and as specified.
- F. Where water jetting is specified or detailed on the plans, high pressure water jetting shall be performed using a minimum pressure of 35,000 psi to remove all existing paint/coatings, dirt, dust, mildew and all other foreign matter.
 - 1. All existing coating removed during water jetting (non-lead based) shall be separated from the wash water, contained and properly disposed of in accordance with the applicable regulations.
 - 2. The wash water resulting from the cleaning operations may be discharged to the plant's sanitary sewer system.
 - 3. Depending on the condition of the existing coating, the contractor may be required to utilize higher pressures than those specified or other cleaning techniques or additives.
 - 4. However, in no case shall the water pressures employed be as such that damage occur to the existing structures.
 - 5. All defective surfaces showing aggregate and visible holes shall be cut out and pointed with a special bonding grout as manufactured by Master Builders, or equal.
 - 6. When surfaces contain small holes which cannot be patched uniformly, or where special patching is necessary, the Contractor shall use Speed Crete Red Line by Tamms or equal prior to applying the specified coatings.
- G. Where chemical removal of coatings is specified or detailed on the plans, all existing paint/coatings shall be removed utilizing an environmentally safe paint/coating removal system specifically designed to remove various types of coatings from varying substrates.
 - 1. The Contractor shall be responsible for testing the coating removal system in the areas where it is specified for use to determine the appropriate system to be utilized, the thickness to which the product will be applied and the amount of time required before the product is removed.
 - 2. The product shall be applied and utilized in strict accordance with the manufacturers printed instructions.
 - 3. Surfaces, which have been stripped, shall be treated in accordance with the manufacturer's recommendations and the coating system manufacturer's recommendations (i.e., neutralizing, water rinsing, power tool cleaning, abrasive blasting, etc.) before the specified coating system is applied.
 - 4. All water utilized in conjunction with the coating stripper in areas which are suspected to contain lead based coatings shall be collected and contained and disposed off in accordance with all applicable regulations.
- H. Unless otherwise noted or specified all existing ferrous metals to be coated shall be power tool cleaned to bare metal in accordance with SSPC-SP-11 to remove all rust, scale and other areas of obvious coating breakdown (loose mill scale, loose rust, loose paint and other detrimental foreign matter).

- 1. Prior to power tool cleaning, all metal surfaces shall be cleaned of foreign matter and oil and grease removed by biodegradable cleaning solvent compatible with the specified system to be applied.
- 2. All edges shall be feathered a minimum of three (3) inches from the center of the cleaning to the tightly adhered existing paint and the existing coating roughened with 80 grit abrasive coated paper to assure proper adhesion of the specified primer.
- 3. In closed or inaccessible areas, hand wire brush at a minimum to guarantee adhesion prior to primer application.
- I. All submerged surfaces outlined for coating under this section shall be abrasive blasted in accordance with SSPC-SP-10 "Near-White Metal Blast.
- J. Where indicated on the Drawings, the Contractor shall remove wallpaper from the existing gypsum wall board and all scratches, gouges, and other imperfections filled with joint compound to provide a smooth surface suitable for painting.
 - 1. All joint compound shall be sanded smooth and the edges feathered to provide a smooth transition to the new dry wall.

3.12 APPLICATION

- A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- B. All finishes must meet mil thickness and color requirements.
- C. Paint shall be evenly spread and well brushed out so that there shall be no pinholes, drops, runs nor sagging of materials.
- D. Embedded roller knap and fibers, dry-spray and over-spray will not be acceptable.
- E. Care shall be taken to ensure the application of a uniform coating and that paint is carefully worked around bolt heads, rivets, weld seams, ladder rungs, joints and other irregularities.
- F. Painting which is found defective shall be removed and repainted. Remove and replace, at the direction of the Engineer, any painting work found to be defective or applied under adverse conditions.
- G. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- H. Sand wood and metal surfaces lightly between coats to achieve required finish.
- I. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- J. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.
- K. Prime concealed surfaces of interior and exterior woodwork with primer paint.

- L. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.
- M. Finishing Mechanical And Electrical Equipment:
 - 1. Paint shop primed equipment.
 - 2. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 - 3. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, and collars and supports, except where items are shop finished.
 - 4. Paint interior surfaces of air ducts visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers and grilles to match face panels.
 - 5. Paint exposed conduit and electrical equipment occurring in finished areas.
 - 6. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 - 7. Color code equipment, piping, conduit, and exposed duct work in accordance with color schedule. Color band and identify with flow arrows, names, and numbering.
 - 8. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.13 FIELD QUALITY CONTROL

- A. All phases of the work in connection with surface preparation and coating application shall be inspected and approved in a step-by-step procedure.
- B. Inspections and testing may include, but are not limited to, surface preparation, post-cleaning cleanliness, paint application, dry film thickness film appearance, continuity and adhesion.
- C. Where applicable, destructive and non-destructive instruments may be utilized to determine that the various phases of the work completed by the Contractor were performed in accordance with the specifications.
- D. Instruments which may be used, include but are not limited to, notch type wet film thickness gages, nondestructive magnetic thickness gages, Tooke gages and adhesion testing equipment.
- E. All testing will be as required by the Engineer.
- F. All coatings shall be tested for holidays and thickness by a wet sponge type, low voltage holiday detector and a dry film mil gauge.
- G. All holidays and millage deficiencies shall be repaired.
- H. Coatings may be tested for thickness and application by use of Tooke type instrument if required by the Engineer.
- I. All equipment for testing shall be provided by the Contractor and supplied by the coating manufacturer, but will be tested as required by the Engineer.

- J. Painting which is found to be defective or found to have been applied contrary to these specified conditions shall be removed and repainted.
- K. The dry film thickness of each coat of paint on a steel substrate shall be determined using a nondestructive dry film thickness gage.
 - 1. The calibration, use and frequency of measurements shall be in accordance with SSPC-PA-2
- L. On non-metallic substrates, a Tooke gage may be utilized to determine the dry film thickness of a coating system.
 - 1. If utilized, the Contractor will be responsible for marking and repairing all damage created by the destructive testing.
 - 2. Damaged areas shall be repaired so that the repairs blend in with the surrounding coating.
 - 3. The Tooke gage may also be utilized to resolve disputes regarding the dry film thickness of coating on metallic substrates.
- M. During coating application, the wet film thickness of each coat of paint shall be determined using a notch type wet film thickness gage in accordance with ASTM D4414.
- N. Where applicable, the determination of the final surface appearance may be based upon comparison with the latest versions of SSPC-VIS-1 or ASTM D610.
- O. During coating operations, the Contractor shall record and submit to the Engineer for his review daily coating application figures.
 - 1. Application rates should be recorded on a per gallon basis and include the location of and approximate square footage of the area in which the coating was applied.
 - 2. Coverage rates shall be in accordance with Manufacturer's recommendations.
- P. Contractor shall repair all damaged test areas at no additional cost.

3.14 REMEDIAL AND REPAIR WORK

- A. Prior to completion of the project, the Contractor shall identify and repair all damaged coatings.
 - Localized coating damage shall first be solvent cleaned in accordance with SSPC-SP 1
 "Solvent Cleaning" and then repaired by power tool cleaning in accordance with SSPC-SP 3
 "Power Tool Cleaning" for damage which does not expose the substrate and SSPC-SP 11
 "Power Tool Cleaning to Bare Metal" for damage that exposes the substrate.
 - 2. All edges shall be feathered a minimum of three (3) inches from the center of the damaged area to the tightly adhered existing paint and the existing coating roughened with 80 grit abrasive coated paper to assure proper adhesion of the coating repair.
 - 3. Extensive coating damage shall be repaired by abrasive blast cleaning to the specified surface cleanliness and the existing coating feathered to tightly adhered existing paint.
 - 4. When performing cleaning work using abrasive blast cleaning, caution shall be exercised to insure that the existing coatings are not exposed to abrasion from the blast cleaning operations.
 - 5. For coating damage that exposes the bare substrate, the coating repair material shall consist of all coats of the specified coating system.
 - 6. For coating damage that does not expose the bare substrate, the coating shall consist of the damaged coatings.

- 7. The total dry film thickness of the repair shall be within the specified total thickness tolerances of the coating system.
- B. The Contractor shall identify and repair deficiencies in the coating work to the full satisfaction of the Owner.
- C. All repair work shall be completed in accordance with the manufacturer's recommendations.
- D. Repairs, which result in an uneven coloring or poor appearance, will not be acceptable.

3.15 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Upon completion of the work, all paint splatters or drippings shall be removed to the full satisfaction of the Owner. If the spray method is used for the application of the exterior paint, care shall be taken to ensure that no overspray falls upon existing equipment and other materials/structures not to be painted. The Contractor shall be responsible for any and all damage resulting from overspray.
- C. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.
- D. Final clean up and restoring the site to its original condition is the responsibility of the Contractor. All empty coating containers, waste coating, thinners and solvents will remain the property of the Contractor and will be properly disposed of and removed from the jobsite. Jobsite disposition of waste such as burning or pouring onto the soil or into surface drains will not be permitted.
- E. Before the work will be considered complete, all rubbish and unused material due to, or connected with, the progress of the work shall be removed from the premises and disposed of in a manner satisfactory to the Owner. Private and public property disturbed and damaged as a result of the work shall be restored to their former condition by the Contractor; final payment will be withheld until that work is finished

3.16 SCHEDULE

- A. General: The Painting Schedule summarizes the painting systems to be applied to the various surfaces. Items which appear in the Painting Schedule are defined as follows:
- B. Exposure terms refer to the environmental conditions to which different surfaces may be exposed. A surface may exist in more than one exposure, e.g. an exterior wall can be categorized not only as "above grade", but also as "below grade", where the exposure is delineated by the grade line.
 - 1. Interior: All surfaces within the confines of a building or other enclosure not constantly exposed to weather, including concealed surfaces subject to trapped moisture, heat or other deteriorating conditions and all surfaces exposed to view.
 - 2. Exterior
 - a. Above Grade: All surfaces above finished grade and exposed to weather.

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- b. Below Grade: All surfaces below the finished grade line. Building surfaces with this exposure shall only be painted when they are structurally common with an interior surface, e.g. exterior walls of a dry pit, not the exterior wall of a below grade tank.
- 3. Submerged: All surfaces below a water surface or exposed to spray. Surfaces exposed to spray include all areas within 6-inches of maximum water surface in quiescent tanks and within 18-inches of maximum water surface in mixed or agitated tanks. Building surfaces with this exposure shall only be painted when surfaces above water level have an interior exposure.

C. Surfaces:

- 1. Floors: Interior surfaces subject to foot or roller traffic.
- 2. Building Surfaces: All structural and architectural surfaces except floors. Building surfaces include, but are not limited to, doors and frames, windows and frames, floor doors and walls.
- 3. Piping: All plumbing and process piping and accessories including valves, fittings, pipe supports, electrical conduit and similar related items.
- 4. Equipment: All mechanical, electrical, and architectural equipment, items, and accessories installed in the work and not defined above. Equipment includes, but is not limited to, pumps, motors, cabinets, ducts, tanks and process equipment.

3.17 MATERIAL SCHEDULES:

A. Material Schedules list pretreatment coats, wash coats, seal coats, prime coats, intermediate coats, finish coats and cover coats that comprise a complete and compatible system of surface protection for the particular substrate. Maintain the unity of these systems, making sure all coats applied to any surface are from the same system and same manufacturer. Verify with the manufacturer the compatibility of the materials used.

B. Painting Schedule

| | | System Schedules | | | | |
|--|-------------------------|-------------------------------------|--|--------------------------------|---------------------------------|--|
| Exposure | Surfaces | Concrete & Concrete Block Substrate | Non- Ferrous Metals Substrate | Ferrous Metals Substrate | Drywall or Wood Substrate | |
| | Building Surface** | 134 | - | 144 | 160 or 168 | |
| | Wet Areas** | - | - | - | 184 | |
| | Equipment* | - | 157 | 144 | - | |
| Interior | Piping* | - | 157 | 144 | - | |
| | Copper Piping | - | 114 | - | - | |
| | Doors** | - | 121 | 141 | - | |
| Exterior Above Grade | Building Surfaces ** | 234 or 238 | 257 | 247 | - | |
| | Wood** | - | - | - | 221 | |
| | Copper Piping | - | 214 | - | - | |
| | Equipment* | - | 257 | 241 | - | |
| Exterior Below Grade | Piping* | - | 257 | 247 | - | |
| Submerged in Wastewater or Water Plant Sludge | Piping* | - | - | 544 | - | |
| | Equipment* | - | - | 544 | - | |
| Submerged in Potable Water | Piping* | - | - | 344 | - | |
| | Equipment* | - | - | 344 | - | |

^{*} See coating, lining, and/or painting paragraphs in individual piping or equipment Specification Sections.

^{**} See finish schedule for where each type shall be used.

C. Schedule Numbering Guide

| First Number – | | Second Number – | | Third Number – | | |
|----------------|----------------------|-----------------|--------------------|----------------|--------------|--|
| | Exposure | | Substrate | | Coating Type | |
| 1 | Interior and Weather | 1 | Non Famous Matal | 1 | | |
| 1 | Protected | 1 | Non-Ferrous Metal | 1 | Alkyd | |
| 2 | Exterior Weather | 2 | Wood | 2 | A amb altia | |
| 2 | Exposure | 2 | w ood | 2 | Asphaltic | |
| | Submerged in | | | | | |
| 3 | Potable Water but | 3 | Concrete, Concrete | 4 | Ероху | |
| 3 | Protected from | 3 | Block, Masonry | | | |
| | Sunlight | | | | | |
| | Submerged in | | | | | |
| 4 | Potable Water and | 4 | Ferrous Metals | 5 | Vinyl | |
| | Exposed to Sunlight | | | | | |
| 5 | Submerged in | 5 | Galvanized Ferrous | 6 | Coal Tar | |
| 3 | Wastewater | 3 | Metals | 6 | Coai Tar | |
| | | 6 | Drywall | 7 | Polyurethane | |
| | | 7 | PVC Pipe | 8 | Acrylic | |
| | | 8 | Moisture Resistant | 9 | Zinc | |
| | | 0 | Drywall | 0 | Latex | |

System: 114
Type: Clear Epoxy

Use: Interior Non-Ferrous Metal; Copper and Brass Operating and Control Piping

Surface Preparation: Clean and polish to bright uniform sheen with approved polishing compound

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|-------------|
| 1 st | 1.0 - 2.0 | Series 1079 |
| 2 nd | 1.0 - 2.0 | Series 1079 |
| System | 3.0 | |

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System: 121 Type: Alkyd

Use: Interior Non-Ferrous Metal; Doors, Frames, Trim

Surface Preparation: Clean

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|-----------------------------------|
| 1 st | 2.0 - 3.0 | Series 10-99W Primer |
| 2 nd | 2.0 - 3.0 | Series 2 Hi-Build Tneme- Gloss |
| 3 rd | 2.0 – 3.0 | Series 2 Hi-Build Tneme- Gloss |
| System | 7.0 | |

System: 134 Type: Epoxy

Use: Interior Masonry and Concrete

Surface Preparation: CC-1

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|--------------------|
| 1 st | | Series 130 |
| 1 | | Envirofill |
| 2 nd | 4.0 | Series N69 Hi- |
| 2 | 4.0 | Build Epoxoline II |
| 3rd | 4.0 | Series N69 Hi- |
| 3 | 4.0 | Build Epoxoline II |
| System | 8.0 | |

System: 141 Type: Alkyd

Use: Interior Ferrous Metal; Doors, Frames, Trim

Surface Preparation: SP-3

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|-----------------------------------|
| 1 st | 3.0 - 5.0 | Series 10 Primer |
| 2 nd | 4.0 - 6.0 | Series 2 Hi-Build Tneme- Gloss |
| 3 rd | 4.0 – 6.0 | Series 2 Hi-Build Tneme- Gloss |
| System | 14.0 | |

System: 144 Type: Epoxy

Use: Interior Ferrous Metal Surface Preparation: SP-10

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| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|--|
| 1 st | 3.0 – 5.0 | Series N69-1211 Epoxoline Primer |
| 2 nd | 4.0 – 6.0 | Series 69-Color Hi-Build Epoxoline II |
| 3 rd | 4.0 – 6.0 | Series 69-Color Hi-Build Epoxoline II |
| System | 14.0 | |

System: 157 Type: Epoxy

Use: Galvanized Metals

Surface Preparation: SP-1 With Manufacturer's Recommended Pre-Treatment

| | 1 | |
|-----------------|-----------------------------------|--|
| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
| 1 st | Passivator or Neutralizer | |
| 2 nd | 4.0 - 6.0 | Series 69-1211 Epoxoline Primer |
| 3 rd | 4.0 - 6.0 | Series 69-Color Hi-Build Epoxoline II |
| System | 10.0 | |

System: 160 Type: Latex

Use: Interior Drywall, Dry Areas Surface Preparation: Clean and Dry

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|----------------------|
| 1 st | 1.0 | Series 6 Tneme- Cryl |
| 2 nd | 1.5 - 3.0 | Series 6 Tneme- Cryl |
| $3^{\rm rd}$ | 2.0 | Series 6 Tneme- Cryl |
| System | 5.0 | |

System: 168

Type: Acrylic Epoxy Use: Interior Drywall – Dry Areas Surface Preparation: Clean & Dry

| | Minimum Dry Film | |
|-----------------|------------------|-------------------|
| Coat | Thickness (Mils) | Tnemec |
| 1 st | 1.0 - 2.0 | 51-792 PVA Sealer |

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| 2 nd | 2.0 - 4.0 | Series 113-Color H. B. Tneme-Tufcoat |
|-----------------|-----------|---|
| 3 rd | 2.0 - 4.0 | Series 113-Color H. B. Tneme-Tufcoat |
| System | 7.0 | |

System: 184

Type: Polyamine Epoxy Use: Interior Drywall- Wet Areas Surface Preparation: Clean & Dry

| | - F | |
|-----------------|--------------------------------------|---|
| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
| 1 st | 1.0 - 2.0 | Series 151-1051 Elasto- Grip FC |
| 2 nd | 2.0 - 4.0 | Series 114-Color H. B. Tneme-Tufcoat |
| 3 rd | 2.0 – 4.0 | Series 114-Color H. B. Tneme-Tufcoat |
| System | 7.0 | |

System: 214

Type: Clear Epoxy

Use: Exterior Non-Ferrous Metal; Copper and Brass Operating and Control Piping

Surface Preparation: Clean and polish to bright uniform sheen with approved polishing compound

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|--------------|
| 1 st | 1.0 - 2.0 | Series 1079r |
| 2 nd | 1.0 - 2.0 | Series 1079 |
| System | 3.0 | |

System: 221 Type: Alkyd

Use: Exterior Wood

Surface Preparation: Clean and dry

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec | |
|-----------------|--------------------------------------|---------------------------------|--|
| 1 st | 2.0 | Series 36 – 603 Undercoater | |
| 2 nd | 1.5 - 2.0 | Series 23 – Color Enduratone | |
| 3 rd | 1.5 – 2.0 | Series 23 – Color Enduratone | |

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| System | 5.0 |
|--------|-----|
|--------|-----|

System: 234

Type: Epoxy
Use: Exterior Concrete Surface Preparation: CC-3

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|-----------------------|
| 1 st | 8.0 - 10.0 | Series 52 Tneme-Crete |
| 2^{nd} | 5.0 - 7.0 | Series 52 Tneme-Crete |
| 3 rd | As Needed | Series 52 Tneme-Crete |
| System | 15.0 | |

System: 238

Type: Acrylic Use: Exterior Concrete Masonry Surface Preparation: CC-1

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|-----------------------------------|
| 1 st | 4.0 - 6.0 | Series 156- Color Enviro-Crete |
| 2 nd | 4.0 - 6.0 | Series 156- Color Enviro-Crete |
| 3 rd | 2.0 | Series 156- Color Enviro-Crete |
| System | 12.0 | |

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System: 241 Type: Alkyd

Use: Exterior Ferrous Metal; Equipment or Machinery

Surface Preparation: SP-10

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|-----------------------------------|
| 1 st | 2.0-3.0 | Series 10 Primer |
| 2 nd | 2.0 - 3.0 | Series 2 Hi-Build Tneme- Gloss |
| 3 rd | 2.0 - 3.0 | Series 2 Hi-Build Tneme- Gloss |
| System | 8.0 | |

System: 247

Type: Polyurethane

Use: Exterior Ferrous Metal; Piping, Valves, Precast Panel Connection Hardware, Supports

Surface Preparation: SP-10

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|-------------------------------------|
| 1 st | 3.0 | Series N69-1211 Epoxoline |
| 2 nd | 4.0 - 6.0 | Series N69 Hi-Build Epoxoline II |
| 3 rd | 2.0 – 3.0 | Series 1074 Endura- Shield II |
| System | 11.0 | |

System: 257

Type: Polyurethane

Use: Exterior Non-Ferrous Metal

Surface Preparation: SP-1

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|---------------------------------------|
| 1 st | 4.0 - 6.0 | Series 69-Color Hi-Build Epoxoline |
| 2 nd | 2.0 - 3.0 | Series 1074-Color Endura-Shield II |
| System | 8.0 | |

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System: 344 Type: Epoxy

Use: Submerged Ferrous Metal (For Potable Water Use)

Surface Preparation: SP-10

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec |
|-----------------|--------------------------------------|-----------------------------|
| 1 st | 4.0 - 6.0 | Series 20-Color Pota-Pox |
| 2 nd | 4.0 - 6.0 | Series 20-Color Pota-Pox |
| 3 rd | 4.0 - 6.0 | Series 20-Color Pota-Pox |
| System | 15.0 | |

System: 544 Type: Epoxy

Use: Submerged Ferrous Metal (For Non-Potable Water Use Only)

Surface Preparation: SP-10

| Coat | Minimum Dry Film Thickness (Mils) | Tnemec | |
|-----------------|--------------------------------------|-----------------------|--|
| 1 st | 4.0 - 6.0 | Series N69-Color | |
| 1 | 4.0 – 0.0 | Hi-Build Epoxoline II | |
| 2 nd | 4.0 - 6.0 | Series N69-Color | |
| | 4.0 - 0.0 | Hi-Build Epoxoline II | |
| 3rd | 4.0 - 6.0 | Series N69-Color | |
| 3 | 4.0 - 0.0 | Hi-Build Epoxoline II | |
| System | 15.0 | | |

3.18 PIPE IDENTIFICATION AND COLOR CODING

A. All new piping installed shall be clearly labeled and marked with flow arrows at locations directed by the Engineer. Each label shall be preceded by the pipe diameter. The proposed size and type of lettering shall be submitted to the Owner and Engineer for approval. The following table of colors is recommended by the Engineer but the final colors and text shall be selected by the Owner.

B. Pipe Identification and Color Coding Table.

| | Paint Colors | | | |
|------------------------------------|-----------------------------------|-----------------------|--------------------|--|
| Pipe System | Pipe | Letters and Arrows | Stencil Text | |
| Air (Compressed) | | | Air | |
| | Light Green | Black | | |
| Air (Process) | Light Green w/Black Bands | Black | Air Process | |
| Air, Instrument | Light Purple | Black | Air Instrument | |
| Alum or Primary Coagulant | Dark Blue w/ Light Brown Bands | Light Brown | Alum | |
| Ammonia Gas | Yellow w/Dark Green Bands | Dark Green | Ammonia Gas | |
| Ammonia Solution | Yellow w/Light Blue Bands | Light Blue | Ammonia Solution | |
| Backwash Water | Light Grey w/Light Green Bands | Light Green | Backwash Water | |
| Carbon Slurry | Black | White | Carbon Slurry | |
| Caustic | Yellow with Green Band | White | Caustic | |
| Chlorine Gas | Yellow w/Red Bands | Red | Chlorine Gas | |
| Chlorine Solution | Yellow | Black | Chlorine Solution | |
| Dewatering | Black w/Orange Bands | Orange | Dewatering | |
| Digested Sludge | Dark Brown w/Red Bands | Red | Digested Sludge | |
| Drains (Plant) | Black w/ White Bands | White | Drain | |
| Effluent, Secondary | Light Grey w/ Black & White Bands | Black | Secondary Effluent | |
| Filter Effluent | Light Grey w/ White Bands | White | Filter Effluent | |
| Filtrate | Black w/Yellow Bands | Yellow | Filtrate | |
| Fluoride (Hydrofluorosilicic Acid) | Light Blue with Red Band | Blue | Fluoride | |
| Foam Spray Water | Dark Green | White | Foam Spray Water | |
| Gasoline | Orange | White | Gasoline | |
| Hydraulic Fluid | Purple | White | Hydraulic Fluid | |
| Injector Water | Light Grey w/Purple Bands | Light Purple | Injector Water | |
| Lime Slurry | Light Green | White | Lime Slurry | |

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| | Paint Colors | | | |
|--|---------------------------------|-----------------------|-------------------------------|--|
| Pipe System | Pipe | Letters and Arrows | Stencil Text | |
| Lubricating Oil/Grease | Dark Blue w/Red Bands | Red | Lubricant Oil/Grease | |
| Mixed Liquor (Aeration Tank Effluent) | Light Grey w/ Pink Bands | Pink | Mixed Liquor | |
| Natural Gas | Red | White | Natural Gas | |
| Ozone | Yellow with Orange Band | White | Ozone | |
| Phosphate Compounds | Light Green with Red Bands | White | Phosphate Compounds | |
| Polymer | Pink w/Dark Green Bands | Dark Green | Polymer | |
| Potassium Permanganate | Violet | White | Potassium Permanganate | |
| Potable Water | Light Blue | White | Potable Water (Cold) (Hot) | |
| Raw Sewage (Wastewater) | Dark Grey | Orange | Sewage | |
| Recirculation Discharge | Orange and Black | Black | Recirculation Discharge | |
| Recirculation Suction | Orange and Brown | Brown | Recirculation Suction | |
| Return Activated Sludge | Light Brown | White | Return Sludge | |
| Scrubber Water | Light Green w/Dark Brown Bands | Dark Brown | Scrubber Water | |
| Scum | Light Brown w/Pink Bands | Pink | Scum | |
| Scum Decant | Light Brown w/ Red Bands | Red | Scum Decant | |
| Sludge Feed | Brown and Black | Black | | |
| Sump Drains (Plant) | Light Grey w/ Orange Bands | Orange | Sump | |
| Settled or Clarified | Dark Blue | Black | Settled | |
| Sewer | Dark Gray | Black | Sewer | |
| Soda Ash | Light Green with Orange Band | White | Soda Ash | |
| Sulfuric Acid | Yellow with Red Band | Red | Sulfuric Acid | |
| Sulfur Dioxide | Light Green with Yellow Band | Yellow | Sulfur Dioxide | |
| Supernatant and Centrate | Brown and Gray | Brown | Supernatant and Centrate | |
| Thickener Filtrate | Light Grey w/Dark Brown & | | Thickener Filtrate | |
| (Supernatant) | Light Brown Bands | Light Brown | (Supernatant) | |
| Thickened Sludge | Light Brown w/Light Green Bands | Light Green | Thickened Sludge | |
| Utility Water | Dark Green w/ Yellow Bands | Yellow | Utility Water (Non-Potable) | |
| Vents (Plant) | Black | White | Vent (Plant) | |

| | Paint Colors | | |
|------------------------|-------------------------------|-----------------------|--------------|
| Pipe System | Pipe | Letters and Arrows | Stencil Text |
| Waste Activated Sludge | Light Brown w/ Black Bands | Black | Waste Sludge |

Color Coding General Notes

- 1. All banding to be 2-inches wide and four feet on center.
- 2. Sample, drain, vent, metering, blow off, decant, and hot lines shall be painted the same color combination as the piping system from which the line originates unless specified otherwise above. The additional pertinent text shall be applied to the pipe.
- 3. Insulated pipe, jacketed with canvas, shall be painted with the color combination specified above.
- 4. Insulated pipe, jacketed with aluminum and/or stainless steel shall have the jacket unpainted. When valves and fittings for such lines are not insulated, the valves and fittings shall be color coded.
- 5. Building service lines such as plumbing lines, HVAC lines, and electrical conduit, shall not be color coded but shall be painted the same color as the background construction.
- 6. All sludge lines not otherwise specified above shall be painted dark brown and stenciled as directed by the Engineer.
- 7. All polymer lines not otherwise specified above shall be painted pink and stenciled as directed by the Engineer.
- 8. All lettering shall be done in capital letters of approved size and type.
- 9. Legend symbols shall be applied on piping on every run and spaced not greater than 8 feet apart.
- 10. Text shall be applied on piping in the middle of pipe runs for runs less than 50 feet or in one room, whichever is the least distance. On runs greater than 50 feet, text shall be applied at third points in the run and no more than 35 feet apart.
- 11. Pumps, chemical tanks and other items of equipment to be painted shall be painted a color corresponding to their service, in accordance with the above schedule.

3.19 SCHEDULE - COLORS

A. The Owner shall select all colors.

END OF SECTION

PLUG VALVES

SECTION 15 00 00

ECCENTRIC PLUG VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. The Contractor shall furnish and install eccentric plug valves as specified and as shown on the Contract Drawings.
- B. Eccentric plug valves shall be furnished complete with operators and accessories at locations shown on the Drawings or where specified.
- C. Plug valves installed above grade shall be painted according to the painting section.
- D. Plug valve manufacturer shall submit shop primer data sheets.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Design Data: Submit manufacturer's latest published literature including illustrations, installation instructions, maintenance instructions and parts lists.
- C. Manufacturer's Certificates: Submit Statement of Compliance, supporting data, from material suppliers attesting that valves and accessories provided meet or exceed AWWA Standards and specification requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of valves.
- C. Provide Operation and Maintenance Data for valves.

1.4 QUALITY ASSURANCE

- A. Install valve according to manufacturer's printed instructions.
- B. The following information shall be cast in or stamped on each valve.
 - 1. Manufacturer's identifying mark.
 - 2. Pressure rating.
 - 3. Place of manufacturing.
- C. Manufacturer to provide certification stating that valve is manufactured per applicable AWWA standard for each valve type and size.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum 5 years experience.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Prepare valves and accessories for shipment according to AWWA Standards and seal valve and ends to prevent entry of foreign matter into product body.
- C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.8 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Coordinate the valve laying length with the piping system.

1.9 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

PART 2 PRODUCTS

2.1 General:

- A. Valves shall be of the 90-degree turn, non-lubricated eccentric type with resilient faced plugs and shall be furnished with end connections as shown on the drawings.
- B. Flanged valves shall be faced and drilled to the ANSI 125/150 lb. standard.
- C. Mechanical Joint ends shall be AWWA Standard C111-64, grooved ends per AWWA C-606-87.
- D. Screwed ends shall be to the NPT standard.

2.2 Plug Valves:

A. Manufacturers:

- 1. Valves shall be manufactured by Clow, DeZurik, Milliken, Pratt and Valmatic.
- 2. Substitutions: Section 01 60 00 Product Requirements
- 3. Experience in the manufacture of similar size and type valves shall be required and verifiable documentation shall be provided.
- 4. The manufacturer of the plug valves shall submit valid documentation that they have successfully manufactured valve installations of the specified size, port type and eccentric design which have been successful in operation for at least five (5) years.

2.3 Valve Body:

- A. Valve bodies shall be of ASTM A126 Class B cast iron. Bodies in 4" and larger valves shall be furnished with a 1/8" welded overlay seat of not less than 90% pure nickel, machined to mate with the resilient faced plug.
- B. Valves that do not provide positive mating of the resilient faced plug with the nickel seat shall not be acceptable.
- C. Seat area shall be raised, with raised surface completely covered with weld to ensure that the plug face contacts only nickel.
- D. Screwed-in seats shall not be acceptable.
- E. True eccentric action shall be required.
- F. Plug valve Cv values shall be at least equal to or greater than the values published in the Dezurik Valve Technical Specifications Bulletin 12.00-1D dated September 2009.

2.4 Plugs:

- A. Plugs shall be of ASTM A126 Class B cast iron.
- B. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft.
- C. The interference between the plug face and the body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in line under pressure.
- D. The plug shall be completely coated with a Buna N compound suitable for use with raw sewage.
- E. The Buna N shall be applied at the factory to ensure that the plug is completely coated and then heat-treated to insure a positive bond.
- F. Following this process, bare cast iron shall not be visible or exposed in the flow area to ensure that the plug is abrasion resistant and suitable for service in raw sewage.

2.5 Bearings:

- A. Bearings shall be sleeve type metal bearings and shall be of sintered, oil impregnated, permanently lubricated type 316 ASTM A743 Grade CF-8M in ½" to 36" sizes.
- B. In valves larger than 36", the upper and lower plug journals shall be fitted with ASTM A-240 type 316 stainless sleeves with bearings of ASTM B30, Alloy C95400 aluminum bronze.
- C. Non-metallic bearings shall not be acceptable.

2.6 Shaft Seals:

A. Valves shaft seals shall be of the multiple V-ring type.

2.7 Testing:

- A. Valve working pressure rating shall be 150 psi.
- B. Each valve shall be given a hydrostatic and seat test at the factory with the results being certified in accordance with ANSI B16.1.

2.8 Actuators - Manual:

- A. Valve actuators for manual valves shall have lever or gear actuators and tee wrenches, extension stems, floor stand, extension bonnet, etc. as indicated on the Drawings.
- B. Hand wheel operators on geared actuators are acceptable in a non-buried environment where the valve is installed less than six feet above the floor.
- C. All valves 6" and larger shall be equipped with gear actuators.
- D. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator.
- E. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings.
- F. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque and to provide seat adjustment to compensate for change in pressure differential or flow direction change.
- G. All buried valves 4" and larger shall have gear operators.
- H. Valve and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water.
- I. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals.

J. All exposed nuts, bolts and washers shall be stainless steel.

2.9 Actuators – 480V Electric:

- A. Electric valve actuators shall be provided with plug valves at the locations shown on the drawings. These actuators shall receive an external signal from control wiring to "open" or "close" as detailed on the drawings. Provide limit 100% open and closed limit switches for remote indication. Motorized actuators shall be rated for 480V, 3Phase and include a 480-120V integral CPT.
- B. Actuators shall be designed to "open" and "close" against a maximum differential pressure of 150 psi.
- C. Actuators shall be designed for external installation with condensation heaters as needed.
- D. Actuators shall be equipped with local "Remote-Off-Local (Open/Close) selector switches.
- E. Actuators shall comply with AWWA C540.
- F. Actuators shall be by Rotork or equal.

2.10 Valve Identification:

A. Valves shall be provided with stainless steel tag and stainless-steel chain to identify valve. Owner shall provide valve ID number in the field.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install all valves, and accessories in accordance with manufacturer's printed instructions, in such manner as to insure a watertight fit, complete and ready for operation.
- B. Operate valves through one (1) cycle, i.e., "open, close, open" or "close, open, close" to assure they have been properly lubricated and adjusted.
- C. Valves installed in horizontal pipeline with sewage applications shall be installed such that the plug is horizontal and rotates upward as valve opens. This prevents sediment from sticking plug open.
- D. Valves installed in vertical pipeline applications shall be installed with the end marked "seat" at the top of the valve.

END OF SECTION

PUMP CHECK VALVES

SECTION 15 40 00

PUMP CHECK VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. Furnish and install the pump check valves and appurtenances at the locations shown on the drawings.
- B. Check valves shall be flexible disc type designed for a normal working pressure of 150 psi.
- C. The peak flows estimated for the check valves to be furnished and installed are less than 250 gallon per minute (gpm) per valve.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Design Data: Submit manufacturer's latest published literature including illustrations, installation instructions, maintenance instructions and parts lists.
- C. Manufacturer's Certificates: Submit Statement of Compliance, supporting data, from material suppliers attesting that valves and accessories provided meet or exceed AWWA Standards (AWWA C508) and specification requirements.
- D. The manufacturer shall submit shop primer data sheets during shop drawing review. The submittal will be rejected without this data. Proposed primers must be compatible with the finish coating system to be applied by the general contractor in the field. Data sheets shall demonstrate compatibility.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.
- C. Operation and Maintenance Data:
 - 1. Submit maintenance instructions for equipment and accessories.
 - 2. Furnish list of equipment and tools needed to maintain equipment.

1.4 QUALITY ASSURANCE

- A. Install valve according to manufacturer's printed instructions.
- B. The following information shall be cast in or stamped on each valve.

- 1. Manufacturer's identifying mark.
- 2. Pressure rating.
- C. Manufacturer to provide certification stating that valve is manufactured per applicable AWWA standard for each valve type and size.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum experience of 5 years.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Prepare valves and accessories for shipment according to AWWA Standards and seal valve and ends to prevent entry of foreign matter into product body.
- C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.
- D. Inspect for damage.

E. Shipping

- 1. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components or for installation requirements.
- 2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which they are intended.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.8 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Coordinate the valve laying length with the piping system.

1.9 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

PUMP CHECK VALVES

1.10 MEASUREMENT AND PAYMENT

- A. Basis of Payment: See Bid Form.
- B. Costs for items not specifically listed in the Bid Form shall be included in the lump sum bid for the project.

PART 2 PRODUCTS

2.1 CONNECTIONS

A. The valves shall be provided with flanges in accordance with ANSI B16.1, Class 125.

2.2 CHECK VALVE DESIGN

- A. The valve body shall be a full flow equal to nominal pipe diameter at all points through the valve. The seating surface shall be on a 45-degree angle to minimize disc travel. A threaded port with pipe plug shall be provided on the bottom of the valve for field installation of a backflow actuator or oil cushion device without special tools or removing the valve from the line. Valve body shall have an integrally cast boss with ½" threaded outlet for pressure gauge installation (by others) downstream of valve disc.
- B. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator.
- C. The disc shall be a one-piece construction, precision molded with an integral O-ring type sealing surface, and contain alloy steel and nylon reinforcement in the flexible hinge area. The flex portion of the disc shall be warranted for twenty-five (25) years. Non-slam closing characteristics shall be provided through a short 35-degree disc stroke and a disc accelerator to provide a cracking pressure of 0.3 psig.
- D. The disc accelerator shall be of one-piece construction and provide rapid closure of the valve in high head applications. The disc accelerator shall be enclosed within the valve and shall be field adjustable and replaceable without removal of the valve from the line. The disc accelerator shall be securely held in place captured between the valve and disc. It shall be formed with a large radius to allow smooth movement over the disc surface.
- E. The valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking, or distortion to the valve disc or seat and shall remain drop tight in high and low pressures.
- F. A mechanical indicator shall be provided to provide disc position indication. The indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position indication.

2.3 MATERIALS

- A. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 class B for 30-inch and larger.
- B. The disc shall be precision molded Buna-N (NBR), ASTM D2000-BG.
- C. The disc accelerator shall be Type 302 stainless steel.

2.4 MANUFACTURER

- A. Valves shall be Val-Matic Surgebuster Series 7200 or equal.
- B. Substitutions: Section 01 60 00 Product Requirements
- C. Experience in the manufacture of similar size and type valves shall be required and verifiable documentation shall be provided.
- D. The manufacturer of the check valves shall submit valid documentation that they have successfully manufactured valve installations of the specified size and type which have been successful in operation for at least five (5) years.

2.5 COATINGS

- A. All surfaces of the valve shall be clean, dry and free from grease before painting.
- B. The exterior of valves to be painted shall be factory primed and field coated as required in Section 09 90 00 PAINTING AND COATING of these Specifications. In accordance with the data provided in the submittal process, primer must be compatible with the finish coating system to be applied by the general contractor in the field.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all valves, and accessories in accordance with manufacturer's printed instructions.

3.2 TESTING

A. Field test valve at 150 psi to demonstrate zero leakage.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION

WASTEWATER COMBINATION AIR VALVES

SECTION 15 60 00

WASTEWATER COMBINATION AIR VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. Furnish and install the wastewater combination air valves (single body type) and appurtenances at the locations shown on the drawings.
- B. Air valve sizes (inlet and outlet size) shall be as detailed on the drawings.
- C. Air valves shall be designed for a normal working pressure of 150 psi.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Design Data: Submit manufacturer's latest published literature including illustrations, installation instructions, maintenance instructions and parts lists.
- C. Manufacturer's Certificates: Submit Statement of Compliance, supporting data, from material suppliers attesting that valves and accessories provided meet or exceed AWWA Standards (AWWA C512) and specification requirements.
- D. The manufacturer shall submit shop primer data sheets during shop drawing review. The submittal will be rejected without this data. Proposed primers must be compatible with the finish coating system to be applied by the general contractor in the field. Data sheets shall demonstrate compatibility.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.
- C. Operation and Maintenance Data:
 - 1. Submit maintenance instructions for equipment and accessories.
 - 2. Furnish list of equipment and tools needed to maintain equipment.

1.4 QUALITY ASSURANCE

- A. Install valve according to manufacturer's printed instructions.
- B. Manufacturer to provide certification stating that valve is manufactured per applicable AWWA standard for each valve type and size.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum experience of 5 years.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Prepare valves and accessories for shipment according to AWWA Standards and seal valve and ends to prevent entry of foreign matter into product body.
- C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.
- D. Inspect for damage.

E. Shipping

- 1. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components or for installation requirements.
- 2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which they are intended.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.8 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Coordinate the valve installation with the piping system to be protected.

1.9 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

1.10 MEASUREMENT AND PAYMENT

- A. Basis of Payment: See Bid Form.
- B. Costs for items not specifically listed in the Bid Form shall be included in the lump sum bid for the project.

PART 2 PRODUCTS

2.1 CONNECTIONS

- A. Single body valves sizes 4-inches and smaller shall have full size NPT inlet and outlets equal to the nominal valve size with a 2-inch inlet on 1-inch valves.
- B. The body inlet connections shall be hexagonal for a wrench connection.
- C. The valve shall have three additional NPT connections for the addition of backwash accessories.

2.2 AIR VALVE DESIGN

- A. Single body valves shall provide an extended body with a through flow area equal to the nominal size. Floats shall be unconditionally guaranteed against failure including pressure surges. A resilient bumper shall be provided on 4-inch and large sizes to cushion the float during sudden opening conditions. The seat shall provide drop tight shut off to the full vale pressure rating.
- B. The wastewater air release valve shall have an extended leverage mechanism with sufficient mechanical advantage so that the valve will open under full operating pressure. An adjustable treaded resilient orifice button shall be used to seal the precision discharge orifice in the cover.
- C. Single body valves shall have a full port orifice, a double guided plug, and an adjustable treaded orifice button. The 1-inch body shall be globe style to increase float clearance and reduce clogging. The plug shall be protected against direct water impact by an internal baffle and an extended float stem. The plug shall have a precision orifice drilled through the center stem. The float shall include a sensitivity skirt to minimize spillage.

2.3 MATERIALS

- A. The valve body and cover shall be constructed of ASTM A126 Class B cast iron.
- B. The float, plug, guide shafts, and bushings shall be constructed of Type 316 stainless steel. Non-metallic guides and bushings are not acceptable.
- C. Resilient seats shall be Buna-N.

2.4 MANUFACTURER

- A. Valves shall be Val-Matic Series 800 Wastewater Combination Air Valve or equal.
- B. Substitutions: Section 01 60 00 Product Requirements
- C. Experience in the manufacture of similar size and type valves shall be required and verifiable documentation shall be provided.
- D. The manufacturer of the air valves shall submit valid documentation that they have successfully manufactured valve installations of the specified size and type which have been successful in operation for at least five (5) years.

WASTEWATER COMBINATION AIR VALVES

2.5 COATINGS

- A. All surfaces of the valve shall be clean, dry and free from grease before painting.
- B. All interior ferrous surfaces shall be coated with holiday free FBE (fusion bonded epoxy).
- C. The exterior of valves to be painted shall be factory primed and field coated as required in Section 09 90 00 PAINTING AND COATING of these Specifications. In accordance with the data provided in the submittal process, primer must be compatible with the finish coating system to be applied by the general contractor in the field.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all valves, and accessories in accordance with manufacturer's printed instructions.

3.2 TESTING

A. Field test valve at 150 psi to demonstrate zero leakage.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION

SECTION 22 05 33

HEAT TRACING FOR PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe heat tracing and accessories.
- B. Related Sections:
 - 1. Section 22 07 00 Plumbing Insulation.

1.2 REFERENCES

- A. IEEE Standards:
 - 1. IEEE 515 Standard for the Testing, Design, Installation and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, characteristics and list of materials for each service and location, including heat tracing and accessories.
- C. Submit layout of each heat trace cable run, power supply end, location of thermostat, location of LED indicator light, location of termination end, etc.
 - 1. Coordinate heat trace cable power requirements with the electrical work.
 - 2. Additional electrical circuits (conduit, fittings, connections and conductors) maybe required due to layout of heat trace cable requirements.
 - a. No additional costs will be paid for by the Owner for these circuits.
- D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Coordinate with plumbing insulation and jacketing materials.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Install heat trace cable and accessories in accordance with manufacturer's written instructions.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers for Heat Trace Cable, Thermostat, Pilot Light and Accessories:
 - 1. nVent Thermal Management (Formerly Raychem).
 - 2. Substitutions: Section 01 60 00 Product Requirements.

2.2 HEAT TRACING

- A. JBS-100 with LED Indicator Light.
 - 1. BTV Cable rated at 10 watts per foot for copper and ductile iron piping.
 - 2. BTV Cable rated at 5 watts per foot for PVC chemical feed lines.
 - 3. AMC F5 Fixed set point freeze protection thermostat.
 - 4. AT-180 Aluminum tape.
 - 5. E-100 -L-A end seal with red signal light.
 - 6. Heating cables shall be self-regulating, capable of maintaining process temperatures up to 150°F and a continuous exposure to pipeline temperature of 185°F while de-energized.
 - 7. Cable must be of parallel construction so that it can be cut to length without changing its power output per unit length.
 - 8. The heater cable assembly shall have a monolithic heating core construction consisting of two parallel nickel-plated copper bus conductors with a semiconductive PTC polymer extruded over and between these parallel conductors.
 - a. A polyethylene dielectric insulating jacket is extruded over the heating element core.
 - 9. The semiconductive heating matrix and primary insulating jacket shall be cross-linked by irradiation.
 - 10. The basic cable will be covered by means of a metallic braid of tinned copper.
 - a. The braid will provide a nominal coverage of eighty percent (80%) and will exhibit a resistance not exceeding 0.0.0045 ohm/ft.

- 11. The cable shall be covered with a corrosion resistant overjacket of thermoplastic elastomer (for possible exposure to aqueous solutions, mild acids or bases).
- 12. Long term stability shall be established by the service life performance test per IEEE 515 Std-current edition.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify piping has been tested before applying heat tracing materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Systems Conveying Chemicals:
 - 1. Heat trace exposed chemical feed system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- B. Heat Trace Cable Testing:
 - 1. Factory inspections and tests for self-regulating, power limiting, series constant wattage and constant wattage (MI) heater cables shall include but are not limited to the following:
 - a. Testing shall be done per the latest IEEE Std. 515 test section and applicable manufacturer's standards.
 - 2. In the field, all heater cables shall be meggered. The following separate field megger readings shall be taken on each self-regulating and each M.I. heater cable:
 - a. Heater cable shall be meggered when received at jobsite before installation.
 - b. Heater cable shall be meggered after installation, but before insulation is applied.
 - c. Heater cable shall be meggered after insulation has been installed.
 - d. All three of the above field megger readings shall be greater than 20 megohms. Otherwise, the heater cable is not acceptable and shall be replaced.
 - 3. Field megger tests shall be recorded for each heater cable, and certified reports shall be submitted to the Owner and Engineer.

3.3 SCHEDULES

A. Install heat tracing on all exterior exposed water, wastewater and chemical feed piping 12-inches and smaller.

END OF SECTION

PIPE INSULATION

SECTION 22 07 00

PIPE INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Piping insulation, jacketing and accessories.

B. Related Sections:

1. Section 22 05 33 - Heat Tracing for Piping.

1.2 REFERENCES

A. ASTM International:

- 1. ASTM A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- 2. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- 3. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- 4. ASTM C195 Standard Specification for Mineral Fiber Thermal Insulating Cement.
- 5. ASTM C449/C449M Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- 6. ASTM C450 Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
- 7. ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- 8. ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- 9. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation.
- 10. ASTM C552 Standard Specification for Cellular Glass Thermal Insulation
- 11. ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- 12. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- 13. ASTM C585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- 14. ASTM C591 Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
- 15. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- 16. ASTM C795 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- 17. ASTM C921 Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- 18. ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

- 19. ASTM C1639 Standard Specification for Fabrication of Cellular Glass Piping and Tubing Insulation
- 20. ASTM D1785 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- 21. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- 22. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service and location, including insulation, jacketing and accessories.
- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Coordinate with heat tracing materials and accessories.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

PIPE INSULATION

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers for Cellular Glass (Foamglas) Insulation Products:
 - 1. Pittsburgh Corning Corporation.
 - 2. Substitutions: Section 01 60 00 Product Requirements
- B. Manufacturers for Pipe Jacketing Products:
 - 1. RPR Products, Inc.
 - 2. Substitutions: Section 01 60 00 Product Requirements.

2.2 PIPE INSULATION

- A. FOAMGLAS TYPE cellular glass pipe insulation.
 - 1. Secure insulation with fiber reinforced tape, Scotch #898 by 3M Corporation.
 - 2. All joints shall be sealed full depth with PITTSEAL 444N sealant.

2.3 PIPE INSULATION JACKETS

- A. Moisture Retarder Jacket:
 - 1. 40 pound Kraft paper coated with one-mil thick, low density polyethylene film, heat and pressure bonded to the interior surface.
- B. Aluminum Pipe Jacket:
 - 1. ASTM B209.
 - 2. Thickness: minimum 0.024 inch thick sheet.
 - 3. Finish: Smooth.
 - 4. Joining: Longitudinal slip joints and 2 inch laps.
 - 5. Fittings: 0.016 inch thick stainless steel die shaped fitting covers with factory attached protective liner.
 - 6. Metal Jacket Bands: 1/2 inch wide; 0.020 inch thick stainless steel.]
- C. Stainless Steel Pipe Jacket:
 - 1. ASTM C450 Type 304 and 316 stainless steel.
 - 2. Thickness: 0.016 inch thick.
 - 3. Finish: Smooth.
 - 4. Metal Jacket Bands: 1/2 inch wide; 0.020 inch thick stainless steel.
- D. Buried Pipe Jacket:

PIPE INSULATION

- 1. Buried piping can be jacketed with stainless steel or PITTWRAP jacketing as manufactured by Pittsburgh Corning Corporation or equal.
- 2. If using PITTSWRAP, follow manufacturer's installation instructions on this heat sealed high polymer asphalt membrane jacketing material.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify piping has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View: Locate insulation and cover seams in least visible locations.

B. Piping Systems:

1. Insulate and jacket exterior exposed piping systems including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

C. Foamglas Insulation:

- 1. Apply insulation close to equipment by grooving, scoring, and beveling insulation.
- 2. Fasten insulation to piping with tape.
- 3. Fill joints, cracks, seams, and depressions with sealant to form smooth surface.
- 4. Miter joints at elbows.
- 5. When application requires multiple layers, apply with joints staggered.
- 6. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.
- 7. Insulation shall be a minimum 1-1/2 inches thick.

D. Pipe Jacket:

- 1. Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe.
- 2. Size insulation large enough to enclose pipe and heat tracing materials.
- 3. Cover pipe with aluminum and/or stainless steel jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.

3.3 SCHEDULES

A. Install insulation on all exterior exposed water, wastewater and chemical feed piping 12-inches and smaller.

END OF SECTION

PLUMBING EQUIPMENT

SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Furnish and install the plumbing systems detailed on the Construction Drawings and as specified herein.

B. Related Sections:

- 1. Drawings, General Conditions, and Supplementary Conditions of these Specifications.
- 2. Section 09 90 00 Painting and Coating: Product and execution requirements for painting specified by this section.
- 3. Section 22 05 33 Heat tracing for Piping.
- 4. Section 22 07 00 Plumbing Insulation.
- 5. Section 31 23 17 Trenching: Execution requirements for trenching for underground piping systems.
- 6. Section 33 13 00 Disinfecting of Water Systems and Piping

1.2 REFERENCES

A. Plumbing Code:

- 1. Comply with the provisions of the following code, except where provisions of such code are less stringent than the local plumbing code in force for the project, in which event the local code shall govern.
- 2. Standard Plumbing Code
- 3. South Carolina State Plumbing Code
- 4. National Plumbing Code

B. American Society of Mechanical Engineers:

- 1. ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings.
- 2. ASME B16.3 Malleable Iron Threaded Fittings.
- 3. ASME B16.4 Gray Iron Threaded Fittings.
- 4. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings.
- 5. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- 6. ASME B16.23 Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
- 7. ASME B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes.
- 8. ASME B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings DWV.
- 9. ASME B31.9 Building Services Piping.
- 10. ASME B36.10M Welded and Seamless Wrought Steel Pipe.
- 11. ASME Section IX Boiler and Pressure Vessel Code Welding and Brazing Qualifications.

C. ASTM International:

- 1. ASTM A47/A47M Standard Specification for Ferritic Malleable Iron Castings.
- 2. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- 3. ASTM A74 Standard Specification for Cast Iron Soil Pipe and Fittings.
- 4. ASTM A234/A234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- 5. ASTM A395/A395M Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- 6. ASTM A536 Standard Specification for Ductile Iron Castings.
- 7. ASTM B32 Standard Specification for Solder Metal.
- 8. ASTM B42 Standard Specification for Seamless Copper Pipe, Standard Sizes.
- 9. ASTM B43 Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
- 10. ASTM B75 Standard Specification for Seamless Copper Tube.
- 11. ASTM B88 Standard Specification for Seamless Copper Water Tube.
- 12. ASTM B251 Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
- 13. ASTM B280 Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- 14. ASTM B302 Standard Specification for Threadless Copper Pipe, Standard Sizes.
- 15. ASTM B306 Standard Specification for Copper Drainage Tube (DWV).
- 16. ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications.
- 17. ASTM C14 Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
- 18. ASTM C76 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- 19. ASTM C443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- 20. ASTM C564 Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- 21. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- 22. ASTM D2239 Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameters.
- 23. ASTM D2241 Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
- 24. ASTM D2447 Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
- 25. ASTM D2464 Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- 26. ASTM D2466 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- 27. ASTM D2467 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- 28. ASTM D2513 Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
- 29. ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

PLUMBING EQUIPMENT

- 30. ASTM D2609 Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
- 31. ASTM D2665 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- 32. ASTM D2680 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- 33. ASTM D2683 Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- 34. ASTM D2729 Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- 35. ASTM D2751 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
- 36. ASTM D2846/D2846M Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
- 37. ASTM D2855 Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- 38. ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- 39. ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- 40. ASTM D3139 Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- 41. ASTM F437 Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- 42. ASTM F438 Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
- 43. ASTM F439 Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- 44. ASTM F441/F441M Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
- 45. ASTM F442/F442M Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
- 46. ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- 47. ASTM F493 Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- 48. ASTM F679 Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- 49. ASTM F1281 Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe.
- 50. ASTM F1282 Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe.
- 51. ASTM F1476 Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

D. American Welding Society:

- 1. AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding.
- 2. AWS D1.1 Structural Welding Code Steel.

E. American Water Works Association:

- 1. AWWA C104 American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- 2. AWWA C105 American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- 3. AWWA C110 American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
- 4. AWWA C111 American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- 5. AWWA C151 American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- 6. AWWA C506 Backflow Prevention Devices-Reduced Pressure Principle and Double Check Valve Types.
- 7. AWWA C601 Standard for Disinfecting Water Mains.
- 8. AWWA M14 Recommended Practice for Backflow Prevention and Cross-Connection Control
- 9. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.
- 10. AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in., for Water Service.

F. Cast Iron Soil Pipe Institute:

- 1. CISPI 301 Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- 2. CISPI 310 Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

G. National Fire Protection Association:

1. NFPA 99 - Standard for Health Care Facilities.

H. American National Standards Institute:

- 1. ANSI A40.5 Threaded Cast Iron Pipe for Drainage, Vent, and Waste Services.
- 2. ANSI A 112.1.2 Air Gap Standard.
- 3. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
- 4. ANSI B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

I. American Society of Sanitary Engineering:

- ASSE 1003 Water Pressure Regulators and Reducing Valves for Domestic Water Supply Systems.
- 2. ASSE 1013 Backflow Preventers, Reduced Pressure Zone Assembly.

J. Factory Mutual (FM) - FM Approval

K. Federal Specifications (FS)

- 1. O-F-506 Flux, Soldering: Paste and Liquid.
- 2. WW-N-351 Nipples, Pipe, Threaded.

- 3. WW-P-521 Pipe Fittings, Flare Fittings, and Flanges; Steel and Malleable Iron (Threaded and Butt Welding) Class 150.
- 4. WW-U-51 Unions, Brass or Bronze, Threaded Pipe Connections and Solder-Joint Tube Connections.
- 5. WW-U-531 Unions, Pipe, Steel or Malleable Iron: Threaded Connection, 150 lb. and 250 lb.
- L. Foundation of Cross-Connection Control and Hydraulic Research (FCCC-HR), University of Southern California Section 10 Manual of Cross-Connection Control.
- M. Food and Drug Administration (FDA) FDA Approval.
- N. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
 - 1. SP-70 Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 2. SP-72 Ball Valves with Flanged or Butt-Welding Ends.
 - 3. SP-80 Bronze Gate, Globe, Angle and Check Valves.
- O. Plumbing and Drainage Institute (P&DI): WH-201 Certification, Sizing, Placement of Water Hammer Arrestors.
- P. Underwriters Laboratories (UL) UL Listed.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- D. Welders' Certificate: Include welders' certification of compliance with ASME Section IX. and AWS D1.1.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Do not install underground piping when bedding is wet or frozen.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of buried piping with trenching.

PART 2 PRODUCTS

2.1 COPPER PIPE AND FITTINGS:

A. Below Ground:

- 1. Tubing: ASTM B 88, Type K, hard drawn unless noted otherwise.
- 2. Fittings: Either, flared cast bronze, solder-wrought copper or bronze; ANSI 1316.22 and 1316.26, except that unions shall be either brass or bronze and either threaded or soldered.

B. Above Ground:

- 1. Tube: ASTM B 88, Type L, hard drawn unless noted otherwise.
- 2. Fittings: Solder type, either cast bronze conforming to ANSI 1316.18 or wrought copper or bronze conforming to ANSI B16.22, except that unions shall conform to FS WW-U-516 and be either brass or bronze and either threaded or soldered.

2.2 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. Pipe and fittings shall be Schedule 80.
 - 1. In general, socket type (glued) fittings shall be used.
 - 2. Pipe shall be in accordance with ASTM D 1785, threaded type fittings shall be in accordance with ASTM D 2464, socket type fittings shall be in accordance with ASTM D 2467, and solvent cement for socket type fittings shall be in accordance with ASTM D 2564.

2.3 PVC BALL VALVES

- A. PVC ball valves shall be true union type except where otherwise indicated on the Drawings.
- B. Valves shall be manufactured of PVC Type 1, Grade 1 molding compound and shall have TEF ball seals and Viton stem and body seals.

- C. Valve shall have a pressure rating of 150 psi C.W.P. at 73° F.
- D. Single union valve with a separate line union will be allowed in close areas.
- E. Union may be positioned two or three feet from valves where space dictates.
- F. All valves shall be as manufactured by ASAHI, or equal.
- G. PVC extension stems and guides, operating nuts, and handles shall be located as shown on the Drawings.
- H. All valves and accessories shall be as manufactured by Spears Manufacturing Co. or equal.

2.4 VALVES

- A. Smaller than 3-inches shall be threaded or soldered.
- B. Gate Valves:
 - 1. Smaller than 3-inches shall be Class 125, Type 111, rated for a hydraulic working pressure of 125 psi.
- C. Check Valves:
 - 1. Smaller than 3-inches shall have bronze trim and either cast iron or steel body, and be rated for a hydraulic working pressure of 125 psi.
- D. Ball Valves:
 - 1. Smaller than 3-inches shall be bronze body with full port, rated for a hydraulic working pressure of 150 psi.
- E. Acceptable Manufacturers: Crane, Nibco, Stockham, Milwaukee, Watts, Apollo, Kitz.

2.5 WATER PRESSURE REDUCING VALVES (1/2 to 3-inch size)

- A. Provide bronze body, spring controlled, and adjustable pressure reducing valve with threaded connections.
- B. Provide valves with high temperature diaphragm and renewable nickel alloy seat.
- C. Provide with thermal expansion bypass.
- D. Rated for 300-psig maximum inlet water pressure with adjustable 25 to 75 psig outlet water pressure.
- E. Tested and certified under ASSE 1003 and the Standard Plumbing Code.
- F. Acceptable Manufacturers: Watts 223, Wilkins, Mueller.

2.6 DRAIN LINE AND FITTINGS

- A. PVC pipe and fittings shall be used for drain lines at locations shown on the Drawings or specified.
- B. PVC pipe and fittings shall be Schedule 80.
- C. Pipe shall be in accordance with ASTM D 1785, fittings shall be in accordance with ASTM D 2466, and solvent cement shall be in accordance with ASTM D 2564.

2.7 FLEXIBLE COUPLING

- A. Banded sleeve type coupling utilizing plain pipe ends, and suitable for non-pressure applications.
- B. Fabricate body of elastomeric polyvinyl chloride and sealing bands of stainless steel.
- C. Provide a leak proof, flexible seal utilizing couplings and bushings if required, compatible with pipe to which connected, including transition from one piping system type to another.
- D. Flexible coupling shall be as manufactured by Fernco Joint Sealer Co. or equal.

2.8 FLOOR DRAINS

- A. The Contractor shall furnish floor drains at locations shown on the Drawings or specified.
- B. Floor drains shall be Josam 31800, Zurn, or equal, with sediment buckets, inside caulking and cast iron grate.

2.9 WALL HYDRANTS

A. Not used for this project.

2.10 EMERGENCY FIXTURES

- A. Safety Shower/Eyewash:
 - 1. Provide combination drench shower/eyewash units as shown on the Drawings.
 - 2. Provide with identification sign for pipe mounting to read "EMERGENCY SHOWER AND EYEWASH FOUNTAIN".

2.11 HOSE BIBS

- A. The Contractor shall furnish hose bibs at locations indicated on the Drawings.
- B. Hose bibs shall be of rough brass, 3/4" compression type having tee handle and vacuum breaker, Chicago Manufacturing Co.'s "No. 998", Speakman, Crane or equal.
- C. Install interior isolation valve prior to all hose bibs

2.12 SANITARY SEWER PIPING, BURIED UNDERNEATH THE BUILDING

- A. All pipe buried under a concrete slab shall be encased in 6 inches of concrete all around the pipe.
- B. Pipe shall be low air pressure tested prior to encasing and air tested again after concrete encasement.
- C. All testing shall be done in the presence of the Engineer.
- D. The Contractor shall perform the test without the Engineer to be sure the pipe passes the low air pressure test. Then the Contractor shall request the Engineer onsite to observe the test.
- E. Provide at least 48 hours notice prior to testing.
- F. Cast Iron Soil Pipe: ASTM A74, extra heavy weight, bell and spigot ends.
 - 1. Fittings: Cast iron, ASTM A74.
 - 2. Joints: ASTM C564, rubber gasket joint devices.
- G. Ductile Iron Pipe: AWWA C150 or AWWA C151, minimum pressure class 350, bell and spigot ends.
 - 1. Fittings: AWWA C110, ductile iron, standard thickness.
 - 2. Joints: AWWA C111, rubber gasket joint devices.
- H. PVC Pipe: ASTM D1785, Schedule 80, polyvinyl chloride (PVC) material, bell and spigot style solvent sealed joint ends.
 - 1. Fittings: ASTM D2467, Schedule 80, PVC.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 Solvent cement.

2.13 BACKFLOW PREVENTERS

- A. Provide backflow preventers shall be installed where shown on the Drawings.
- B. Backflow preventers shall be rated for operation with inlet water pressures up to 175 psig and water temperatures up to 140 degrees F.
- C. Provide with separate bronze strainer with 20 mesh stainless steel basket.
 - 1. Install upstream of backflow preventer.
- D. Reduced Pressure Principle Assembly (RPZ) type backflow preventers shall be tested and certified in accordance with ASSE 1013 and AWWA C511.
- E. Double Check Detector Assembly (DCDA) type backflow preventers shall be tested and certified in accordance with ASSE 1048 and AWWA C510.
- F. Provide isolation valves on the inlet and outlet of each backflow preventer for maintenance.
 - 1. These valves shall be quarter turn, full port, and resilient seated, bronze ball valves on backflow preventers up to 2 inch in size.
 - 2. For backflow preventer sizes 2-1/2" 10", provide non rising stem resilient seated gate valves.

- G. Provide bronze ball body valve test cocks (minimum of 4 for each backflow preventer).
- H. The reduced pressure principle backflow preventers shall be complete with the following:
 - 1. The backflow preventer shall consist of two (2) spring-loaded check valves and a spring-loaded, diaphragm actuated, differential pressure relief valve located in the zone between the check valves.
 - 2. The relief valve shall automatically maintain pressure within the zone, which is lower than the supply pressure.
 - 3. The relief valve shall automatically drain to atmosphere to prevent siphon conditions when supply pressure drops.
- I. The drain line on the backflow preventer shall be copper pipe run full size to the floor drain.

2.14 PIPING ACCESSORIES

- A. Nipples: FS WW-N-351 and be of same type material as piping on which installed.
- B. Unions for Copper Tubing: Brass of bronze, have either threaded or solder joint ends and conform to FS WW-U-516.
- C. Unions for Steel Piping: FS WW-U-531.
- D. Escutcheons: Polished chromium-plated pressed steel, split-hinged, locking type held in-place by either an internal tension spring or a set-screw; encompass sleeve or opening.
- E. Bolts and Nuts: Machined brass, stainless steel or galvanized carbon steel, and not smaller than ¹/₄-inch; bolts shall have hexagonal heads and nuts shall be hexagonal.
- F. Solder for Solder-Jointed Tubing: 95 percent tin and 5 percent antimony. Flux shall be non-corrosive type conforming to FS 0 F-506.

2.15 PRESSURE GAUGES

- A. Provide pressure gauges as called for on the Drawings.
- B. Gauges shall be liquid filled.
- C. Each gauge shall have a gauge cock.
- D. Gauges shall have a pressure rating 0-200 psig at a minimum or operate in the middle 1/3 of the range.
- E. Gauges shall be as manufactured by H.O Trerice or equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify excavations are to required grade, dry, and not over-excavated.
- C. Verify trenches are ready to receive piping.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection to existing piping system or manhole and make sure size, location, and invert are as indicated on Drawings.
- B. Establish minimum separation of 18 inches from water lines and sewer drain piping.
- C. Make sure bedding material at trench bottom is at correct elevation to provide uniform bedding for piping.
- D. Install pipe on prepared bedding.
- E. Route pipe in straight line.
- F. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- G. Install drain valves at locations indicated on Drawings.
- H. Install plastic ribbon tape continuous over top of pipe.
- I. Install trace wire continuous over top of PVC pipe.
- J. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with these specifications.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.

- 3. Evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inch compacted layers to 12 inches minimum cover over top of pipe. Compact to 95 percent maximum density.
- 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
- 5. Do not use wheeled or tracked vehicles for tamping.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls and floors.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not accessible.
- H. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- I. Establish invert elevations, slopes for drainage to 1/4 inch per foot minimum. Maintain gradients.
- J. Slope piping and arrange systems to drain at low points.
- K. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- L. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- M. Insulate piping.
 - 1. Stem extensions are required for all insulated valves.
 - 2. Refer to Section 22 07 00.
- N. Install pipe identification.

3.5 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

ETOWAH WATER & SEWER AUTHORITY

PLUMBING EQUIPMENT

- B. Test domestic water piping system in accordance with these specifications.
- C. Test sanitary waste and vent piping system in accordance with these specifications.

3.6 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean and disinfect water system in accordance with these specifications.

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

SECTION 23 05 53

INDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Labels.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Samples: Submit two tags, labels, pipe markers, size used on project.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged equipment; include tag numbers.

1.5 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

ETOWAH WATER & SEWER AUTHORITY

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Equal to Craftmark Identification Systems
- B. Product Description: Laminated three-layer plastic with engraved white letters on black background color.

2.2 TAGS

- A. Plastic Tags:
 - 1. Manufacturers:
 - a. Equal to Craftmark Identification Systems.
 - 2. Laminated three-layer plastic with engraved white letters on black background color. Tag size minimum 1-1/2 inches diameter.
- B. Metal Tags:
 - 1. Manufacturers:
 - a. Equal to Craftmark Identification Systems.
 - 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- C. Information Tags:
 - 1. Manufacturers:
 - a. Equal to Craftmark Identification Systems
 - 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Typewritten letter size list of applied tags and location plastic laminated.

2.3 LABELS

- A. Manufacturers:
 - 1. Equal to Craftmark Identification Systems
- B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- D. Install tags using corrosion resistant chain. Number tags consecutively by location.
- E. Identify fan units with plastic nameplates. Identify in-line pumps and other small devices with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Tag automatic controls, instruments, and relays. Key to control schematic.
- H. Identify ductwork with plastic nameplates. Identify with fan unit identification number and area served.

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting and balancing of air systems.
 - 2. Measurement of final operating condition of HVAC systems.
 - 3. Vibration measurement of equipment operating conditions.

1.2 REFERENCES

- A. Associated Air Balance Council:
 - AABC MN-1 National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

- A. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- B. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms
- C. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- D. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty.
- E. Submit draft copies of report for review prior to final acceptance of Project.
- F. Furnish reports in soft cover, letter size, binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flow measuring stations, balancing valves and rough setting.
- B. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. Prior to commencing Work, calibrate each instrument to be used.

1.6 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years experience certified by AABC.
- B. Perform Work under supervision of AABC Certified Test and Balance Engineer.

1.7 SEQUENCING

A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Service and balancing valves are open.

3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- G. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near occupied area entry.

3.6 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
 - 1. Air Inlets and Outlets.
 - 2. Ductless Split System Air Conditioner.
 - 3. Exhaust fan
- B. Report Forms
 - 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Engineer
 - g. Project Contractor
 - h. Project altitude
 - i. Report date
 - 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
 - 3. Instrument List:
 - a. Instrument
 - b. Manufacturer

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TESTING, ADJUSTING AND BALANCING FOR HVAC EQUIPMENT

- c. Model number
- d. Serial number
- e. Range
- f. Calibration date
- 4. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP and kW
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
- 5. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
- 6. Cooling Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air DB temperature, design and actual
 - g. Entering air WB temperature, design and actual
 - h. Leaving air DB temperature, design and actual
 - i. Leaving air WB temperature, design and actual
 - j. Saturated suction temperature, design and actual
 - k. Air pressure drop, design and actual
- 7. Air Moving Equipment:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual
 - j. Inlet pressure
 - k. Discharge pressure
 - 1. Sheave Make/Size/Bore
 - m. Number of Belts/Make/Size
 - n. Fan RPM
- 8. Return Air/Outside Air Data:
 - a. Identification/location
 - b. Design air flow

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TESTING, ADJUSTING AND BALANCING FOR HVAC EQUIPMENT

- c. Actual air flow
- d. Design return air flow
- e. Actual return air flow
- f. Design outside air flow
- g. Actual outside air flow
- h. Return air temperature
- i. Outside air temperature
- j. Required mixed air temperature
- k. Actual mixed air temperature
- 1. Design outside/return air ratio
- m. Actual outside/return air ratio
- 9. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
- 10. Duct Leak Test:
 - a. Description of ductwork under test
 - b. Duct design operating pressure
 - c. Duct design test static pressure
 - d. Duct capacity, air flow
 - e. Maximum allowable leakage duct capacity times leak factor
 - f. Test apparatus
 - 1) Blower
 - 2) Orifice, tube size
 - 3) Orifice size
 - 4) Calibrated
 - g. Test static pressure
 - h. Test orifice differential pressure
 - i. Leakage
- 11. Air Distribution Test Sheet:
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

SECTION 23 09 23

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes control equipment.
- B. Related Sections:
 - 1. Section 23 09 00 Instrumentation and Control for HVAC: Control system components.
 - 2. Section 23 09 93 Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
 - 3. Section 26 05 03 Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI MC85.1 Terminology for Automatic Control.

1.3 SYSTEM DESCRIPTION

- A. Provide control systems consisting of hand switch, variable frequency drive, relays, power supply and other apparatus and accessories to operate mechanical systems, and to perform functions specified.
- B. Provide installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate the following:
 - 1. Trunk cable schematic showing programmable control-unit locations and trunk data conductors.
 - 2. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 3. Description and sequence of operation for operating equipment.
 - 4. Use terminology in submittals conforming to ASME MC85.1.
 - 5. Coordinate submittals with information requested in Section 23 09 93.
- C. Product Data: Submit data for each system component and software module.
- D. Manufacturer's Installation Instructions: Submit installation instruction for each control system component.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of control components.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
 - 2. Submit data specified in "Submittals" in final "Record Documents" form.
- C. Operation and Maintenance Data:
 - 1. Submit interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
 - 2. Submit inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds
- B. Furnish one year manufacturer warranty for direct digital controls.

1.9 MAINTENANCE SERVICE

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.

PART 2 PRODUCTS

2.1 DIRECT DIGITAL CONTROLS

- A. Manufacturers:
 - 1. VFD manufacturer shall be equal to Emerson.

2.2 CONTROL UNITS

- A. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.
- B. Control Units Functions:
 - 1. Control fan speed in SUMMER, WINTER and OFF switch positions.
 - 2. Perform in stand-alone mode:
 - a. Summer/Winter/Stop fan speed control.

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: System control panels shall be wired in accordance with Section 26 05 03.
- B. Disconnect Switch: Factory-mount in control panel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify conditioned power supply is available to control unit.
- C. Verify field end devices and wiring is installed prior to installation proceeding.

3.2 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where they are not subject to excessive vibration.
- B. Install conduit and electrical wiring in accordance with Section 26 05 03.
- C. Install electrical material and installation in accordance with appropriate requirements of Division 26.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 Quality Requirements: Manufacturers' field services.
- B. Start and commission systems. Allow adequate time for start-up and commissioning prior to placing control systems in permanent operation.

3.4 DEMONSTRATION AND TRAINING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate complete and operating system to Owner.

SEQUENCE OF OPERATION FOR HVAC CONTROLS

SECTION 23 09 93

SEQUENCE OF OPERATION FOR HVAC CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes sequence of operation for:
 - 1. Split system air conditioner
 - 2. Unit heaters
 - 3. Exhaust fan
 - 4. Louvers

B. Related Sections:

1. Section 23 09 00 - Instrumentation and Control for HVAC: For equipment, devices, and system components to implement sequences of operation.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate mechanical system controlled and control system components.
 - 1. Label with settings, adjustable range of control and limits. Submit written description of control sequence.
 - 2. Submit flow diagrams for each control system, graphically depicting control logic.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 SPLIT SYSTEM AIR CONDITIONER

A. Sequence of Operation: Unit shall operate automatically to maintain space temperatures determined by the wall thermostat setpoint.

3.2 UNIT HEATERS

A. Sequence of Operation: Unit heaters shall operate automatically to maintain space temperatures determined by the integral thermostat setpoint.

SEQUENCE OF OPERATION FOR HVAC CONTROLS

3.3 EXHAUST FAN

A. Sequence of Operation: Exhaust fan EF-101 shall operate subject to the position of the OFF-SUMMER-WINTER hand switch. The fan shall stop when the switch is in the OFF position. The fan shall operate at the summer air flow rate when in the SUMMER switch position and at the winter flow rate when in the WINTER switch position. Summer and Winter air flow rates shall be per the schedule on the Drawings.

3.4 LOUVERS

A. Sequence of Operation: Louvers shall be interlocked with EF-101 to open when the fan starts and close when the fan stops.

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Refrigerant piping.
 - 2. Pipe hangers and supports.

1.2 REFERENCES

A. SYSTEM DESCRIPTION

- B. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- C. Provide pipe hangers and supports in accordance with ASME B31.5, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.

1.3 SUBMITTALS

A. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.

B. Product Data:

- 1. Piping: Submit data on pipe materials, fittings, and accessories.
- 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
- 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
- C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Test Reports: Indicate results of piping system pressure test.
- E. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of equipment and refrigerant accessories.
- B. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.5 code for installation of refrigerant piping systems.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years of experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Furnish one year manufacturer warranty for valves excluding packing.

PART 2 PRODUCTS

2.1 REFRIGERANT PIPING

- A. Copper Tubing to 7/8 inch OD: ASTM B88, Type K, annealed.
 - 1. Fittings: ASME B16.26 cast copper, compression type.
 - 2. Joints: Flared.

2.2 UNIONS, FLANGES, AND COUPLINGS

- A. 2 inches and Smaller:
 - 1. Copper Pipe: Bronze, soldered joints.

2.3 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Equal to Carpenter & Paterson Inc.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- C. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
- D. Vertical Support: Steel riser clamp.

- E. Copper Pipe Support: Carbon steel rings, adjustable, copper plated.
- F. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- G. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with ASME B31.5.
- B. Support horizontal piping hangers as scheduled.
- C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Install hangers to allow 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- F. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.
- G. Provide copper plated hangers and supports for copper piping.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.3 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

- F. Flood refrigerant piping system with nitrogen when brazing.
- G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- H. Insulate piping; refer to Section 23 07 00.
- I. Install refrigerant piping in accordance with ASME B31.5.

3.4 INSTALLATION - REFRIGERANT SPECIALTIES

A. Refrigerant Liquid Indicators:

- 1. Install line size liquid indicators in main liquid line downstream of condenser.
- 2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
- 3. Install line size liquid indicators downstream of liquid solenoid valves.

B. Refrigerant Valves:

- 1. Install service valves on compressor suction and discharge.
- 2. Install gage taps at compressor inlet and outlet.
- 3. Install check valves on compressor discharge.
- 4. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.
- C. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.

D. Filter-Dryers:

- 1. Install permanent filter-dryer in systems containing hermetic compressors.
- 2. Install replaceable cartridge filter-dryer upstream of each solenoid valve.

E. Solenoid Valves:

- Install in liquid line of systems operating with single pump-out or pump-down compressor control.
- 2. Install in liquid line of single or multiple evaporator systems.
- 3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

3.5 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test refrigeration system with dry nitrogen to 500 psig. Perform final tests at 27 inches vacuum and 500 psig using electronic leak detector.
- C. Repair leaks.
- D. Retest until no leaks are detected.

3.6 SCHEDULES

A. Pipe Hanger Spacing:

| | COPPER | MINIMUM |
|-----------|---------|----------|
| PIPE SIZE | TUBING | HANGER |
| Inches | MAXIMUM | ROD |
| | HANGER | DIAMETER |
| | SPACING | COPPER |
| | Feet | TUBING |
| | | Inches |
| 1/2 | 5 | 3/8 |
| 3/4 | 5 | 3/8 |
| 1 | 6 | 3/8 |

SECTION 23 34 00 HVAC FANS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Propeller fans.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 204 Balance Quality and Vibration Levels for Fans.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- B. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- B. Balance Quality: Conform to AMCA 204.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

HVAC FANS

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Furnish one year manufacturer's warranty for fans.

PART 2 PRODUCTS

2.1 PROPELLER FANS

A. Manufacturers:

1. Equal to Greenheck Corp.

B. Construction:

- 1. Impeller: Fabricated steel, fabricated aluminum or cast aluminum blades and hubs, statically and dynamically balanced to AMCA 204-05, keyed and locked to shaft, directly connected to motor.
- 2. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.
- 3. Motor: Permanently lubricated, heavy duty and furnished at the RPM, voltage and phase as indicated on drawings.
- 4. Fans shall bear the AMCA Certified Ratings Seals for Sound and Air performance.

C. Accessories:

- 1. Outlet Damper: Multiple blade with offset hinge pin, blades linked, line voltage motor drive, power open, spring return.
- 2. Safety Screens: Expanded galvanized metal over inlet, motor, and drive to comply with OSHA regulations.

D. Capacity:

1. Capacity as indicated on drawings.

E. Electrical Characteristics and Components:

- 1. Electrical characteristics as indicated on drawings.
- 2. Disconnect Switch: Factory mount disconnect switch on equipment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify wall openings are installed and dimensions are as instructed by manufacturer.

3.2 INSTALLATION

- A. Secure wall fans with stainless steel screws to structure.
- B. Install safety screen where inlet or outlet is exposed.
- C. Install motor operated dampers on discharge of exhaust fans and as indicated on Drawings.

AIR OUTLETS AND INLETS

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Louvers

1.2 REFERENCES

- 1. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 Method of Testing for Rating the Performance of Air Outlets and Inlets.
- 2. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 Test Methods for Louvers, Dampers, and Shutters.

1.3 SUBMITTALS

- 1. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level. Submit color palette for color selection by Engineer with submittal.
- 2. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of air outlets and inlets.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience

1.6 WARRANTY

A. Furnish one year manufacturer warranty for air outlets and inlets.

PART 2 PRODUCTS

2.1 Louvers

- A. Manufacturers: Equal to Greenheck.
- B. Product Description: Combination drainable louver with motor operator.
- C. Type: 6 inch deep with blades on 45 degree slope, heavy channel frame.

AIR OUTLETS AND INLETS

- D. Fabrication: 0.081-inch thick extruded aluminum blades, with 0.125-inch thick frame.
- E. Mounting: Furnish with exterior flat flange with screw holes in jambs for installation.
- F. Bird Screen: Bird screen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify inlet and outlet locations.
- B. Verify ceiling and/or wall systems are ready for installation.

3.2 INSTALLATION

A. Install louver with wall sleeve.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Check location of louvers and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

DUCTLESS SPLIT SYSTEM AIR CONDITIOER

SECTION 23 81 26

DUCTLESS SPLIT SYSTEM AIR CONDITIONER

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes ductless split system air conditioner and accessories.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- B. Product Data, Submit the following:
 - 1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
 - 3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
 - 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
 - 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- B. Protect units from weather and construction traffic by storing in dry, roofed location.

1.6 WARRANTY

A. Furnish five year manufacturer warranty for air handling units.

1.7 Quality Assurance

- A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be rated in accordance with Air Conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI label.

DUCTLESS SPLIT SYSTEM AIR CONDITIOER

1.8 EXTRA MATERIALS

A. Furnish one set of filters for each unit.

PART 2 PRODUCTS

2.1 PACKAGED OUTDOOR UNITS

1. Manufacturers:

1. Equal to Mitsubishi. See Drawings for design basis model number.

2.2 INDOOR UNIT

1. General:

1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes will be charged with dry air instead of R-410A before shipment from the factory.

2. Unit Cabinet:

- 1. The casing shall have a white finish.
- 2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
- 3. Furnish a separate back plate that secures the unit firmly to the wall.

3. Fan:

- 1. The evaporator fan shall be an assembly with a line-flow fan direct driven by a single motor.
- 2. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
- 3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
- 4. A motorized air sweep flow louver shall provide an automatic change in airflow by directing the air up and down to provide for uniform air distribution.
- 4. The indoor fan shall consist of three (3) speeds, High, Medium and Low.

5. Filter:

1. Return air shall be filtered by means of an easily removable washable filter.

6. Coil:

- 1. The evaporator coil shall be of nonferrous construction with smooth plate fins on copper tubing.
- 2. The tubing shall have inner grooves for high efficiency heat exchange.
- 3. All tube joints shall be brazed with phoscopper or silver alloy.
- 4. The coils shall be pressure tested at the factory.
- 5. A condensate pan and drain shall be provided under the coil.

7. Electrical:

- 1. The unit electrical power shall be per the schedule on the drawings.
- 2. The indoor unit shall not have any supplemental electrical heat elements.

DUCTLESS SPLIT SYSTEM AIR CONDITIOER

8. Control:

- 1. The unit shall have a wireless controller to perform input functions necessary to operate the system.
- 2. The controller shall consist of a Power On/Off switch, Mode Selector, Temperature Setting, Timer Control, Fan Speed Select and Auto Vane selector.
- 3. The indoor unit shall perform Self-diagnostic Function, Test Run switching and Check Mode switching.
- 4. Temperature changes shall be by 2°F increments with a range of 65 87°F.
- 5. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wireless controller, providing emergency operation and controlling the outdoor unit.
- 6. The control voltage between the indoor unit and the outdoor unit shall be 12 volts, DC.
- 7. The system shall be capable of automatically restarting when power is restored after power interruption.
- 8. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and System/Mode function switching.

2.3 OUTDOOR UNIT

1. General:

1. The outdoor unit is designed specifically for use with indoor units. These units are equipped with a circuit board that interfaces to the indoor unit and perform all functions necessary for operation. The unit must have a powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

2. Unit Cabinet:

1. The casing shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

3. Fan:

- 1. The unit shall be furnished with a direct drive propeller type fan.
- 2. The motor shall have inherent protection, be permanently lubricated bearings.
- 3. The fan motor shall be mounted for quiet operation.
- 4. The fan shall be provided with a raised guard to prevent contact with moving parts.
- 5. The outdoor unit shall have a horizontal discharge airflow.

4. Coil:

- 1. The condenser coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
- 2. The coil shall be protected with an integral metal guard.
- 3. Refrigerant flow from the condenser shall be controlled by means of a metering orifice.

5. Compressor:

- 1. The compressor shall be of a high performance hermetic, inverter driven rotary type.
- 2. The outdoor unit shall have an accumulator.
- 3. The compressor will be equipped with an internal thermal overload.

DUCTLESS SPLIT SYSTEM AIR CONDITIOER

- 4. The outdoor unit must have the ability to operate with a maximum height difference of 25 feet and have refrigerant tubing length of 49 feet between indoor and outdoor units without the need for line size changes, traps or additional oil.
- 5. The compressor shall be mounted to avoid the transmission of vibration.

6. Electrical:

- 1. The unit electrical power shall per the schedule on the drawings.
- 2. The outdoor unit shall be controlled by the microprocessor located in the indoor unit and outdoor unit.
- 3. The control voltage between the indoor unit and the outdoor unit shall be 12 volts, DC.

2.4 CAPACITY

- 1. Supply Fan Performance:
 - 1. As indicated on Drawings
- 2. Return Fan Performance:
 - 1. As indicated on Drawings.
- 3. Refrigerant Cooling Coil:
 - 1. As indicated on Drawings.
 - 2. Entering Air Temperature:
 - a. Dry Bulb: 95 degrees F.
 - b. Wet Bulb: 74 degrees F.

2.5 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics:
 - 1. As indicated on drawings

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify concrete pad for condensing unit is ready for unit installation.

3.2 INSTALLATION - AIR HANDLING UNIT

- A. Install condensate piping with trap and route from drain pan through wall for outdoor disposal.
- B. Install components furnished loose for field mounting.

3.3 INSTALLATION - CONDENSING UNIT

- A. Install unit on concrete pad.
- B. Install refrigerant piping from indoor unit to condensing unit. Install refrigerant specialties furnished with unit.
- C. Evacuate refrigerant piping and install initial charge of refrigerant.

DUCTLESS SPLIT SYSTEM AIR CONDITIOER

- D. Install electrical devices furnished loose for field mounting.
- E. Install control wiring between indoor unit, condensing unit, and field installed accessories.

3.4 CLEANING

- A. Vacuum clean coils and inside of unit cabinet.
- B. Wash filter media at Substantial Completion.

END OF SECTION

CONVECTION HEATING UNITS

SECTION 23 82 00

CONVECTION HEATING UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

- 1. Electric unit heaters.
- 2. Wash-down unit heaters.

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

1.3 SUBMITTALS

- 1. Section 01 33 00 Submittal Procedures: Submittal procedures.
- 2. Shop Drawings: Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations. Indicate schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers.
- 3. Product Data: Submit coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions. Submit mechanical and electrical service locations, capacities and accessories or optional items.
- 4. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.
- 5. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- 1. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- 2. Project Record Documents: Record actual locations of components and locations.
- 3. Operation and Maintenance Data: Submit manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.5 DELIVERY, STORAGE, AND HANDLING

- 1. Accept units on site in factory packing. Inspect for damage. Store under roof.
- 2. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.7 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 ELECTRIC UNIT HEATERS

- A. Manufacturers shall be equal to:
 - 1. Q-Mark.
- B. Assembly: UL listed and labeled assembly with terminal box and cover, and built-in controls.
- C. Heating Elements: Aluminum-finned, copper clad steel sheath heating element.
- D. Cabinet: Heavy gauge die-formed steel housing.
- E. Fan: Direct-drive propeller type, statically and dynamically balanced, with fan guard. Fan motor shall be completely enclosed.
- F. Motor: Permanently lubricated, sleeve bearings for horizontal models; ball bearings for vertical models.
- G. Control: Automatic reset thermal cut-out, capillary type.

2.2 WASH-DOWN UNIT HEATER

- A. Manufacturers shall be equal to:
 - a. Q-mark
- B. Assembly: Unit heaters shall be UL listed for corrosive area and NEMA 4X wash down requirements.
- C. Coil: Corrosion resistant 300 stainless steel sheathed with 316 stainless steel fins. Elements shall be attached to the junction box with leak-resistant stainless steel fittings.
- D. Casing: Case shall be 16 gage Type 304 stainless steel with stainless steel hardware. Supply unit with stainless steel swivel type mounting bracket.
- E. Controls: The controls shall be completely factory prewired and tested and enclosed in a NEMA 4X enclosure. The control center shall include automatic reset over-temperature protector, fan delay relay, motor contactor and fused transformer for 24V control circuit and terminal blocks for remote thermostat connection.

CONVECTION HEATING UNITS

F. The fan and motor assembly shall include a totally enclosed, permanently lubricated, ball bearing motor, epoxy coated for corrosion resistance. The fan shall be aluminum with corrosion resistant coating, directly connected to the motor and be dynamically balanced. The unit shall have an adjustable louvered outlet grille.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify concealed blocking and supports are in place and connections are correctly located.

3.2 INSTALLATION

A. Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

3.3 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

END OF SECTION

GENERAL ELECTRICAL PROVISIONS

SECTION 26 00 00

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 DESCRIPTION

- A. Furnish and install all materials, equipment, labor, supervision and services necessary to complete all electrical work specified herein and shown on the Drawings.
- B. Principal Features
 - 1. Panelboards 480V and 208/120V
 - 2. Complete system of conduits, cables and conductors to supply electrical energy throughout the facility.
 - 3. Installation of Control Panels and instruments
 - 4. All field terminations, including instruments,

1.2 APPLICABLE STANDARDS AND CODES

- A. Local, State, and National Electrical Codes.
- B. National Electrical Code, 2014.
- C. Rules of the Electrical Utility and the National Electrical Safety Code.
- D. Life Safety Code 101.
- E. NECA Standard of Installation.
- F. NFPA (National Fire Protection Association).

1.3 FEES AND TESTS

A. Contractor shall be responsible for all fees for permits, inspections, and tests necessary to complete this work. Contractor shall demonstrate to the Owner and the Engineer that all items of equipment installed are completely operational and free of defects in all modes.

1.4 COORDINATION WITH OTHER TRADES

A. Furnish and locate all anchor bolts, inserts and supports for installation by the other trades as required. Coordinate the location of all fixtures, outlets, equipment, and devices with other trades to avoid conflicts.

1.5 LIST OF PROPOSED MANUFACTURERS

A. List of Proposed Materials: The Contractor shall submit a complete list of the proposed manufacturers for each proposed item as required to complete the work.

GENERAL ELECTRICAL PROVISIONS

Additional submittal data, sufficient to determine equality, shall be required if the Contractor proposes to substitute another manufacturer's equipment.

- 1. Intent of Drawings
 - a. Electrical plan drawings show only general locations of equipment, devices and raceways, unless specifically dimensioned. The Contractor shall be responsible for the proper routing of raceway, subject to the review of the Engineer.
- 2. Departures from Contract Documents
 - a. Submit to the Engineer in writing details of any necessary, proposed departures from these Contract Documents, and the reasons therefore. Submit such requests as soon as practicable and within 30 days after award of the Contract. Make no such departures without written approval of the Engineer.

PART 2 PRODUCTS

2.1 REFERENCE TO DRAWINGS

A. Reference shall be made to Drawing Schedules, Details, Notes, and Specifications for: Manufacturer, model, catalog number, size, capacity, performance, ratings and installation of equipment and material.

2.2 CHOICE OF MATERIALS AND EQUIPMENT

- A. In submitting substitutions, bidders should note the following minimum considerations: (1) capacities shown are absolute minimal and must be equaled, (2) physical size limitations for space allotted, (3) structural properties, (4) noise level, (5) interchangeability, (6) compatibility with other materials and assemblies, (7) similar items shall be same manufacture and style wherever possible.
- B. All material and equipment, for which a UL, ANSI, or a NEMA Standard is established, shall be so approved and labeled or stamped.
- C. Adhesives are not acceptable as a mounting, supporting, or assembling technique, unless noted otherwise.

2.3 ELECTRICAL EQUIPMENT

- A. NEMA Standards shall be taken as minimum requirements for electrical equipment.
- B. Equipment shall operate properly under a plus or minus 10 percent of the system voltage.

2.4 SUBMITTALS DURING CONSTRUCTION

A. Provide complete manufacturers' descriptive information and shop drawings for all permanently installed equipment, material and devices furnished under Division 26, Electrical, including certified outline drawings, arrangement drawings, elementary (schematic) diagrams, interconnection and connection diagrams, in accordance with

GENERAL ELECTRICAL PROVISIONS

provisions elsewhere in these Contract Documents. Provide the number of copies specified in Section 01 33 00. Operation and Maintenance Manuals shall be submitted in accordance with Section 01 70 00.

- B. Provide certified shop drawings, literature and requested samples showing items proposed for use, size, dimensions, capacity, special features required, schematic (elementary) control diagrams, equipment schedules, rough-in, etc., as required by the Engineer for complete review and for use during installation. Use NEMA device designations and symbols for all electric circuit diagrams submitted. Make content of the schematic (elementary) connection or interconnection diagrams in accordance with the latest edition of NEMA ICS 1.
- C. Manufacturer's standardized elementary diagrams will not be acceptable unless applicable portions of the diagram have been clearly identified and non-applicable portions deleted or crossed out.
- D. Certified arrangement drawings, outline dimensions, and weights for all major (engineered) equipment including, but not limited to:
 - 1. Low voltage switchgear.
 - 2. Transformers.
 - 3. Variable frequency drives.
- E. Functional description or logic diagrams for all control systems furnished under Division 26, Electrical.
- F. Characteristic curves for all protective devices.
- G. Certified drawings and descriptive literature for all equipment and devices furnished under Division 26, Electrical, and not listed above.
- H. Schematic (elementary drawings for any electrical control and bills of material for equipment including, but not limited to:
 - 1. Motor control
 - 2. Control systems furnished under Division 26, Electrical.
 - 3. Switchgear, Breakers, and Automatic Controllers
 - 4. Variable Frequency Drives
- I. Connection diagrams showing all internal wiring and all required field connections for the following:
 - 1. Low voltage switchboard
 - 2. Breakers
 - 3. Variable Frequency Drives
- J. The interconnection diagrams shall show terminal points, intermediate connections, device designation, terminal numbers, polarity of dc circuits, conductor identification, and any other information necessary to show which conductor connects to which point; the Contractor shall review and sign off on the control interconnection diagrams.

GENERAL ELECTRICAL PROVISIONS

- K. In addition to submittals for specific items mentioned above, furnish shop drawing information on the following items:
 - 1. Conduit, tubing, and fittings.
 - 2. Wireway.
 - 3. Outlet and device boxes.
 - 4. Pull boxes and junction boxes.
 - 5. Terminal junction boxes.
 - 6. 600-volt conductors.
 - 7. Control cable.
 - 8. Receptacles.
 - 9. Surge suppressors

PART 3 EXECUTION

3.1 WIRING ELECTRICALLY OPERATED EQUIPMENT

A. The Contractor shall be responsible for electrical connections to all equipment requiring electrical power. This responsibility applies to equipment furnished under this and other Divisions and by the Owner.

3.2 RECORD AND AS-BUILT DOCUMENTS

- A. Maintain at the job site a set of Contract Documents kept current by indicating thereon all changes, revisions and substitutions, between work as specified and as installed.
- B. Furnish Owner with complete set of Operation and Maintenance Manuals.

3.3 EQUIPMENT OPERATION

A. This Division is responsible for: (1) proper rotation, (2) observing that lubrication has been properly performed, (3) that motors operate within nameplate limits, and (4) adjustment of circuit breaker and MCP trip settings.

3.4 CLEANING AND PAINTING

A. Fixtures, panels and equipment shall be thoroughly cleaned. All equipment shall be touched up or repainted as required to present a clean professional appearance. Paint all ferrous metal that is not otherwise protected against corrosion. Paint exposed pipe threads with Bitumastic No. 50.

3.5 IDENTIFICATION

- A. Identify all major items of equipment including controls, panels, switches, contactors, motor starters, junction boxes and metering by permanent nameplates, with wording approved by Engineer. Secure metal nameplate frame with screws or brads. Adhesives are acceptable on components within NEMA 1 enclosures.
- B. Nameplates after installation shall be easily visible and shall bear notations corresponding to those shown on record drawings.

GENERAL ELECTRICAL PROVISIONS

- C. Each instrument shall be identified with a stamped stainless steel tag system (Brady or approved equal). Instrument tags shall be permanently attached to each individual instrument and stamped with the appropriate number per instrument specification section.
- D. Each cable shall be identified with a permanent labeling system (Brady Catalog Number B-292 with printed legends or approved equal). Instrumentation cables shall be labeled with the appropriate instrument number of the originating signal (Ex. FT-2020-1). Multiplex cables, power and control cables shall be labeled with the appropriate cable number per the conduit and cable schedules. Refer to PICS shop drawings for instrument cable identification.
- E. All switchgears, MCC's, MCC compartments, power panels, lighting panels, control panels, control cabinets, etc. shall be identified with permanently mounted phenolic labels.
- F. All power and lighting panels shall have typed schedules mounted on panel doors.
- G. All terminals and associated wires shall be numbered and labeled respectively, and wiring diagrams shall be installed in the MCC or electrical panel doors.

3.6 TEST PERIOD

- A. Each piece of equipment shall continue to meet performance specifications throughout the first year of operation. Contractor shall replace or repair any defect due to faulty workmanship or material which shall develop within 1 year from date of acceptance.
- B. For first year after final acceptance, Contractor shall provide, at no cost to Owner, any required maintenance and service necessary to assure the proper operation of the system. Date of acceptance shall be certified by Engineer as that date on which the Contract Work has been satisfactorily completed, as a whole, in accordance with the Contract Documents.

3.7 GROUNDING

A. See Specification 26 05 26.

3.8 ELECTRICAL TESTING AND START-UP

A. General

- 1. Prior to energizing any equipment, the electrical contractor shall thoroughly vacuum clean the equipment with an industrial type vacuum cleaner. The outside of all electrical equipment shall be cleaned and paint touched up as required to leave equipment in an "as purchased" condition.
- 2. During start-up of new equipment, the electrical contractor shall provide sufficient personnel to aid with start-up of the electrical equipment to remove any faults, and to make the necessary adjustment for proper operation of electrical equipment and installation. This includes sufficient personnel to aid equipment service personnel in their check-out of the electrical equipment and service.

GENERAL ELECTRICAL PROVISIONS

- 3. All testing equipment shall be furnished by the Contractor.
- 4. All failures under tests due to defective material or poor workmanship shall be corrected by the Contractor at no expense to the Owner.
- 5. The electrical contractor shall not, under any circumstances, energize any electrical equipment covered by these Specifications without first obtaining permission from the Engineer.

B. Grounding

- 1. After all connections have been made to the ground, ground tests shall be made to verify its adequacy. See specification 26 05 26.
- C. Typewritten directories shall be inserted in all panels showing the designation of each circuit. All power and replacement fuses necessary for testing shall be furnished and paid for under this item.

D. Circuit Continuity

 Complete installation shall be free of short circuits, open circuits, and other defects. Insulation Resistance and Continuity Tests shall be performed in accordance with Section 26 01 26-3.2 to prove that all parts of the installation are intact.

3.9 INSTALLATION OF EQUIPMENT

A. The electrical contractor shall coordinate with the Local Utility Company, Contractor and Owner in order to have electric power available when required.

3.10 TEMPORARY ELECTRIC POWER

A. The contractor shall coordinate, furnish, pay for, and provide any necessary provisions for electric power used during construction.

END OF SECTION

SECTION 26 05 19

WIRE AND CABLE

PART 1 GENERAL

1.1 SCOPE

- A. Work covered by this section includes furnishing all labor, equipment, and materials required to install, connect, and test all wire and cable, including splices, terminations, connectors, and accessories for a complete installation as shown on the Drawings and/or specified herein.
- B. The Contractor's attention is directed to the fact that all wires and cables are not necessarily shown on the Drawings, which are more or less schematic. However, the Contractor shall be responsible for furnishing and installing all wire and cable indicated or required to properly connect and place into operation all equipment and services requiring such wiring and/or cable.

1.2 QUALITY ASSURANCE

- A. Samples of all wire and cable, clearly marked and long enough to show complete identification, shall be submitted to the office of the Engineer for approval prior to wiring installation.
- B. No defective or damaged wire and cable shall be incorporated into the work.

1.3 SIZING OF CONDUCTORS

- A. Unless otherwise required or directed by the Engineer, conductors shall be furnished in the sizes shown on the Drawings. No wire for lighting, power, or motor control circuits shall be smaller than No. 12 AWG. Motor control circuits carrying less than 8 amps may be No. 14 AWG. No wire for instrumentation and low-level signal transmission pairs shall be smaller than No. 16 AWG for single pairs or No. 20 AWG for bundled cable.
- B. All wires and cables shall be of such size as to conform to the regulations of the current edition of the National Electrical Code for current carrying capacity.
- C. Where the size of lighting wiring is not given on the Drawings, it shall be of such size that the voltage drop from the main panel to the lighting panel is not more than 1 percent, and the drop in the branch circuit is not more than 2 percent. The voltage drop in motor feeder, when the wire size is not specified, shall not be more than 3 percent at full load from the Motor Control Center to the motor terminal.

1.4 SHOP DRAWINGS AND ENGINEERING DATA

A. Complete shop drawings and engineering data shall be submitted in accordance with requirements of the Section 01 33 00 of these Specifications.

1.5 STORAGE AND PROTECTION

- A. Store and protect all wire and cable in accordance with the manufacturer's recommendations and requirements of the Section 01 60 00 of these Specifications.
- B. Wire and cable shall be stored indoors in a dry and warm location and in its original packaging.

1.6 GUARANTEE

A. Provide a guarantee against defective materials and workmanship in accordance with requirements of the Section 00 72 14 Article 23 of these Specifications.

PART 2 PRODUCTS

2.1 CONDUCTORS - GENERAL

- A. Conductors shall be solid or Class B concentric stranded, soft or annealed, uncoated copper free from kinks and defects in accordance with ASTM B 3 or B 8.
- B. Copper conductors should have a conductivity not less than 97 percent.
- C. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's "E-Number" permanently marked on the outer covering at not more than 2-foot intervals.
- D. All wires shall conform to the latest Standards of the ASTM and ICEA and shall be tested for their full length by these Standards.
- E. All control circuit wiring and all wiring No. 8 AWG and larger shall be stranded. Lighting branch circuits No. 12 and No. 10 AWG may be solid. Wiring shall be stranded as follows:
 - 1. No. 14 thru No. 2 AWG shall have a minimum of 7 strands.
 - 2. No. 1 thru No. 4/0 AWG shall have a minimum of 19 strands.
 - 3. No. 250 MCM thru No. 500 MCM shall have a minimum of 37 strands.
 - 4. All circuits except control and instrumentation circuits shall have a separate grounding conductor carried in the conduit.

2.2 CONDUCTORS FOR WIRE AND CABLE

- A. XHHW For service entrance, motor branch, and feeder circuits operating at 208, 240, and 480 volts, the conductors shall be single-conductor, cable rated, 600 volts. The single-conductor cable shall consist of uncoated annealed copper, Class B stranded per ASTM B 8 and insulated with corona, ozone, heat and moisture resisting cross-linked polyethylene insulation rated to withstand a copper temperature of 90 degrees C, Underwriter's approved Type XHHW and shall be as manufactured by Southwire, General Cable Corporation, Okonite Company or equal.
- B. THWN-2 For general lighting and receptacle branch circuits operating at 120 volts, the conductor shall be single-conductor cable rated 600 volts. The single-conductor cable shall be uncoated annealed copper. No. 12 and No. 10 AWG may be solid, or

stranded; larger cables shall be stranded per ASTM B 8 or B 3 and insulated with polyvinyl chloride insulation rated to withstand a copper temperature of 75 degrees C, Underwriter's approved Type THWN-2, and shall be as manufactured by Southwire, General Cable Corporation, Okonite Company, or equal.

- C. For lighting fixture drop wire or for running in fluorescent units, the conductors shall be single-conductor cable rated 600 volts. The single-conductor cable shall be stranded tinned copper with a 31-mil-thick wall silicone insulation and a glass braid jacket overall rated to withstand a copper temperature of 150 degrees C, Underwriter's approved silicone insulated fixture wire type SFF-2, and shall be as manufactured by General Cable Corporation, General Electric Company, or equal.
- D. For control circuits the conductors may be single or multi-conductor cable rated 600 volts. The conductors shall consist of uncoated annealed copper Class B stranded per ASTM B 3 or B 8 and shall be No. 14 or No. 12 AWG, 7-strand, identified at each end using Brady wire markers B-500 vinyl cloth, Thomas and Betts "E-Z Code" wire markers, or equal.
 - 1. Single-conductor cable shall have 45-mil-thick wall of cross-linked polyethylene or polyvinyl chloride insulation, color red, to withstand a copper temperature of 90 degrees C, Underwriter's Laboratories approved Type RHH-RHW, and shall be as manufactured by General Electric Company, Phelps Dodge, General Cable, Okonite, or equal.
 - 2. Multi-conductor cable shall consist of single-conductor cables rated 600 volts and insulated to withstand a copper temperature of 90 °C cabled together to form a cable assembly which is Underwriter's Laboratories approved for installation in conduit. The core shall be color coded in accordance with ICEA, Method 1, with a plastic tape cover and a PVC or neoprene jacket overall.
- E. Bare grounding conductor shall be Class A or B medium hard drawn, high conductivity bare copper, sized as shown on the Drawings. Conductors No. 6 AWG and smaller may be solid. Conductors No. 4 AWG and larger shall be stranded.
- F. Flexible power cords shall be moisture-resistant, oil-resistant, neoprene-sheathed service cable designed for extra hard usage, Type SO, rated 600 volts at 90 degrees C continuous conductor temperature. Flexible heater cords shall be moisture-resistant, oil-resistant, neoprene and cotton sheathed service cable designed for extra hard usage, Type HSO, rated 600 volts at 90 degrees C continuous. Insulation shall be thermoplastic ethylene-propylene conforming to ICEA S-68-516. Neoprene shall conform to ASTM D 752. All flexible cords shall be UL listed.

2.3 INSTRUMENTATION AND THERMOCOUPLE EXTENSION WIRING

A. Instrumentation and low level DC signal wiring shall be shielded, twisted pair conductors. Single twisted pairs shall consist of 2, Class B stranded, No. 16 AWG annealed copper conductors, 1 white and 1 black, with 15 mils of PVC insulation rated for 600 volts and 90 degrees C minimum continuous conductor temperature. Pairs shall be twisted to a lay of 1.5 to 2.5 inches. A 0.35 mil by 0.50 mil aluminummylar tape shield with stranded, bare No. 18 AWG, tinned copper drain wire in contact with the aluminum side of the shield shall be applied helically around the twisted pair. An overall jacket of 90 degrees C black PVC at least 30 mils in

thickness shall be applied to the outside. Shield coverage shall be full 100 percent. All instrumentation wiring shall be UL listed.

B. Twisted, Shielded Triad Instrumentation Cable for RTD circuits: Stranded copper conductors, size #16 AWG. Insulate conductors individually with color-coded PVC. Provide shield for each triad and tinned-copper drain wire. Provide flame-retardant PVC outer jacket. Cable shall be rated 600 volts and 90 degrees C. Cable shall be designed for noise rejection for use in process control signals.

2.4 AUDIO SIGNAL WIRING

A. Audio signal wiring for public address and sound systems shall be shielded, twisted pair instrumentation cable with 2 No. 16 AWG conductors constructed in accordance with the requirements of Part 2.3 of this section.

2.5 TELEPHONE AND COMMUNICATION WIRING

- A. Indoor telephone and communication cable shall consist of solid, minimum No. 22 AWG, annealed copper conductors insulated and standard telephone color coded with polyethylene and twisted together in pairs. Pairs shall be cabled together and protected with a metal tape shield and a polyethylene or PVC jacket overall. Cable shall be suitable for installation in ducts.
- B. Buried telephone cable shall be REA approved for aerial installation on messenger wire, installation in underground ducts, and direct burial. Cable shall consist of solid, minimum No. 22 AWG annealed copper conductors insulated and standard telephone color coded with polypropylene or polyethylene and twisted together in pairs. Each pair shall be twisted to a different lay length. Cable with more than 25 pairs shall be assembled from oscillated, bundled, 25-pair subunits. Bundled pairs shall be covered by a nonhygroscopic tape, an inner jacket of polyethylene, a shield of aluminum or tinned copper, and an outer jacket of black, high-molecular weight polyethylene copolymer. Cable core shall be completely filled with a nontoxic, petrolatum-polyethylene weatherproofing compound. Jacket shall be sequentially marked to indicate footage.

2.6 SPLICES AND TERMINATIONS

- A. Splices, taps and attachment of fittings and lugs shall be electrically and mechanically secure, and approved solderless lugs and connectors shall be used. Lugs and connectors shall be top quality product of Burndy, O-Z, Thomas and Betts, or equal manufacturer. Conductors shall not bind at bushings. Lugs shall be of the correct sizes for the conductors joined and strands shall not be cut from a conductor.
- B. Splices, taps, and terminations of cable rated 600 volts and less requiring tape shall be half lap and at least 3 layers. Taping shall be neatly done and form a permanent insulation equal in mechanical and electrical strength to the insulation of the conductor. Taping shall be as follows:
 - 1. Rubber Insulation
 - a. Inner Layer: Okonite Rubber Tape, 3M "Scotchfil" Electrical Insulation Putty, Plymouth "Plysafe" Tape, or equal.

- b. Outer Layer: 3M "Scotch No. 88" Tape, Permacel No. 295 Tape, Slipknot Grey Tape, or equal.
- c. Thermoplastic Insulation: 3M "Scotch No. 88" Tape, Permacel No. 295 Tape, Slipknot Grey Tape, or equal.
- 2. Terminations at motor junction boxes shall be sealed with 3M "Scotchkote" Electrical Coating over the outer layer of tape. All splices 600 volts and less in No. 8 AWG and larger sizes shall be made using approved bolted connectors properly taped as specified herein.
- C. For No. 10 AWG and smaller branch circuit and fixture conductors operating at 277 volts or less, live spring pressure connectors rated for 600 volts may be used for splices and junctions. When installed in a fixture, connectors shall be rated for 1,000 volts.

2.7 GROUND RODS

- A. Ground rods shall be Copperweld, sectional type. Ground rods shall be UL listed and REA approved and shall conform to ANSI C33.8.
- B. Connections between grounding conductors and grounding rods shall be mechanical if above ground, thermal if underground.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All interconnecting wiring shall be installed in approved conduit or cable trays and connected as shown on the Drawings and/or specified herein. Unless otherwise shown or specified, all wiring shall be run in conduit.
- B. Unless otherwise shown on the Drawings, wiring shall be run by the most direct route keeping overall circuit length to a minimum.
- C. Instrumentation and low level signal wiring shall not be located in the same conduit as motor wiring, feeder wiring, branch circuit wiring, or control wiring. Control wiring shall not be located in the same conduit as feeder wiring, or instrumentation wiring.
- D. All control and circuit wiring in cabinets, boxes, gutters, etc. shall be neatly tied and held using nylon cable ties and mounting brackets.
- E. After installation, conductors shall not have dents, scars, cuts, pressure indentations, abraded areas, etc.
- F. Conductors 600 volts and below shall not be bent to a radius less than 12 times the cable diameter. Conductors above 600 volts shall not be bent to a radius of not less than 24 times the cable diameter.
- G. Wiring run in metallic conduits shall be arranged such that there are an equal number of conductors of each phase in each conduit. Under no circumstances shall metallic conduits contain one single conductor or several conductors of only one phase. This

requirement shall not apply to single, bare grounding conductors run in conduit to grounding rods or grids.

- H. Conductors may be coated with talc, soapstone, Ideal "Yellow 77" or "Wire Lube", Electro-Compound "Y-ER EAS," or equal, to facilitate pulling into raceways, but in no case may they be greased or coated with any substance injurious to conductor insulation and jacket. Pulling tension shall be exerted primarily on the strongest component of conductors, normally the metallic conductors themselves and not on the insulation jacket. When installing cable in conduit with pulling eye attached to copper conductor, the tension shall not exceed 0.008 pound per circular mil area of the conductor nor 5,000 pounds, whichever is smaller. When a basket grip is used over the outer jacket of the cable, the maximum pulling tension shall not exceed 0.008 pound per circular mil area of the conductor nor 1,000 pounds, whichever is smaller. In no case shall pulling tensions recommended by the wire manufacturer be exceeded. The maximum sidewall pressure exerted on the insulation and sheath at a cable bend shall not exceed 300 pounds per foot of conduit bending radius. Conductors shall not be pulled "through" any outlet, condulet or box. Separate "pulls" shall be made on each side of such point.
- I. Unless otherwise specified, splices shall be made at outlet or conduit boxes, pull or junction boxes, manholes, or vaults. No splice shall be drawn into a conduit. Splices in wiring rated 600 volts and below shall be made with enough spare wire for 2 splices to be remade with the wire at the same location.
- J. All instrumentation and thermocouple extension wire shields shall be grounded. Shields on individual circuits shall be electrically continuous and shall be grounded at only 1 point in the circuit. Shields on thermocouple extension wire shall be grounded at the thermocouple only.
- K. Surge suppressors shall be installed with the shortest line lead possible, but in no case longer than 18 inches unless otherwise shown on the drawings.
- L. Inside manholes, all cables are to have racks with insulator supports. Supports are to be within 6 inches of each side of a splice and spaced not farther than 3 feet apart.
- M. All conductors are to be identified. Branch circuits, motor feeders, and lightning wiring shall be identified by color coding consistent with the existing facility. If the facility is new, the color code shall be as follows:

| | 277/480V | 120/208/240V |
|---------|-----------------|--------------|
| Phase A | Brown | Black |
| Phase B | Orange | Red |
| Phase C | Yellow | Blue |
| Neutral | Grey | White |
| Ground | Green w/ Stripe | Green |

N. The color coding on No. 8 AWG and smaller conductors shall be continuous in length. No taping, painting or other means of coding will be acceptable. Conductors

No. 6 AWG and larger and conductors operating above 600 volts shall be black with color coded tape visible at each point of access or view.

- O. All circuits shall be identified at each termination and at all accessible locations such as manholes, hand holes, and pull-boxes. A circuit name shall be assigned based on the equipment at the load end of the circuit. Add a suffix letter if necessary to make the circuit number unique. Utilize sleeves for conductor sizes #2 AWG and smaller, and marker plates attached with nylon tie cords for larger conductor sizes. Taped-on markers or markers relying on adhesives shall not be allowed.
- P. Conductors used for temporary construction power shall not be used for the permanent installation, and the permanent conductor system shall not be used for construction power unless authorized in writing by the Engineer. Circuit protective devices shall never be temporarily bypassed.
- Q. Cables shall be pulled and installed without splices. Splices shall only be made with the Engineer's approval.
- R. Apply fireproofing tape to cables in hand holes and manholes, and in other locations such as vaults, throughout their exposed length. Follow the tape manufacturer's installation instructions closely.

3.2 TESTING

- A. Perform visual and mechanical inspection of each individual exposed power cable #6 AWG and larger for physical damage, correct terminations in accordance with the Drawings, cable bends in accordance with bending radius requirements, proper circuit identification, proper lug type, tightness of bolted connections with proper torque level per NETA ATS, Table 10.12 or manufacturer's specifications, and proper grounding.
- B. Perform Insulation Resistance Testing of all conductors #6 AWG and larger with respect to ground and each adjacent conductor. Apply 1,000 volts dc for one minute on 600 volts insulated conductors in accordance with NETA. Minimum insulation resistance values shall not be less than 50 meg-ohms. Investigate all deviations between adjacent phases.
- C. Perform Continuity test by ohmmeter method to ensure proper cable connections of all conductors #6 AWG and larger.

END OF SECTION

SECTION 26 05 26

GROUNDING

PART 1 GENERAL

1.1 STANDARDS

A. All electrical systems shall be grounded in accordance with the National Electrical Code, Local Codes, these Specifications and the contract drawings.

PART 2 PRODUCTS

2.1 CABLE AND EQUIPMENT

- A. Use green colored and bare stranded copper conductors.
- B. Use approved ground clamp manufactured for such purpose.
- C. Use approved grounding electrodes and ground rod.
- D. Make permanent ground connection with exothermic weld method.

PART 3 EXECUTION

3.1 GENERAL

- A. In general, alternating current circuits of 600 volts and below, surge suppressors, conductor raceway systems, and platform steel framework shall be effectively and permanently connected to a grounding system by means of copper conductors having cross section as required by the National Electrical Code and of capacity sufficient to ensure continuity and continued effectiveness of the ground connections under conditions of excess current. If some of the equipment to be grounded is not covered herein by detailed instructions or is not shown completely and clearly on the Drawings, such provisions of the National Electrical Code as may apply are to be considered minimum requirements for the work.
- B. All metallic conduit systems, whether used for power or lighting wiring, shall be installed in such a manner as to produce electrical continuity and shall be bound together at one or more points and connected to the building system ground, except that isolated sections of conduit not exceeding 4 feet in length are not to be grounded or bonded unless specifically called for.
- C. Rigid metal conduit systems made up with fittings, boxes, and apparatus housings having fully-threaded hubs need no additional provisions for continuity of ground. If the conduit system contains cutouts, pull boxes, junction boxes, switchboxes, etc., to which the conduit is fastened by means of locknuts and bushings, such interruptions in

GROUNDING

the grounding continuity shall be eliminated by bonding the conduit to the housings or by separately grounding each box and conduit sections, etc., that are so isolated. Grounding wedge lugs shall be used between all bushing and metal boxes. Paint and other nonconducting material shall be removed from the surface of conduit, fittings, and metal housings prior to connecting grounding clamps, straps, or other devices.

- D. Equipment Grounding: Panel, starters, lighting fixtures, motor control center, etc., for power and lighting constitute the fundamental center of the associated distribution systems. As such, the metallic enclosures, frames, and other noncurrent carrying metal parts of this equipment shall be connected by one or more grounding conductors to the grounding system. Install a ground connection from the ground bus of switchgears, MCCs, and other electrical panels with ground bus to the ground grid.
- E. All motor frames shall be grounded. The ground conductor shall be run inside the conduit containing the power conductors. In the case of most 3-phase circuits, this means a fourth conductor in each branch circuit. The grounding conductor may be as large as the power conductor or as small as allowed by Section 250 of the NEC but shall not be smaller than No. 12 AWG. The grounding conductor shall be stranded, with green insulation through No. 4 AWG; larger sizes may be bare stranded. Ground connection at the motor shall be terminal lug or servit post inside motor conduit box and the other end connected to the ground bus in the motor control center.
- F. Transformer Grounding: Bond the neutrals of outdoor substation transformers and distribution transformers within buildings to system ground network, and any additional grounding electrodes shown near the transformers. Connect the case of the transformer to the grounding system as well.
- G. In making ground connections, the surfaces to all parts that will touch shall be thoroughly cleaned to ensure making good electrical contacts.
- H. All clamped joints shall be made up firmly. Thermal joints shall be equal to CadWeld Type TA. Where exposed to mechanical injury, the grounding conductor shall be suitably protected by pipe or other substantial guard. If guards are iron pipe or other magnetic material, the grounding conductor shall be electrically connected to both ends of the guard to reduce impedance of the circuit.
- I. Grounding conductors shall be without splice or joint if applicable and shall be straight and short except that when laid underground they shall be laid slack to prevent their being readily broken unless otherwise mechanically protected.
- J. No fuse, switch, circuit breaker, or similar disconnecting devices shall be inserted in the grounding conductor or connection throughout the entire installation.
- K. Grounding conductors shall be medium hard drawn, stranded bare copper wire sized as required by the National Electrical Code Article 250. Conductors Size No. 6 and smaller may be solid; Size No. 4 and larger shall be stranded. Ground wire shall be carried in conduit to the grounding point.
- L. Ground rods where required, shall be of copper-clad steel not less than ³/₄-inch in diameter, 10 feet long or as shown on the Contract Drawings, and driven full length into the earth. The maximum resistance of a single driven ground shall not exceed 5

GROUNDING

ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, a minimum of 2 additional rods shall be installed not less than 10 feet on center. Connections between grounding conductors and ground rods shall be mechanical if exposed, thermal if buried.

- M. Except where specifically indicated otherwise, all exposed noncurrent-carrying metallic parts of electrical equipment, raceway systems, and neutral conductor of the wiring system shall be grounded. The ground connection shall be made at the main service equipment and shall be extended to driven rods on the exterior of the building.
- N. All neutral conductor shall be continuous throughout the system and shall be grounded only at the point of origin of the service neutral.
- O. All receptacles shall have provision for grounding conductor connection, and shall be grounded to the grounding conductor and outlet box.
- P. All exposed steel columns, tanks, ladders, towers, and elevated platform shall be effectively grounded using No. 4/0 or larger bare copper grounding conductors and driven ground rods. Where multiple columns or tanks must be grounded, ground points shall be interconnected by minimum No. 4/0 bare copper grounding conductors buried approximately 18 inches below finished grade.
- Q. Anchor bolts securing exposed electrical equipment, structures, metal enclosures, and tanks located outdoors shall be electrically connected to the steel reinforcement in the concrete foundation or footing. Connection shall consist of minimum No. 2/0 bare copper conductors and mechanical grounding clamps.
- R. Surge arrestor ground terminals shall be connected to the equipment ground bus. Ground paths for lightning and surge arresters and capacitors shall be kept as short and direct as practical. If possible, arresters shall be connected in direct shunt relationship to the equipment terminals. Supporting brackets shall be connected directly to the equipment frame.
- S. Grounding resistors, where specified, shall have a resistance within the boundary limits specified in IEEE Standard 142 in order to minimize transient overvoltages during ground faults. Ground fault current shall not be less than that required to operate protective devices or 25 amps, whichever is greater.
- T. Lightning and surge arresters used with grounded-wye systems which do not have effectively grounded neutrals as defined by IEEE Standard 100 shall have a voltage rating not less that the maximum phase-to-phase voltage of the system.
- U. The grounding system equivalent resistance shall not exceed 5 ohms for the entire system under normally dry conditions unless otherwise specified. After the grounding system has been installed and all connections made, tests shall be made by the Electrical Contractor to determine the resistance to earth. If the resistance of the entire system exceeds the specified maximum, additional ground rods shall be driven to reduce the resistance to this value.
- V. Gas piping or piping conveying flammable liquids shall not be used as grounding electrodes.

- W. The use of salts or electrolytes to reduce earth resistance shall not be permitted.
- X. Permanently connect the green ground conductor to each receptacle junction box (self-tapping screw).
- Y. Install a ground rod inside each manhole. Connect any metallic raceway and all noncurrent-carrying metal parts to the ground rod with a No. 6 AWG (min.) copper conductor. Similarly, provide a ground rod for every pole-mounted site lighting and make grounding connections.
- Z. Bond the standby generator neutral to the grounding system with a properly sized grounding conductor. Ground the generator frame to the ground grid.
- AA. Ground metallic fences when used to enclose electrical equipment.
- BB. Bond all metallic pipe systems, ducts, etc as per the NEC.

3.2 TESTING

- A. Ground resistance testing shall be done in accordance with IEEE standard 81-1993 to confirm that the resistance of the grounding system is 5 ohms or less (test shall not be run within 72 hours of last rain fall). Ground resistance testing shall be done with the power off and the grounding electrode conductor isolated from the utility, and the service to prevent coupling. The testing equipment shall use the fall of potential method of earth resistance measurement. The test equipment must be designed to reject the effects of stray ac and dc currents on readings.
- B. A test report shall be submitted to the engineer and included in the O & M manual for the project. The report shall include but not be limited to:
 - Date of test
 - Time of day
 - Weather condition (ex. 82°F, 82% RH, cloudy)
 - Date of last rain fall $\geq \frac{1}{2}$ " in a 24 hour period
 - Soil type
 - Minimum of five (5) readings
 - A plot of all readings indicating a level spot in the curve at the system resistance.
- C. All ground resistance testing shall be done in the presence of the Engineer. If test measurements indicate a grounding system resistance of greater than 5 ohms, additional grounding cable shall be buried in locations and at the direction of the Engineer. Ground resistance testing as described herein shall be repeated after the additional ground cable has been installed. The installation of grounding cable and repeat testing shall be done until the 5 ohm grounding system resistance has been achieved.
- D. Test equipment for ground resistance measurement shall be Vibroground by Associated Research, Megger null balance by Biddle, or alternate approved by the Engineer.

END OF SECTION

SECTION 26 05 33

BOXES

PART 1 GENERAL

1.1 SCOPE

A. All boxes required throughout the electrical raceway system shall be furnished and installed in accordance with the requirements which follow.

1.2 SECTION INCLUDES

- A. Outlet boxes.
- B. Pull and junction boxes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Boxes shall be equal to Appleton, Crouse Hinds, Raco, or Steel City.

2.2 MATERIALS

A. Outlet Boxes

- 1. Sheet Metal Outlet Boxes: NEMA OS-1, UL 514; galvanized steel, with ½ inch male fixture studs where required.
- 2. Cast Boxes: Cast feralloy with galvanized or cadmium finish, deep type, gasketed cover, threaded hubs for use with steel conduit, UL 514.
- 3. Floor Boxes: Full adjustable, steel, water and concrete tight equal to T&B model number 68 D.
- 4. Except as indicated otherwise on the drawings or in these specifications, all junction boxes or pull boxes 4 inch trade size or smaller in any dimension shall be galvanized malleable iron or acceptable equal cast ferrous metal for use with steel conduit.

B. Pull and Junction Boxes

1. Junction boxes and pull boxes shall be as indicated on the drawings and as specified in these specifications. Where no type or size is indicated elsewhere for junction boxes or pull boxes, they shall be in accordance with the requirements of the NEC, Article 314, Paragraphs 28, 29, 40 and 41 for use on systems with a nominal rating of 600 volts and less, and Section IV for use on systems with a nominal rating of over 600 volts.

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- a. Sheet Metal Boxes: NEMA OS-1; galvanized steel. Boxes larger than 12-inches in any dimension are hinged enclosure. Equal to Hoffman Bulletin A-51.
- b. Cast Metal Boxes: NEMA 250; Type 4, galvanized cast iron box and cover, neoprene gasket, stainless steel cover screws, UL listed as raintight. Provide flat-flanged type for surface mounting and outside flange recessed cover type for underground use. Boxes for sidewalk or other traffic areas to have appropriate duty cover with non-skid finish.
- c. Corrosion Resistant Boxes: UL 508 Type 4X, gasketed screw cover. For boxes larger than 12-inches in any dimension provide hinge on one side and stainless steel toggle latches (equal to Hoffman A-FC412SS) on the other three sides. Equal to Type 304 stainless steel equal to Hoffman Bulletin A-51.
- d. Floor Boxes: Floor boxes shall be cast iron with bolted covers. The boxes shall be approximately 12 inches square and 10 inches deep, and shall be located as shown on the drawings with the lid flush with the finished floor. Floor boxes shall be Neenah No. R-7517-DB or alternate acceptable to the Engineer.
- 2. Electrical enclosures, except junction boxes and pull boxes 4 inch trade size and smaller and other enclosures of cast metal, shall be constructed from steel plate reinforced as required to provide true surfaces and adequate support for devices mounted thereon.
- 3. Except as indicated otherwise in these specifications or on the drawings, all junction boxes and pull boxes larger than 4 inch trade size for use in indoor locations shall be sheet steel hot-dip galvanized after fabrication and those for use in outdoor or wet corrosive indoor locations shall be 316 stainless steel.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordination of Box Locations

- 1. Provide boxes as shown on Drawings, and as required for splices, taps, wire pulling and equipment connections.
- 2. Box locations shown on the Drawings are approximate unless dimensioned. Verify box locations prior to rough-in. Coordinate mounting heights and locations of outlet mounted above counters, benches, backsplashes, and other furnishings. Any outlet may be relocated by up to 10 feet before it is permanently installed without incurring additional cost.

3.2 INSTALLATION

A. Box Installation

1. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation, except provide minimum 24-inch separation in acoustic-rated walls.

ROXES

- 2. Locate boxes in masonry walls to require cutting of masonry unit comer only. Coordinate masonry cutting to achieve neat openings for boxes.
- 3. Support boxes independently of conduits openings.
- 4. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- 5. In inaccessible ceiling areas, position outlets and junction boxes within 6-inches of recessed luminaires to be accessible through luminaire ceiling opening.
- 6. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- 7. Align wall-mounted outlet boxes for switches, thermostats, and similar devices. Align adjacent devices at different elevations in one vertical line. Set floor boxes level and flush with finish flooring material.
- 8. Unless otherwise noted, use only cast outlet boxes. Galvanized steel boxes shall be used only in finished areas where they are completely concealed within walls or ceiling.
- 9. Conduit openings in boxes shall be made with a hole saw or shall be punched. Field locate holes in junction and pull boxes so as to afford the maximum bending radius for the conductors.
- 10. Boxes mounted on concrete shall be secured by self-drilling anchors. Mounting on steel shall be by drilled and tapped screw holes, or by special support channels welded to the steel, or by both. Boxes larger than 4 inch trade size shall be leveled and fastened to the mounting surface with not less than 1/4 inch air space between the enclosure and mounting surface. All mounting holes in the enclosure shall be used.
- 11. Except as prevented by the location of other work, all junction boxes and outlet boxes shall be centered on structures.
- 12. Label cover of junction boxes with circuit numbers of conductors in the box.
- 13. Medium voltage boxes and low voltage boxes shall be kept separate. Provide physical partitions where required.
- 14. Unless indicated otherwise on the drawings or in these specifications, electrical enclosures except junction boxes and pull boxes 4 inch trade size and smaller, shall be as follows:

| <u>Location</u> | Enclosure Type |
|--|--------------------------|
| Indoor (Nonhazardous) Dry Areas | NEMA 1 |
| Areas where moisture conditions are more severe than those for which NEMA 1 enclosures are intended | NEMA 4 |
| Wet, corrosive indoor areas Outdoor (Nonhazardous) | NEMA 4X SS NEMA 4X SS |

ROXES

Class 1, Division 2

NEMA 7

END OF SECTION

SECTION 26 05 34

CONDUIT

PART 1 GENERAL

1.1 SCOPE

- A. Work covered by this section includes furnishing all labor, equipment, and materials required to install electrical conduit and fittings as specified herein and/or shown on the Drawings.
- B. The Contractor's attention is called to the fact that all conduits and conduit fittings are not necessarily shown completely on the Drawings, as the Drawings are schematic. However, the Contractor shall furnish and install all conduits and conduit fittings indicated or required for the proper connection and operation of the equipment.

1.2 SHOP DRAWINGS AND ENGINEERING DATA

A. Shop drawings and engineering data shall be submitted in accordance with requirements of the Section 01 33 00 of these Specifications.

1.3 STORAGE AND PROTECTION

A. Store and protect conduit and fittings in accordance with the manufacturer's recommendations and requirements of the Section 01 60 00 of these Specifications. Conduit shall be stored aboveground and adequately supported.

1.4 GUARANTEE

A. Provide a guarantee against defective equipment and workmanship in accordance with requirements of the Section 00 72 14 Article 23 of these Specifications.

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise shown or specified, all conduits shall be rigid metal. See the paragraph on Conduit Application for additional information.
- B. Conduit terminations at electrical equipment such as electric motors, dry type transformers and heaters shall be made using liquid-tight, flexible metal conduit.
- C. Damaged, dented, flattened, or kinked conduit shall not be used.

2.2 RIGID METAL CONDUIT

- A. Rigid metal conduit shall be heavy wall, mild steel conduit conforming to ANSI C80.1 and Federal Specification WW-C-581, hot dip galvanized both inside and out. All conduits shall bear the approved stamp of the Underwriters Laboratories.
- B. Rigid metal conduit shall be by Allied Tube & Conduit, Republic, or equal.

2.3 RIGID NONMETALLIC CONDUIT

- A. Rigid nonmetallic conduit for voltages 600V and less shall be Schedule 40 heavy wall polyvinyl chloride (PVC) electrical conduit rated for 90 degrees C conductors and conforming to NEMA TC-2, Type EPC-40-PVC. It shall be listed by Underwriters Laboratories in conformance with the National Electrical Code. Conduit fittings, elbows, and joint cement shall be produced by the same manufacturer as the conduit. Conduits shall be as manufactured by Carlon, Allied Tube and Conduit, Borg-Warner, or equal.
- B. Rigid nonmetallic conduit for voltages higher than 600V shall be polyvinyl chloride (PVC) power duct rated for 90 degrees C conductors and conforming to NEMA TC-6, Type EB. Conduit fittings, elbows, and joint cement shall be produced by the same manufacturer as the conduit. Conduit shall be as manufactured by Carlon, Olin, or equal.

2.4 PLASTIC-COATED RIGID METAL CONDUIT

- A. Rigid metal conduit prior to application of plastic coating shall conform to Part 2.02, Rigid Metal Conduit, of this section.
- B. Plastic coating shall be polyvinyl chloride (PVC) bonded to the metal a uniform thickness of 40 mils the full length of the conduit except the threads. The bond between the metal and PVC coating shall be equal or greater than the tensile strength of the PVC coating.
- C. A coupling shall be furnished loose with each length of conduit and shall have a PVC sleeve extending 1 pipe diameter, or 2-inches, whichever is least, beyond the end of the coupling. Elbows shall have the same thickness of PVC coating as on the conduit. All threaded conduit and elbow ends shall have plastic thread protectors.
- D. The rigid steel galvanized PVC coated conduit and fittings shall be KorKap as manufactured by Plastic Applicators, Houston, Texas; Plasti-Bond as manufactured by Pittsburgh Std. Div. of Robroy Industries, Verone, Pa.; or equal.
- E. PVC-coated rigid conduit shall meet the ASTM D870 Boil Test.

2.5 RIGID ALUMINUM CONDUIT

- A. Rigid aluminum conduit shall be manufactured of 6063 alloy in temper designation T-1. The fittings shall be of the same alloy.
- B. All conduits shall bear the approved stamp of the Underwriters Laboratories and be manufactured to ANSI C80.5 and Federal Specification WW-C-540c.

C. Rigid Aluminum conduit shall be by Republic, Allied Tube and Conduit, or equal.

2.6 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

A. Flexible conduit shall have an oil-resistant, liquid-tight jacket in combination with flexible metal reinforcing tubing and shall be designed for use with waterproof fittings. An integral ground wire shall be pulled. Flexible conduit shall be American Brass Sealtite Type UA as manufactured by Electric-Flex Company; Flexible Metallic Conduit as manufactured by Ideal Industries, Inc; or equal. Only Underwriter's Laboratories approved fittings shall be used.

2.7 CONDUIT FITTINGS AND BUSHINGS

- A. Wherever conduits terminate in sheet steel boxes, double bonding type locknuts and bushings shall be used except when terminating in cast hubs. All bushings shall be insulated metallic type, equal to O. Z. Electrical Manufacturing Company, Type B; T & B Company, 1200 Series; Appleton Electric Company, Type BU-I; or equal.
- B. Where conduits terminate in steel or cast NEMA 4 enclosures with no factory-installed threaded hubs, a threaded hub shall be installed equal to Myers Electric Products, Inc., Type ST or STG; Appleton Electric Company, Type HUB; Crouse-Hinds, Type HUB; or equal.
- C. All conduits terminating at motor control centers shall be suitably grounded to the
 motor control center ground bus using grounded type insulated bushings equal to O.
 Z. Electrical Manufacturing Company, BLB or IGB; Appleton, Type BIB; Thomas
 and Betts, 3800 Series; or equal.
- D. Conduit expansion fittings shall be O. Z. Electrical Manufacturing Company, Type EX with Bonding Jumper, Type XJ; Appleton, Type SJ with Type XJB4 Bonding Jumpers; Crouse-Hinds, Type XJ with GC100 Bonding Jumper; or equal.
- E. All outdoor conduit penetrations shall enter the enclosures, panels, junction boxes from the bottom side. Top and side penetrations are not permitted without the Engineer's approval.
- F. All outdoor conduit hubs shall be watertight Myers hubs.

2.8 CONDUIT BOXES

A. Exposed conduit boxes and pulling elbows shall be of die-cast, copper-free aluminum with threaded body and removable neoprene- gasketed cover. Conduit boxes shall conform to Federal Specification W-C-586a and shall be Crouse-Hinds "Condulet," Appleton "Unilet Form 85," or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Minimum size conduit shall be 3/4 inch aboveground and 1 inch below ground except where noted otherwise, and no conduit shall have more than 40 percent of its internal area occupied by conductors.
- B. During construction all installed conduits shall be temporarily plugged, capped, or otherwise protected from the entrance of dust, trash, moisture, etc., and any conduits that may become clogged shall be replaced. No conductor shall be pulled in until all work that might cause damage to the conduit or conductors has been completed.
- C. Conduit connections to sheet metal enclosures shall be securely fastened by double lock nuts inside and outside and shall have grounding bushings.
- D. Conduit straps or brackets secured to concrete, brick, or masonry shall be by means of expansion bolts, toggle bolts, or approved drill anchors. No wood plugs will be permitted.
- E. Conduits supported from building walls shall be installed with at least 1/4-inch clearance from the wall using pipe spacers equal to Appleton Electric Company,
 T & B Company, Steel City, or equal. Clamp back to prevent the accumulation of dirt and moisture behind the conduit.
- F. Unless otherwise shown or specified, exposed rigid conduit shall be installed parallel or at right angles to structural members, surfaces, and building walls.
- G. Two or more conduits in the same general routing shall be parallel with symmetrical bends.
- H. Conduits shall be at least 12 inches from high temperature piping, ducts, and flues.
- I. Conduit installed horizontally shall allow headroom of at least 7 feet, except where it may be installed along structures, piping, equipment, or in other areas where headroom cannot be maintained because of other considerations.
- J. Wherever necessary conduit boxes and pulling elbows shall be inserted in the lines. Gaskets shall be used to ensure a dust and watertight installation on all conduit boxes and fittings.
- K. All bends and turns in conduits shall have a bend radius of not less than 6 times the internal diameter of the conduit. Bends shall be made using an approved bender to provide smooth bends with no kinks, dents, or flattening.
- L. All concealed conduit shall be placed in walls, floors, ceilings, or slabs at the proper time in accordance with the progress of the work. The Contractor shall cooperate in every respect in meeting schedules and shall not delay the structural work unnecessarily. Conduits embedded in concrete shall be blocked and braced in place by use of adequate conduit separators to prevent displacement during pouring of the concrete. Where conduit interferes with structural steel, steel reinforcement, or in the opinion of the Engineer occupies too much space in the slab, the conduits shall be

rearranged or installed exposed as directed by the Engineer. No additional payment will be made for such rearrangement of conduit whether or not additional conduit or fittings might be required.

- M. Conduit wall seals with water stops shall be installed in outside walls below grade for all incoming or outgoing underground conduit emerging directly into the building area. The conduit wall seals shall have a pressure ring and sealing grommet to ensure a watertight installation.
- N. Conduit expansion fittings and ground bonding jumpers shall be installed on all conduits passing through building expansion joints to provide movement in the conduit system.
- O. Where groups of conduits terminate together or pass through floors, provide template to hold conduits in proper relation to each other and to building.
- P. Conduits shall be plugged or capped with plastic caps during construction to protect threads and prevent entrance of dirt and water.
- Q. Conduits shall be adequately supported at intervals as required by the National Electrical Code. One to two exposed conduits running parallel to each other may be supported by strap anchors, or 1-hole clamps (walls only). Exposed conduits larger than 2 inches or groups of more than 2 conduits run parallel shall be supported by means of minimum 12 gauge, slotted steel channels fitted with 2-piece, bolted pipe clamps. All conduit supports, clamps, straps and brackets shall be stainless steel for corrosion resistance.
- R. Runs of conduit shall not contain more than four 90-degree bends (360-degrees total) between conduit boxes panelboards, or terminations. In general and to the extent practical length of conduit runs between conduit boxes or similar means of access shall not exceed 100 feet.
- S. Exposed service entrance conduits and main feeder conduits shall be identified using stenciled letters at intervals not to exceed 20 feet. Size of letters shall be equal to one-half the diameter of the conduit or 2 inches, whichever is less.
- T. In Class 1, Division 2 areas, the contractor is responsible for installing seal-off fittings as required by Articles 500, 501, and 502 of the National Electric Code. The drawings do not show seal off fittings and it is the contractor's responsibility to locate and install the seal-offs based on field routing of the conduit.

3.2 INSTALLATION OF RIGID METAL CONDUIT

- A. Terminations and connections of rigid metal conduit shall be threaded. Conduits shall be reamed free of burrs and terminated with insulated metallic conduit bushings.
- B. Conduit threads shall be coated with a petroleum base corrosion-inhibitor with low electrical contact resistance before assembly equal to Burndy Engineering Company, Inc., Penetrax "A" or equal screw thread lubricant (zinc-petroleum or zinc-chromate compounds are permissible).

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- C. All conduits shall be suitably grounded to the plant ground grid using grounded type insulated bushings, O. Z. Electrical Manufacturing Company, Type BLG or IGB, T & B Company, Appleton Electric Company, or equal.
- D. Conduit across structural joints where structural movement is allowed shall have bonded, weathertight expansion and deflection fitting the same size as the conduit.
- E. Support spacing for conduits 1 inch and smaller shall not exceed 6 feet, and conduits 1½ inches and larger shall not exceed 10 feet. Supports shall be as specified under basic electrical materials and methods. Conduits 1½-inch and smaller may be supported by 1-hole conduit straps and 2 inches and larger shall be supported by 2-hole conduit straps. Conduit racks shall be as manufactured by Unistrut, Kindorf, or equal. Conduit racks shall be 316 stainless steel.
- F. Conduit joints shall be made up tight using a pipe wrench. Channel lock pliers will not be permitted, and unions shall be used as necessary to aid in the installation. Conduits shall be cut square and the ends reamed smooth after threading to prevent injury to conductors. Conduit joints in concrete or exposed to weather or damp locations shall be drawn up tight and coated with insulating paint before casting in concrete or painting exposed conduit system.
- G. Plastic-coated rigid metal conduit and fittings shall be installed in accordance with the manufacturer's specifications and recommendations. Any damage to the plastic coating shall be repaired in accordance with the manufacturer's requirements. The manufacturer shall certify the installers before installation can be started.

3.3 INSTALLATION OF RIGID NONMETALLIC CONDUIT

- A. Field bending of polyvinyl chloride conduit shall be made with appropriate equipment. No torches or flame-type devices shall be used.
- B. When joints are to be made with polyvinyl chloride conduit, the conduit shall be cut with a fine-tooth saw and deburred. Conduit ends shall be wiped clean of dust, dirt, and shavings and shall be dry. Solvent cement shall be applied to bond the joint. The joint should be watertight.
- C. Polyvinyl chloride conduit shall be installed in accordance with the manufacturers' specifications and recommendations.

3.4 INSTALLATION OF LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Terminations at motors shall be made with flexible liquid-tight metal conduit from conduit stub to terminal box; flexible connection shall be made as short as possible. Flexible conduit shall be Type UA, black. Underwriter's Laboratories approved flexible liquid-tight conduit connectors shall be as manufactured by Thomas and Betts Company, Appleton Electric Company, or equal.
- B. Uncoated flexible metal conduit may be used for short connections between junction boxes and lighting fixtures or speakers installed in suspending ceiling systems. Flexible metal conduit shall be connected using Underwriters Laboratories approved grounding connectors.

3.5 INSTALLATION OF UNDERGROUND CONDUIT

- A. All underground conduits shall be concrete-encased unless otherwise noted on the Drawings or directed by the Engineer. No conduit shall be concealed or encased until the Engineer has inspected the conduit for proper installation and accurate placement.
- B. The Contractor shall be responsible for all excavating, draining trenches, forming of duct assembly and protective concrete envelope, backfilling, and removal of excess earth
- C. Underground conduit shall be installed with a minimum 3-inch per 100-foot downward slope for drainage. Drains shall be provided at all low points.
- D. Bends and turns shall be made using long sweeps. Ninety-degree bends will be used only where required and shall be kept at a minimum. Field coordinate conduit bends with minimum bending radius of conductor prior to installation of conduits.
- E. Where rigid nonmetallic conduits emerge from underground, an adapter from rigid nonmetallic conduit to rigid metal conduit shall be installed and all exposed conduit shall be rigid metal conduit. The last bend shall be rigid galvanized steel.
- F. All rigid metal conduit risers shall be protected with 2 coats of a Bitumastic compound before concrete is poured from a point 12 inches below grade to a point not less than 6 inches above grade or surface of concrete. All stub-ups shall extend upward with one length of rigid metal conduit until after concrete is poured to assure vertical alignment.
- G. Conduits shall be encased in concrete with 3-inch minimum concrete cover all around.
- H. Concrete for concrete encasement shall be Class B concrete conforming to requirements of the section entitled "Cast-In-Place Concrete," of these Specifications. Longitudinal and lateral steel reinforcement shall be provided as shown on the Drawings.
- I. All underground conduit runs for voltages less than 600 volts shall be at least 24 inches below grade and shall have a minimum conduit separation of 4 inches. Provide a magnetic warning tape 12" below finished grade.
- J. All underground conduit runs for voltages over 600 volts shall be at least 36 inches below grade and shall have a minimum conduit separation of 4 inches. Conduit shall have a minimum 4-inch concrete cover on all sides. Provide a magnetic warning tape 12" below finished grade.
- K. All underground conduit runs shall be rodded and a mandrel drawn through followed by a swab to clean out any obstructions that may cause cable abrasions. The mandrel shall be 12 inches in length and the diameter ½ inch less than the inside diameter of the conduit.
- L. All underground conduit runs shall be marked by a strip of permanently colored red polyethylene tape, 0.004 inch thick and 6 inches wide, buried above the conduit and 6 inches below finished grade. Provide a magnetic warning tape 12" below finished grade.

CONDUIT

M. All spare conduits shall be provided with permanent waterproof caps at stub-ups and shall be furnished with a 500# fiber tape pulling wire. Waterproof raceway tags shall be attached to the pulling cords, at each end and at each intermediate pulling point. The raceway tags shall identify the origin and destination of the conduit.

3.6 CONDUIT APPLICATION

- A. Install the following conduit types, unless otherwise shown on the drawings.
 - 1. Outdoors, Exposed (Not Buried): PVC Coated Rigid Conduit
 - 2. Indoors
 - a. Dry Areasb. Wet AreasAluminum RigidAluminum Rigid
 - 3. Underground (Under Slabs-on-Grade, Encased or Embedded in Concrete)
 - a. PVC Schedule 40
 - 4. Hazardous Gas Areas
 - a. PVC Coated Rigid
 - 5. Chemical Feed Areas
 - a. PVC Schedule 80
 - 6. Transition Areas and Final Connections to Equipment
 - a. Motor Connections Flexible metal, liquid-tight conduit.
 - b. Light Fixture Connections Flexible metal non-metallic liquid-tight conduit in dry areas and liquid-tight in wet areas.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SCOPE

- A. Panelboards shall be furnished in the quantities and with components, devices, and materials meeting the requirements indicated in the panelboard list on the drawings.
- B. Panelboards shall be designed and fabricated in accordance with NEMA standards for panelboards. Each panelboard, or all current controlling devices in each panelboard, shall bear the UL label.

1.2 SECTION INCLUDES

A. Panelboards.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

1.4 REFERENCE STANDARDS

- A. Design, manufacturing and assembly of elements of panelboards and devices herein specified shall be in accordance with the standards of the below listed organizations.
 - 1. American National Standards Institute (ANSI)
 - 2. National Electrical Manufacturers Association (NEMA)
 - 3. National Fire Protection Association (NFPA)
 - 4. National Electrical Code, NFPA-70 (NEC)
 - 5. Underwriters Laboratories, Inc. (UL)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equipment shall be manufactured by General Electric, Siemens, Square D, or Eaton/Cutler- Hammer.

2.2 MATERIALS

- A. Panelboards: NEMA PB-1; UL 67.
- B. Rating: Voltage and ampere ratings are shown on the Drawings. Unless otherwise indicated, interrupting ratings (RMS symmetrical) are 14,000 amps for 480 volt panelboards and 10,000 amps for 240 and 208 volt panelboards.

PANELBOARDS

C. Cabinets: Indoor panelboards shall be in NEMA 1 cabinets. The cabinet shall be code gage gasketed steel. It shall consist of a box with a removable front complete with hinged door, latch and master keying lock. The box shall be flanged galvanized sheet steel. Boxes shall be a minimum of 20 inches wide and 5-7/8 inches deep. Code gauge galvanized steel; sized to accommodate devices indicated and afford wire bending space in accordance with NEC requirements.

Outdoor panelboards shall be in a NEMA 4X cabinet.

D. Fronts: Surface or flush as indicated, door-in-door construction, finished in light grey enamel over a rust inhibitor. Furnish flush lock for fronts less than 48-inches high and vault type handle with three point catch for fronts 48-inches and higher. Key all locks alike.

E. Bus:

- 1. Rigid buses of copper or copper alloy shall be installed to provide consecutive phasing of branch circuit connections.
- 2. The solid neutral bus shall have solderless connectors, numbered to agree with branch circuits. The bus shall be insulated from the cabinet with provisions for grounding.
- 3. The equipment grounding bus with main lug shall have solderless connectors, numbered to agree with branch circuits.

F. Circuit Breakers:

- 1. NEMA AB-1; molded case type, thermal-magnetic trip with internal common trip on multi-pole breakers.
- 2. Protective overcurrent devices for branch circuits shall be of the size and type indicated on the drawings.
- 3. Panelboard branch circuit breakers shall be the thermal magnetic, bolt-in, individually front replaceable type and shall indicate "On", "Off", and "Tripped". Circuit breakers indicated as multiple pole shall be common trip.
- 4. Continuous and interrupting ratings shall be as shown on the drawings. Provide breaker fully rated for interrupting ratings noted; series ratings are not acceptable.
- G. Provide engraved nameplates giving the voltage rating and panel designation as indicated. Provide a UL service entrance label for panelboards used as service entrance equipment.
- H. Surge Protection: Where indicated, provide transient voltage surge suppressors.

PART 3 EXECUTION

3.1 INSTALLATION

A. All panelboards shall be installed so that circuit breakers are not more than 6 feet above the finished floor and not lower than 24-inches above the floor. Panels

PANELBOARDS

- shall be installed in accordance with the requirements of NEC Article 312 Paragraph 8, Article 408 and the following articles.
- B. The cabinets shall be leveled and securely fastened to the mounting surface, utilizing all of the mounting holes provided in the panelboard cabinets.
- C. Each cabinet shall be installed, conduits connected, and wires pulled before the panel interior is installed. A heavy cardboard panel front shall be temporarily secured to the front of the panelboard to protect the interior from dirt or damage until the permanent metal front is installed.
- D. Each panelboard front shall be carefully aligned and adjusted until its edges are parallel to the panelboard interior and the building lines, and then shall be firmly secured with the fasteners provided.
- E. For flush mounted panels provide a 3/4-inch empty raceway for each three unused spaces and spare poles. Terminate in a junction box located above the ceiling or other approved accessible location for future extension.
- F. Prior to energizing panelboards clean out construction dirt and debris. Paint any scratches on the trims or dead front barriers. Megger each phase to phase and ground to ensure that no short circuits exist.
- G. Adjust panel barriers so that no openings occur between them and panel front. Provide filler plates and plugs as necessary to maintain dead front integrity.
- H. A circuit directory cardholder and card with a clear plastic covering shall be provided on the inside of each cabinet door. The directory card shall provide a space to identify each circuit in the panelboard. The directory for each panelboard shall be accurately typed with the names of the load served by each breaker to permit ready location of the protective devices controlling circuit loads. Note spare circuits in pencil.
- I. Each panelboard shall be identified with a suitable engraved nameplate mounted at the top of the front plate. Each nameplate shall be engraved with the panelboard identification indicated on the Contract Drawings.

END OF SECTION

DISCONNECT SWITCHES

SECTION 26 28 16

MOTOR DISCONNECT SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Three phase motor disconnect switches.
- B. Single phase motor disconnect switches under 1 horsepower.
- C. Single phase motor disconnect switches over 1 horsepower.

1.2 SUBMITTALS

A. Submit shop drawings in accordance with Section 01 33 00.

PART 2 PRODUCTS

2.1 THREE PHASE MOTORS

- A. Disconnect switches for three phase motors shall be a heavy-duty type rated 600 volts, and shall be UL listed. Outdoor switches shall be in NEMA 3R enclosures; indoor switches in non-corrosive atmospheres shall be in NEMA 1 enclosures; indoor switches in wet, corrosive atmospheres shall be in NEMA 4X enclosures.
- B. Switches shall be single throw non-fusible with provisions for padlocking the handle in the open position.

2.2 SINGLE PHASE MOTORS UNDER 1 HORSEPOWER

- A. Disconnect devices for single phase motors up to 1 horsepower, not controlled with magnetic starters, shall be toggle operated manual motor starters rated 240 volts ac. Outdoor switches shall be in NEMA 3R enclosures; indoor switches in non-corrosive atmospheres shall be in NEMA 1 enclosures; indoor switches in wet, corrosive atmospheres shall be in NEMA 4 enclosures.
- B. Switches shall be non-fusible type with a thermal overload trip assembly. The handle shall include a handle guard with provisions for padlocking the handle in the open position. Continuous ratings shall be as shown on the Contract Drawings.

2.3 SINGLE PHASE MOTORS OVER 1 HORSEPOWER

A. Disconnect switches for single phase motors over 1 horsepower in noncorrosive atmospheres and having separate overload protection and control shall be general duty rated for 240 volts ac. Outdoor switches shall be in NEMA 3R enclosures and indoor switches shall be in NEMA

DISCONNECT SWITCHES

1 enclosures.

- B. Disconnect switches for single phase motors over 1 horsepower in corrosive atmospheres and having separate overload protection and control shall be heavy duty rated for 600 volts ac in NEMA 4X enclosures.
- C. Switches shall be 2 pole non-fusible, single throw type with provisions for padlocking in the open position. Continuous ratings shall be as shown on the Contract Drawings.

2.4 NAMEPLATES

A. Nameplates shall be provided for each motor disconnect switch to identify the load served. Nameplates shall be engraved with 3/16 inch minimum height black letters on a white background, and shall be mounted on the front of the enclosure with stainless steel screws.

2.5 ACCEPTABLE MANUFACTURERS

A. Disconnect switches shall be manufactured by General Electric, Cutler Hammer, Square D, or Engineer approved alternate.

PART 3 INSTALATION

3.1 INSTALLATION

A. Install in accordance with the manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

- A. TESTS
 - 1. Megger each bus, phase-to-phase and phase-to-ground.

END OF SECTION

INTERIOR LIGHTING

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.1 SCOPE

A. Work covered by this section includes furnishing all labor, equipment, and materials required to install all lighting equipment, fixtures, lamps, outlet boxes, hangers, and all related work for a complete installation.

1.2 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with requirements of the Section 01 33 00 of these Specifications.
- B. The Contractor shall submit for review and approval, a complete list of fixtures he intends to furnish, including technical specifications, assembly details, and photometric data.

1.3 STORAGE AND PROTECTION

A. Lighting equipment shall be stored and protected in accordance with requirements of the Section 01 60 00 of these Specifications.

1.4 GUARANTEE

A. Provide a guarantee against defective or deficient workmanship and products in accordance with requirements of the Section 00 72 14 Article 23 of these Specifications.

PART 2 PRODUCTS

2.1 FIXTURES

- A. Interior lighting fixtures of types and sizes as indicated on the fixture schedule shall be furnished and installed complete.
- B. All lighting fixtures, lampholders and accessories are to be Underwriters Laboratories approved.
- C. Unless called for otherwise, all pendant mounted fixtures shall be equipped with stem. Aligners shall be used on all pendant mounted fixtures hung from irregular or sloping ceilings.
- D. The fluorescent and high intensity discharge fixtures shall be complete with ETL-UL approved constant wattage ballasts and lamps as indicated on the schedule.

INTERIOR LIGHTING

- E. Vapor-proof units shall have galvanized malleable iron or cast aluminum hood, glass globe and aluminum guards or as called for in the fixture schedule.
- F. All lighting fixtures which accommodate the use of gaskets shall be properly fitted with gaskets of an approved material.

2.2 LAMPS

- A. All lighting fixtures shall be provided with lamps of the proper type and wattage, as noted on the Drawings. Any lamps broken previous to the final acceptance of the work shall be replaced by the Contractor at his own expense.
- B. Incandescent lamps shall be wired with screw shell connected to neutral conductors. They shall be supplied with standard inside frosted lamps of wattage indicated, unless otherwise specified.
- C. Unless otherwise noted, fluorescent lamps shall be standard cool white.
- D. High intensity discharge lamps shall be sized as indicated on the schedule and suitable for the application indicated on the Drawings.

2.3 BALLASTS

- A. All fluorescent ballasts shall be electronic and shall bear the "CBM" and "ETL" labels. The ballasts shall be listed by Underwriters' Laboratories and shall meet all applicable ANSI lamp and ballast specifications as included in CBM requirements.
- B. The ballasts shall be sound rated and this sound group rating indicated on the ballast. The ballasts specified shall have the lowest sound rating consistent with the requirements of the application.
- C. All HID ballasts shall carry the "CBM" and "ETL" labels. The ballasts must be tested by the Underwriters' Laboratories.

2.4 CONTROLS

A. Photoelectric control shall be provided where indicated on the Drawings.

2.5 SPARE PARTS

- A. The Contractor shall provide 2 spare lamps of each voltage and type required.
- B. Lamps shall be suitably protected against impact for long-term storage.

ETOWAH WATER & SEWER AUTHORITY

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Contractor shall coordinate all work to assure a finished, neat appearance. Lamps, ballasts, mounting rings, fuses and other essentials shall be provided to entirely complete the lighting work in a workmanlike manner.
- The Contractor shall verify the final ceiling and finish schedules to insure the proper installation and mounting of fixtures; and shall coordinate with the Ceiling Contractor before making submittals.
- C. Suspended fixtures shall be supported at not more than 4-foot intervals.
- D. Pendant, chain or suspended fixtures shall be installed with a minimum clearance from bottom of fixture to floor as shown on Drawings.
- All fixtures shall be adequately supported in an approved manner whether or not the method or type of support is specified or detailed.
- The locations of lighting fixtures shall be shown in general on the Drawings. These locations shall be checked by the Engineer at the time of installation and shall be varied within reasonable limits so as to miss piping or other obstructions without extra cost to the Owner.
- G. Contractor shall specifically adhere to manufacturer's instructions and wiring diagrams where required.
- Install all lamps at the time fixtures are mounted. All burned-out lamps shall be replaced by the Contractor before the work is accepted by the Owner.

END OF SECTION

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.01 SCOPE

- A. This Section includes earthwork and related operations, including, but not limited to, clearing and grubbing the construction site, dewatering, excavating all classes of material encountered, pumping, draining and handling of water encountered in the excavations, handling, storage, transportation and disposal of all excavated and unsuitable material, construction of fills and embankments, backfilling around structures and pipe, backfilling all trenches and pits, compacting, all sheeting, shoring and bracing, preparation of subgrades, surfacing and grading, and any other similar, incidental, or appurtenant earthwork operations which may be necessary to properly complete the work.
- B. The Contractor shall provide all services, labor, materials, and equipment required for all earthwork and related operations, necessary or convenient to the Contractor, for furnishing complete work as shown on the Drawings or specified in these Contract Documents.

1.02 GENERAL

- A. The elevations shown on the Drawings as existing are taken from a field-run survey conducted prior to design and are intended to give reasonably accurate information about the existing elevations. The Contractor shall become satisfied with the existing conditions, elevations, and improvements by his own means and to the exact quantities of excavation and fill required.
- B. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.
- C. All excavated and filled areas for structures, trenches, fills, topsoil areas, embankments, and channels shall be maintained by the Contractor in good condition until final acceptance by the Owner. All damage caused by erosion or other construction operations shall be repaired by the Contractor using material of the same type as the damaged material.
- D. The Contractor shall control grading in a manner to prevent surface water from running into excavations. Obstruction of surface drainage shall be avoided. A means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains.
- E. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition, condition of the material.
- F. Tests for compaction and density shall be conducted by the independent testing laboratory, selected in accordance with Section 01 45 00 of these Specifications.
 - 1. The soils testing laboratory is responsible for the following:
 - a. Field compaction testing shall be based on using the maximum dry density determined by the Standard Proctor Compaction Test accordance with ASTM D 698.
 - b. Maximum dry density for non-cohesive materials shall mean maximum index density as determined by the "Maximum Index Density of Soils Using a Vibratory Table", ASTM D 4253.

- c. Determination of in-place backfill density shall be done in accordance with ASTM D 1556, "Density of Soil in Place by the Sand or Method", ASTM D 2937, "Density of Soil in Place by the Drive-Cylinder Method" or ASTM D 2922, "Density of Soil Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)".
- d. Building Slab Subgrade and Paved Areas: Field density tests for each two feet of fill material; one test for each 500 square feet of fill.
- e. Footing Subgrade other than structures on Auger Cast Piles: For each strata of soil on which each footing will be placed, conduct at least one test to verify required design bearing capacities. For each strata of soil on which continuous footings will be placed conduct at least one test per 40 linear feet to verify required design bearing capacities.
- f. Backfill of Foundation Walls in Non-Structural Areas (supporting sidewalk): Conduct at least one test per 40 linear feet of wall backfill or as prescribed by testing laboratory.
- g. Backfill of Foundation Walls Supporting Structural Loads (adjacent buildings or paved areas): Check compaction and perform field density tests for each two feet of fill material; one test for each 50 linear feet of wall backfill.
- h. Inspecting and testing stripped site, subgrade, and proposed fill materials.
- 2. Contractor's duties relative to testing include:
 - a. Notifying laboratory of conditions requiring testing.
 - b. Coordinating with laboratory for field testing.
 - c. Providing representative fill soil samples to the laboratory for test purposes. Provide 50-pound samples of each fill soil.

3. Inspection:

- a. Earthwork operations, suitability of excavated materials for fill and backfill, and placing and compaction of fill and backfill is subject to inspection. Engineer will observe earthwork operations.
- b. Foundations and shallow spread footing foundations are required to be inspected by a geotechnical engineer to verify suitable bearing and construction.
- G. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart 0, Motor Vehicles, Mechanized Equipment, and Marine Operations, and shall be conducted in a manner acceptable to the Engineer.
- H. It is understood, and agreed, that the Contractor has made a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and floodplains. The Contractor shall be responsible for providing all services, labor, equipment, and materials necessary or convenient to the Contractor for completing the work within the time specified in these Contract Documents.

I. Related Sections:

- 1. Section 31 10 00 Site Clearing.
- 2. Section 31 23 16.26 Rock Removal.
- 3. Section 31 23 19 Dewatering.

- 4. Section 01 45 00 Quality Control.
- 5. Section 03 30 00 Cast-In-Place Concrete

PART 2 PRODUCTS

2.01 MATERIALS AND CONSTRUCTION

A. Earthwork Materials:

- 1. Fill Material, General:
 - a. Approval Required: All fill material shall be subject to the approval of the Engineer.
 - b. Notification: For approval of imported fill material, notify the Engineer and testing laboratory at least one week in advance of intention to import material, designate the proposed borrow area, and permit testing as necessary to prove the quality of the material.

2. Onsite Fill Material:

- a. All on-site fill material shall be soil exclusive of organic matter, frozen lumps, or other deleterious substances.
- b. It shall contain no rocks or lumps over 3 inches maximum in dimension.
- 3. Imported Fill Materials: All imported fill material shall meet the requirements of on-site fill material.
- 4. Sand Cushions and Sand Fill: Sand cushions and sand fill shall consist of a sand-gravel fill of such gradation that 100 percent will pass a 3/8-inch sieve and not more than 10 percent by weight is lost by washing.
- 5. Coarse Aggregate or Crushed Stone: Coarse aggregate shall conform to the Georgia Department of Transportation Standard Specifications for Construction of Road and Bridges, 800.01, size No. 57, Group 11 and shall have the following gradation:

| Sieve Size | % |
|------------|---------|
| | Passing |
| 2-inch | |
| 1-1/2-inch | 100 |
| 1-inch | 95- 100 |
| 1/2-inch | 25 –60 |
| No. 4 | 0- 10 |
| No- 8 | 0-5 |

6. Fine Aggregate: All fine aggregate shall conform to the Georgia Department of Transportation Standard Specifications for Construction of Road and Bridges, 801.01 and shall have the following gradation:

| SIEVE SIZE | % PASSING |
|------------|-----------|
| No. 4 | 100 |
| No. 16 | 25 -75 |
| No. 100 | 0 - 25 |

- 7. Pea Gravel: Pea gravel shall be clean, naturally rounded aggregate, 1/8 to 3/4-inch in diameter per ASTM C 33.
- 8. Top Soil: Dark organic weed free loam, free of muck.
- 9. Concrete: Concrete shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5-inches. For job mixed concrete, submit the concrete mix design for approval by the Engineer. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.
- B. Sheeting, Bracing and Timbering: The Contractor shall furnish, place, and maintain all sheeting, bracing and timbering required to properly support trenches and other excavations in open cut and to prevent all movement of the soil, pavement, structures, or utilities outside of the trench or pit.

1. General:

- a. Cofferdams and bracing design, including computations, shall be prepared before commencing construction operations. Drawings and design computations shall be signed and sealed by a professional engineer registered in the State of Georgia. The drawings and design computations shall not be submitted to the Engineer as the contractor is solely responsible for shoring, means and methods.
- b. Sheeting, bracing and timbering shall be so placed as to allow the work to be constructed to the lines and grades shown on the Drawings and as ordered by the Engineer.
- c. If at any time the method being used by the Contractor for supporting any material or structure in or adjacent to any excavation is not reasonably safe, the Contractor shall provide additional bracing and support necessary to furnish the added degree of safety.
- d. All sheeting in contact with the concrete or masonry shall be cut off as directed by the Engineer and left in place.
- 2. Timber: Timber may be substituted for steel sheet piling when approved by the Engineer. Timber for shoring, sheeting, or bracing shall be sound and free of large or loose knots, and in good condition. Size and spacing shall be in accordance with OSHA regulations.
- 3. Steel Sheet Piling: Steel sheet piling shall be the continuous interlock type. The weight, depth, and section modulus of the sheet piling shall be sufficient to restrain the loads of earth pressure and surcharge from existing foundations and/or live loads. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth that the ground under existing structures shall be protected against lateral movement. The Contractor shall provide closure and sealing between sheet piling and existing facilities. Steel piling within three feet of an existing building, structure or pipeline shall remain in place, unless otherwise directed by the Engineer.
- 4. Remove bracing and sheeting in units when backfill reaches the point necessary to protect

the structures and adjacent property. Leave sheeting in place when, in the opinion of the Engineer, it cannot be safely removed. Cut off sheeting left in place at least two feet below the surface.

C. Other Materials: All other materials, not specifically described but require for proper completion of the work of this Section, shall be as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 GENERAL

A. Safety: Comply with local regulations and with the provisions of the "Man Accident Prevention in Construction" of the Associated General Contractors of America, Inc., Occupational Safety and Health Act and all other applicable safety regulations.

B. Topsoil:

- 1. Remove all topsoil to a depth at which subsoil is encountered, from all areas under buildings, pavements, and from all areas which are to be cut to low grades or filled.
- 2. With the Engineer's approval, topsoil to be used for finish grading may be, stored on the site.
- 3. Properly dispose of all excess topsoil off site.

C. Bracing and Sheeting:

- 1. Furnish, put in place, and maintain all sheeting, bracing, and shoring as may be required to properly support the sides of all excavations and to prevent all movement of earth which could in any way injure the work, adjacent property, or workers,
- 2. Properly support all excavations in locations indicated on the Drawings and where necessary to conform to all pertinent rules and regulations and these Specifications, even though, such locations are not indicated on the Drawings.
- 3. Exercise care in the removal of sheeting, shoring, bracing and timbering to prevent collapse or caving of the excavation faces being supported and damage to the work and adjacent property.
- 4. Do not leave any sheeting or bracing in the trench or excavation after completion of the work, unless approved by the Engineer.

D. Obstructions:

- 1. Remove and dispose of all trees, stumps, roots, boulders, sidewalks, driveways, pavement, and the like, as required for the performance of the work.
- 2. Exercise care in excavating around catch basins, inlets, manholes, utilities, or active process lines to not disturb or damage these structures.
- 3. Avoid removing or loosening castings or pushing dirt into catch basins, inlets, and manholes.
- 4. Damaged or displaced structures or casting shall be repaired, replaced and dirt entering the structures during the performance of the work shall be removed at no additional cost to the Owner.

E. Utilities to be Abandoned:

1. When pipes, conduits, sewers, or other structures are removed from the trench, leaving

- dead ends in the ground, such ends shall be fully plugged or sealed with brick and non-shrink grout.
- 2. Abandoned structures such as manholes or chambers shall be entirely removed unless otherwise specified or indicated on the Drawings.
- 3. All materials from abandoned utilities which can be readily salvaged shall be removed from the excavation and stored on the site at a location as directed by the Owner.
- 4. All salvageable materials will remain the property of the Owner unless otherwise indicated by the Owner.
- F. Extra Earth Excavation: In case soft or excessively wet material which, in the opinion of the Engineer, is not suitable, is encountered below the final subgrade elevation of an excavation or underneath a structure, the Engineer may order the removal of this material and its replacement with crushed stone or other suitable material in order to make a suitable foundation for the construction of the structure.

3.02 EXCAVATION

A. Method:

- 1. All excavation shall be by open cut from the surface except as indicated Drawings.
- 2. All excavations for pipe appurtenances and structures shall be made in such a manner, and to such depth and width, as will give ample room for building the structures, and for bracing, sheeting, and supporting the sides of the excavation, for pumping and draining groundwater which may be encountered and for the removal from the excavation of all materials excavated.
- 3. Take special care so that the soil below the bottom of the structure to be built is left undisturbed.
- B. Grades: Excavate to grades indicated on the Drawings. Where excavation grades are not indicated on the Drawings, excavate as required to accommodate installation.
- C. Disposal of Excavated Material:
 - 1. Remove and properly dispose of all excavated material not needed to complete filling, backfilling, and grading.
 - 2. The contractor shall legally dispose of all excess spoil material off-site at no additional expense to the Owner.

3.03 EXCAVATING FOR STRUCTURES

A. Earth Excavation: Earth excavation shall include all substances to be excavated other than rock. Earth excavation for structures shall be to limits not less than two feet outside wall lines, to allow for formwork and inspection, and further as necessary to permit the trades to install their work. All materials loosened or disturbed by excavation shall be removed from surfaces to receive concrete or crushed stone.

B. Rock Excavation

1. Definition of Rock: Any material which cannot be excavated with a single tooth ripper drawn by a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (comparable to Caterpillar D 8K or Caterpillar 977 front-end loader and occupying an original volume of at least one cubic yard). The Engineer shall be the sole determinant as to the limits the material is classified as rock.

- 2. Excavation: Where rock is encountered within excavation for structures, it shall be excavated to the lines and grades indicated on the Drawings, or as otherwise directed by the Engineer. The Contractor shall be responsible for obtaining any blasting permits required.
- 3. Blasting: Blasting operations shall be conducted in accordance with all existing ordinances and regulations, including OCGA, Chapter 9, Title 25. All structures shall be protected from the effects of the blast. Blasting shall be done by licensed experienced workers. Dispose of excavated rock in accordance with applicable federal, state, county, and local regulations.
 - a. If, in the sole opinion of the Engineer, the Contractor persistently uses excessive blasting charges or blasts in an unsafe or improper manner, the Engineer will direct the Contractor to employ an independent, qualified blasting consultant, approved by the Engineer, to supervise the preparation for each blast and approve the quantity of each charge.
 - b. The Contractor will notify the Inspector before any charge is set and prior to blasting. Following review by the Inspector regarding the proximity (normally within 300 linear feet) of permanent structures to the blasting site, the Engineer may direct the Contractor to employ an independent qualified specialty subcontractor, approved by the Engineer, to monitor the blasting by use of seismograph, identify areas where light charges must be used, conduct pre-event and post-event inspections of all structures, including photographs or videos, and maintain a detailed written log.
 - c. Any damage caused as a result of blasting operations shall be promptly repaired by the Contractor at the Contractor's own expense.
- 4. No allowance shall be made for overcutting or for excavation below the required elevations. The Engineer must be given reasonable notice to measure all rock.
- 5. If excess excavation is made or the material becomes disturbed to require removal below final subgrade elevations or beyond the prescribed limits, the resulting space shall be refilled with concrete as specified in this Section.
- C. Excavation for Foundations: Footings and slabs on grades shall rest on undisturbed earth, rock, or compacted materials to insure proper bearing.
 - 1. Unsuitable Foundation Material: Any material, in the opinion of the Engineer, which is unsuitable for foundation shall be removed and replaced with compacted crushed stone, or with compacted fill material as directed by the Engineer. No determination of unsuitability will be made until requirements for dewatering are satisfactorily met.
 - 2. Foundation in Rock Foundations: Should excavation for a foundation be partially in rock, the Contractor shall undercut that portion of the rock 12-inches and bring the excavation to grade with compacted crushed stone.
 - 3. Pipe Trenches Beneath Structures: Where piping or conduit passes beneath footings or slabs resting on grade, trenches shall be excavated to provide a minimum 6-inch clearance from all surfaces of the pipe or conduit. The trench shall be backfilled to the base of the structure with concrete.
 - 4. Unauthorized Excavation: Care shall be taken that excavation does not extend below bottom levels of footings or slabs on earth or rock. Should the excavation, through carelessness or neglect, be carried below such levels, the Contractor shall fill in the resulting excess excavation with concrete under footings and compacted crushed stone or other approved material under slabs. Should excavation be carried beyond outside lines of

footings such excess excavation shall be filled with concrete, or formwork shall be provided, as directed by the Engineer.

D. Unsuitable Bearing:

- 1. If suitable bearings for foundations are not encountered at the elevations indicated on the Drawings, immediately notify the Engineer.
- 2. Do not proceed further until instructions are received and necessary measurements made for purposes of establishing additional volume of excavation.

3.04 COMPACTION

- A. Fill materials supporting roadways, parking areas, sidewalks, structures, and buildings and backfill around structures shall be compacted to 95 percent of the maximum dry density as determined by the Standard Proctor Test (ASTM D698). The moisture content of the fill soil shall be between 0 and +3 percent of optimum as it is compacted. The top 12-inches of fill materials supporting structures or pavement shall be compacted to 98 percent of the maximum dry density. Fill placed for general site grading shall be compacted to 95 percent of the maximum dry density.
- B. Compaction of embankments shall be by sheepsfoot rollers with staggered, uniformly spaced knobs and suitable cleaning devices. The projected area of each knob and the number and spacing of the knobs shall be such that the total weight of the roller and ballast when distributed over the area of one row of knobs shall be 250 psi. Placement and compaction of materials shall extend beyond the final contours sufficiently to insure compaction of the material at the resulting final surface. Final contours shall then be achieved by a tracked bulldozer shaping the face of the embankment.
- C. Compaction of backfill around structures shall be accomplished by heavy power tamping equipment.
- D. If tests indicate that density of fill is less than that specified, the area shall be; recompacted or undercut, filled, and compacted until specified density is achieved.

3.05 FILL

A. Controlled Fill:

- 1. The fill for roadways, parking areas, walks, structures, and building slabs on grade shall be controlled fill.
- 2. After the existing ground or excavated area has been proof rolled and examined by the Engineer, all holes and other irregularities shall be filled and compacted before the main fill is placed.
- 3. The fill shall be placed in even layers not exceeding 10-inches in depth and shall be thoroughly compacted as herein specified.
- 4. If an analysis of the soil being placed shows a marked difference from one location to another, the fill being placed shall not be made up of a mixture of these materials.
- 5. Each different type of material shall be handled continuously so that field control of moisture and density may be based upon a known type of material.
- 6. No fill shall be placed following a heavy rain without first making certain on isolated test areas that compaction can be obtained without damage to the already compacted fill.

B. Proof rolling:

- 1. All areas where roadways, parking areas, sidewalks, structures, and buildings are to be constructed on cut areas, compacted fill, and other areas where indicated on the Drawings, shall be proof rolled to detect soft spots prior to the placement of fill material and placement of fill, which shall be used for the construction of foundations.
- 2. Proof rolling shall consist of moving a 20-30 ton loaded dump truck or other pneumatic tire roller of the same weight over the subgrade before the subgrade is shaped.
- 3. Proof rolling shall be witnessed by the Engineer.
- 4. Subgrade shall be proof rolled with six passes of the truck or roller. Depressions that develop during the proof rolling operation shall be filled with suitable material and those filled areas shall be proof rolled with six passes of the roller. If, after having been filled and proof rolled, the subgrade still contains depressions, the area shall be undercut to the hill depth of the soft material or five feet, whichever is less, backfilled, recompacted, and re-proof rolled to achieve a subgrade acceptable to the Engineer.
- 5. After the proof rolled subgrade has been accepted by the Engineer, the surface of the subgrade shall be finish rolled with a smooth steel wheel roller weighing not less than 10 tons. Finished surface of the subgrade shall be within a tolerance of 1/4-inch at every point.
- 6. Conduits, pipes, culverts, and underdrains shall be neither disturbed nor damaged by proof rolling operations. Rollers shall neither pass over, nor approach closer than five feet to, conduits, pipes, culverts, and underdrains unless the tops of those products are deeper than three feet.

C. Placement:

- 1. Prior to placement of any material in embankments, the area within embankment limits shall be stripped of topsoil and all unsuitable materials removed in accordance with this Section. The area shall then be scarified to a depth of at least 6-inches.
- 2. Fill materials shall be placed in continuous, approximately horizontal layers extending the full width of the embankment cross-section and the full dimension of the excavation where practical and having a net compacted thickness of not over 6-inches.
- D. Final Grading: Upon completion of construction operations, the area shall be graded to finish contour elevations and grades shown on the Drawings. Graded areas shall be made to blend into conformation with remaining ground surfaces. All surfaces shall be left smooth and free to drain
- E. Excess Material: Surfaces and slopes of waste fills shall be left smooth and free to drain.

F. Moisture:

- 1. Fill materials shall be placed at optimum moisture content within practicable limits, but not less or more than two percent of optimum. Optimum moisture shall be maintained by sprinkling the layers as placed or by allowing materials to dry before placement.
- 2. If fill, material is too wet, provide and operate approved means to assist the drying of the drying of the fill until suitable for compaction.
- 3. If fill material is too dry, provide and operate approved means to add moisture to the fill layers.

3.06 BACKFILLING

- A. Backfill carefully to restore the ground surface to its original condition. Dispose of excess material in accordance with this Section.
- B. Backfill and compact underlying roadways, parking areas, grassed areas, sidewalks, structures, and buildings in accordance with the requirements of Article 3.04 of this Section.
- C. Backfilling Around Structures:
 - 1. General
 - a. Remove debris from excavations before backfilling.
 - b. Do not backfill against foundation walls until so directed by the Engineer; nor until all indicated perimeter insulation and/or waterproofing is in place.
 - c. Wherever possible, backfilling shall be simultaneous on both sides of the walls to equalize lateral pressures.
 - d. Do not backfill against walls until all permanent construction is in place to furnish lateral support on both top and bottom of wall.
 - e. Backfilling against walls shall take place after all the concrete in the affected members has attained the specified strengths.
 - 2. Materials: Backfill material placed against structures built or encountered during the work of this Section shall be suitable fill material. No broken concrete, bricks or similar materials will be permitted as backfill.

3.07 GRADING

- A. General: Perform all rough and finish grading required to attain the elevations indicated on the Drawings. Perform finish grading to an accuracy of +0.10 foot.
- B. Backfill and compact underlying roadways, parking areas, sidewalks, structures buildings in accordance with Article 3.04 of this Section.
- C. Treatment After Completion of Grading:
 - 1. After grading is completed, permit no further excavation, filling or grading, except with the approval of the Engineer.
 - 2. Use all means necessary to prevent the erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

3.08 EXCESS WATER CONTROL

- A. Regulations and Permits: Obtain all necessary soil erosion control permits in accordance with the Georgia Soil Erosion and Sedimentation Control Act and all pertinent rules, laws, and regulations of all applicable federal, state, county and municipal regulatory agencies.
- B. Unfavorable Weather: Do not place, spread, or roll any fill material during unfavorable weather conditions. Do not resume operations until moisture content and fill density are satisfactory to the Engineer.
- C. Provide berms or channels to prevent flooding of subgrade. Promptly remove all water collected in depressions.
- D. Pumping and Drainage:

- 1. Provide, maintain, and use at all times during construction adequate means and devices to promptly remove and dispose of all water from every source entering the excavations or other parts of the work.
- 2. Dewater by means that will ensure dry excavations, preserve final lines and grades, do not disturb, or displace adjacent soil.
- 3. All pumping and drainage shall be done with no damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic, or the work of other contractors, and in accordance with all pertinent laws, ordinances and regulations.
- 4. Do not overload or obstruct existing drainage facilities.

3.09 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within one year after final acceptance of the Work by the Owner.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after receipt of written notice from the Engineer or Owner.

3.10 CLEANING

A. Upon completion of the work of this Section, remove all rubbish, trash, and debris resulting from construction operations. Remove surplus equipment and tools. Leave the site in a neat and orderly condition acceptable to the Engineer, and in conformance with Section 01 70 00 of these Specifications.

END OF SECTION

SITE CLEARING

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SCOPE

- A. This section covers the work necessary to remove all interfering or objectionable material from the designated areas of work as shown on the Drawings or designated in the Specifications.
- B. This work shall also include the preservation from the injury or defacement of all vegetation and existing objects designated to remain, as shown, or as specified herein.
- C. Review with the Engineer the location, limits, and methods to be used prior to commencing the work under this section.

1.2 REFERENCE STANDARDS

There are no reference standards listed in this section.

PART 2 PRODUCTS

2.1 MATERIALS AND PROCEDURES

A. Provide all materials, suitable and in adequate quantity, required to accomplish the work as specified herein.

2.2 CLEARING

A. Definition: Clearing shall consist of cutting, removing, and disposing of trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth, and shall be performed in such a manner as to remove all evidence of their presence from the surface and shall be inclusive of sticks and branches greater than one inch in diameter or thickness. Clearing shall also include the removal and disposal of trash piles, rubbish, and fencing; and the preservation of trees, shrubs, and vegetative growth, which are not designated for removal.

2.3 PRESERVATION OF TREES, SHRUBS, AND OTHER VEGETATION

A. Protect trees, shrubbery, and other vegetation not designated for removal from damage resulting from the work. Cut and remove tree branches only where, in the opinion of the Engineer, such cutting is necessary to effect construction operation. Remove branches other than those required to affect the work to provide a balanced appearance of any tree, as approved prior to removal. Scars resulting from the removal of branches shall be treated with an approved tree sealant.

SITE CLEARING

2.4 GRUBBING

A. Definition: Grubbing shall consist of the removal and disposal of wood or root matter below the ground surface remaining after clearing and shall include stumps, trunks, roots, or root systems greater than one inch in diameter or thickness to a depth of forty-eight (48) inches below the ground surface.

2.5 CLEARING AND GRUBBING LIMITS

- A. No areas on site shall be used for borrow.
- B. There shall be no on-site waste disposal.

2.6 DISPOSAL OF CLEARING AND GRUBBING DEBRIS

- A. Burning is prohibited.
- B. Material shall be promptly removed from the site and disposed of in accordance with all local laws, codes, and ordinances. The contractor shall bear full responsibility for lawful and safe disposal of all cleared and grubbed material.

2.7 STRIPPING

- A. Definition: Stripping shall include the removal and storage of all organic sod and topsoil, and the removal and disposal of grass and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped. The exact depth of stripping and storage areas will be determined by the Engineer.
- B. Areas to be Stripped: Areas to be stripped are areas where fill is to be placed and where construction of buildings, driveways, sidewalks and other structures is to occur as shown on the Drawings.
- C. Disposal of Strippings: Topsoil from the strippings shall be stockpiled in the designated areas and used for the finished site grading.
- D. Other strippings will become the property of the Contractor and will be removed from the site.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

3.2 PREPARATION

A. The Contractor shall clearly mark at appropriate intervals the limits of clearing. The limits shall be marked a minimum of seven days (7) in advance of clearing operations and are subject to review and approval by the Engineer and Owner.

SITE CLEARING

B. Unless otherwise specified or directed, the area to be cleared shall be limited to the edge of the easement limits shown on the Construction Drawings.

3.3 PROTECTION

- A. The Contractor shall plan all operations to ensure that damage does not occur to any trees, shrubs, or other vegetation outside the limits of clearing.
- B. Protect trees, plant growth, and features designated to remain as final landscaping. Provide barricades during construction.
- C. Protect survey control points, property corners, and existing structures from damage or displacement.
- D. Every precaution shall be taken to prevent timber from falling on private property.
- E. All watercourses, buffers, and other environmentally sensitive areas indicated on the drawings shall remain undisturbed.
- F. Damage of any kind, including damage to trees, shrubs, landscaping, fencing and other structures which are not scheduled to be removed shall be the Contractor's responsibility and all cost resulting from such damage shall be borne by the Contractor.

3.4 CLEARING AND GRUBBING

- A. Clearing shall consist of the felling, trimming, and cutting of trees and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the area to be cleared. Unless otherwise indicated, the entire area within the easement limits shown on the construction drawings shall be cleared and grubbed.
- B. Selective clearing shall be done in areas designated by the Engineer or Owner. Selective clearing shall consist of removing vegetation, brush, stumps, and materials from the area. Selected trees shall be left standing and care shall be taken not to damage trees that remain. Grubbing will not be required in areas designated for selective clearing.
- C. Where the tree limbs are in close proximity to utility wires, the tree shall be taken down in sections to eliminate the possibility of damage to the utility.
- D. All roots and stumps on or within the limits of clearing shall be removed by grubbing. Holes remaining after roots and stumps have been grubbed shall be backfilled promptly with sound material to prevent the infiltration and ponding of water.
- E. All fences adjoining any excavation or embankment that may be damaged or buried, shall be carefully removed, stored, and replaced. Any fencing that, in the Owner's opinion, is damaged during the Work shall be replaced with new fence material at no cost to the Owner.
- F. Surface rocks and boulders shall be grubbed from the soil and removed from the site if not suitable as riprap.

ETOWAH WATER & SEWER AUTHORITY

SITE CLEARING

- G. Remove landscaping features including, but not necessarily limited to, fences, cultivated trees, cultivated shrubbery, man made improvements, subdivision, and other signs within the right of way and easement. The Contractor shall take extreme care in moving landscape features and promptly reestablish these features.
- H. In advance of or in conjunction with clearing and grubbing operations, effective erosion and sedimentation control measures shall be implemented.
- I. Any tree or branch which remains but in the opinion of the Engineer or Owner is unsound and likely to fall shall be cut back or cleared and disposed by the Contractor.

3.5 REMOVAL

- A. Disposal of timber and other combustible materials by burning shall not be permitted. All material cleared and grubbed becomes the property of the Contractor and shall be removed from the site and disposed in accordance with all applicable regulations.
- B. Continuously clean-up and remove waste materials from site. Do not allow materials to stockpile or accumulate on site.
- C. Do not bury materials on site. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

- A. Excavated topsoil shall be removed and stockpiled without mixing with foreign materials for use in finish grading and grassing. New topsoil shall be provided for all existing established lawns and in other areas as required to sustain plant growth.
- B. Do not excavate wet topsoil.
- C. Remove and dispose of excess soil not intended for reuse, from site.

END OF SECTION

SITE PREPARATION

SECTION 31 10 10

SITE PREPARATION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section describes materials and equipment to be utilized and requirements for their use in preparing the work site for construction. The Contractor shall furnish all materials, equipment and labor necessary to complete the work.
- B. Comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state or federal authorities having jurisdiction.
- C. Related Sections:
 - 1. Section 31 10 00 Site Clearing

1.2 CLEARING AND GRUBBING

- A. Within the limits shown on the Drawings, the site will be cleared and grubbed to prepare for construction.
- B. All sumps, roots, foundations and planking embedded in the ground shall be removed and disposed of properly by the Contractor.

1.3 PRELIMINARY GRADING

A. Preliminary grading shall consider and maintain the existing functions of the site.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Identify required lines, levels, contours and datum.

3.2 PREPARATION

- A. Contact local Utility Location Information Service before starting work and notify utility companies about schedule and work.
- B. Protect utilities indicated to remain from damage.

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SITE PREPARATION

- C. Protect adjacent property, landscape, lawns, and other features remaining as a portion of final landscaping.
- D. Maintain benchmarks, monuments, property corners and other reference points.
 - 1. Re-establish, at no cost to the Owner, any such reference points if disturbed or destroyed.

END OF SECTION

SECTION 31 23 16

TRENCH EXCAVATION AND FILL

PART 1 GENERAL

1.1 SCOPE

- A. The work under this Section consists of furnishing all labor, equipment and materials and performing all operations in connection with the trench excavation and backfill required to install the site utilities, including all pipelines, shown on the Drawings and as specified.
- B. Excavation shall include the removal of any trees, stumps, brush, debris, or other obstacles which remain after the clearing and grubbing operations, which may obstruct the work, and the excavation and removal of all earth, rock, or other materials to the extent necessary to install the utility and appurtenances in conformance with the lines and grades shown on the Drawings and as specified.
- C. Backfill shall include the refilling and compaction of the fill in the trenches and excavations up to the surrounding ground surface or road grade at crossing.
- D. The trench is divided into five specific areas:
 - 1. Foundation: The area beneath the bedding, sometimes also referenced to as trench stabilization.
 - 2. Bedding: The area above the trench bottom (or foundation) and below the bottom of the barrel of the pipe.
 - 3. Haunching: The area above the bottom of the barrel of the pipe up to a specified height above the bottom of the barrel of the pipe. See drawings for haunching material limits for PVC pipe.
 - 4. Initial Backfill: The area above the haunching material and below a plane 18 inches above the top of the barrel of the pipe for ductile iron pipe, and 12 inches above the haunching material for PVC pipe.
 - 5. Final Backfill: The area above a plane at the top of the initial backfill.
- E. The choice of method, means, techniques and equipment rests with the Contractor. The Contractor shall select the method and equipment for trench excavation and backfill depending upon the type of material to be excavated and backfilled, the depth of excavation, the amount of space available for operation of equipment, storage of excavated material, proximity of man made improvements to be protected, and prevailing practice in the area.

1.2 QUALITY ASSURANCE

A. Density: All references to "maximum dry density" shall mean the maximum dry density defined by the "Maximum Density Optimum Moisture Test", ASTM D 698. Determination of the density of foundation, bedding, haunching, or backfill materials in place shall meet with the requirements of ASTM D 1556, "Density of Soil in Place by the Sand Cone Method", ASTM D 2937, "Density of Soil in Place by the Drive Cylinder Method" or ASTM D 2922, "Density of Soil and Soil Aggregate In Place by Nuclear Methods (Shallow Depth)."

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TRENCH EXCAVATION AND FILL

- B. Sources and Evaluation Testing: Testing of materials to certify conformance with the Specifications shall be performed in accordance with Section 01 45 00 of these Specifications. The Owner approved testing laboratory shall perform tests, and payment shall be in accordance with Section 01 21 13 of these specifications. Tests shall be upon change of source and at sufficient intervals during the work to certify conformance of all select material furnished for use on this Project or has required by the Engineer.
- C. Field density tests for each two feet of lift, one test per 350 feet of pipe installed, or more frequently if ordered by the Engineer.

1.3 SUBMITTALS

- A. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property. Where requested by Engineer or Owner, include structural calculations to support plan.
- B. Product Data: Submit data for geotextile fabric indicating fabric and construction.

1.4 SAFETY

A. Perform all trench excavation and backfilling activities in accordance with the Occupational Safety and Health Act of 1970 (PL 91 596), as amended. The Contractor shall pay particular attention to the Safety and Health Regulations Part 1926, Subpart P "Excavation, Trenching & Shoring" as described in OSHA publication 2226.

1.5 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 TRENCH FOUNDATION MATERIALS

- A. The bottom of the trench shall provide a foundation to support the pipe and its specified bedding.
- B. Crushed stone shall be utilized for trench foundation (trench stabilization) and shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble, or dolomite) or Group II (quartzite, granite or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

2.2 BEDDING AND HAUNCHING MATERIALS

A. Unless specified otherwise, bedding and haunching materials shall be compacted stone for PVC Pipe Bedding, and crushed stone for Type 5 bedding as specified below.

- B. Crushed stone utilized for bedding and haunching shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble, or dolomite) or Group II (quartzite, granite or gneiss). Stone size shall be No. 57.
- C. Earth materials utilized for bedding and haunching shall be suitable materials selected from materials excavated from the trench.
 - 1. Suitable materials shall be clean and free of rock larger than 2 inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes, and other unsuitable materials.
 - Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements.
 - 3. When necessary, earth bedding and haunching materials shall be moistened to facilitate compaction by tamping.
 - 4. If materials excavated from the trench are not suitable for use as bedding or haunching material, provide select material conforming to the requirements of this Section at no additional cost to the Owner.

2.3 INITIAL BACKFILL

- A. Initial backfill material shall be crushed stone or earth materials as specified for bedding and haunching materials.
- B. Earth materials utilized for initial backfill shall be suitable materials selected from materials excavated from the trench.
 - 1. Suitable materials shall be clean and free of rock larger than 2 inches at its largest dimension, organics, cinders, stumps, limbs, frozen earth or mud, man-made wastes, and other unsuitable materials.
 - Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it is allowed to dry properly and it is capable of meeting the specified compaction requirements.
 - 3. When necessary, initial backfill materials shall be moistened to facilitate compaction by tamping.
 - 4. If materials excavated from the trench are not suitable for use as initial backfill material, provide select material conforming to the requirements of this Section.

2.4 FINAL BACKFILL

- A. Final backfill material shall be general excavated earth materials, shall not contain rock larger than 2 inches at its greatest diameter, cinders, stumps, limbs, man-made wastes, and other unsuitable materials.
- B. If materials excavated from the trench are not suitable for use as final backfill material, provide select material conforming to the requirements of this Section.

2.5 SELECT BACKFILL

A. Select backfill shall be materials which meet the requirements as specified for bedding, haunching, initial backfill or final backfill materials, including compaction requirements.

2.6 CONCRETE

- A. Concrete for bedding, haunching, initial backfill or encasement shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. Ready mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.
- B. For job mixed concrete, submit the concrete mix design to the Owner for approval.

PART 3 EXECUTION

3.1 TRENCH EXCAVATION

- A. All excavation of every description and of whatever substance encountered shall be performed to the depth shown or specified, or both, for all sewers, manholes, piers, conduit, and other appurtenances.
- B. Topsoil and grass shall be removed in accordance with the requirements of Section 31 10 00.
- C. Trenches shall be excavated to the lines and grades shown on the Drawings with the centerlines of the trenches on the centerlines of the pipes and to the dimensions which provide the proper support and protection of the pipes and other structures and accessories.

D. Trench Width for Pipelines

- 1. The sides of all trenches shall be vertical to a minimum of one foot above the top of the pipe. Unless otherwise indicated on the Drawings, the maximum trench width shall be equal to the sum of the outside diameter of the pipe plus two feet. The minimum trench width shall be that which allows the proper consolidation of the haunching and initial backfill material.
- Excavate the top portion of the trench to any width within the construction easement or
 right-of-way which will not cause unnecessary damage to adjoining structures, roadways,
 pavement, utilities, trees, or private property. Where necessary to accomplish this,
 provide sheeting and shoring.
- 3. Wherever the prescribed maximum trench width is exceeded, the Contractor shall use the next higher Class or Type of bedding and haunching as shown on the Drawings for the full trench width as actually cut. The excessive trench width may be due to unstable trench walls, inadequate or improperly placed bracing and sheeting which caused sloughing, accidental over excavation, intentional over excavation necessitated by the size of the Contractor's tamping and compaction equipment, intentional over excavation due to the size of the Contractor's excavation equipment, or other reasons beyond the control of the Engineer or Owner.
- 4. Where rock is encountered in trenches, excavate to remove boulders and stones to provide a minimum of 6-inches of clearance between the rock and any part of the pipe or appurtenance.
- 5. Trench widths for installation of ductile iron gravity sewer pipe shall be in accordance with AWWA C 600-87 as amended to date. Trenches may be of extra widths to permit the placement of timber support, sheeting, bracing, and alternatives when approved by the Engineer.

E. Depth

- 1. The trenches shall be excavated to the required depth or elevation which allow for the placement of the pipes and bedding to the dimensions shown on the Drawings. All mains less than 12-inches in diameter shall have a minimum of 48-inches of cover above the top of pipe or 48-inches below edge of pavement, whichever is greater. All mains 12-inches and larger in diameter shall have a minimum of 60-inches of cover above the top of pipe or 60-inches below edge of pavement, whichever is greater unless otherwise directed by the Owner.
- 2. The depth of cover shall not exceed that as shown on the Drawings by more than two feet without approval of the Engineer.
- 3. Where rock is encountered in trenches for pipelines, excavate to the minimum depth which will provide clearance below the pipe barrel of 8 inches for pipe 21 inches in diameter and smaller and 12 inches for larger pipe and manholes. Remove boulders and stones to provide a minimum of 6 inches clearance between the rock and any part of the pipe, manhole or accessory.

F. Excavated Materials

- 1. Excavated materials shall be placed adjacent to the work to be used for backfilling as required. Topsoil shall be carefully separated and lastly placed in its original location.
- 2. Excavated material shall be placed sufficiently back from the edge of the excavation to prevent caving of the trench wall, to permit safe access along the trench and not cause any drainage problems. Excavated material shall be placed so as not to damage existing landscape features or man-made improvements.
- 3. Where rock is excavated with earth material, care shall be taken not to contaminate the excavation material for use as final backfill with excavated rock larger than the maximum size allowed.
- 4. All excavation which has qualities unsuitable for final backfill and which is otherwise not used for backfill shall be removed from the site as excess excavation at no additional cost to the Owner.

3.2 SHEETING, BRACING, AND SHORING

- A. Sheeting, bracing, and shoring shall be in accordance with the requirements of these Specifications.
 - 1. Where sloping of the trench walls does not adequately protect persons within the trench from slides or cave-ins.
 - 2. In caving ground.
 - 3. In wet, saturated, flowing or otherwise unstable materials. The sides of all trenches and excavations shall be adequately sheeted, braced, and shored.
 - 4. Where necessary to prevent damage to adjoining buildings, structures, roadways, pavement, utilities, trees, or private properties which are required to remain.
 - 5. Where necessary to maintain the top of the trench within the available construction easement or right of way.
- B. Timber: Timber for shoring, sheeting, or bracing shall be sound and free of large or loose knots and in good, serviceable condition. Size and spacing shall be in accordance with OSHA regulations.
- C. Steel Sheeting and Sheet Piling:

- 1. Steel sheet piling shall be of the continuous interlock type.
- 2. The weight, depth, and section modulus of the sheet piling shall be sufficient to restrain the loads of earth pressure and surcharge from existing foundations and live loads.
- 3. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth that the ground under existing structures shall be protected against lateral movement at all times.
- 4. The Contractor shall provide closure and sealing between sheet piling and existing facilities.
- 5. Sheet piling within three feet of an existing structure or pipeline shall remain in place, unless otherwise directed by the Owner.

D. Trench Shield:

- 1. A trench shield or box may be used to support the trench walls.
- 2. The use of a trench shield does not necessarily preclude the additional use of bracing and sheeting.
- 3. When trench shields are used, care must be taken to avoid disturbing the alignment and grade of the pipe or disrupting the haunching of the pipe as the shield is moved.
- 4. When the bottom of the trench shield extends below the top of the pipe, the trench shield will be raised in 6-inch increments with specified backfilling occurring simultaneously.
- 5. At no time shall the trench shield be "dragged" with the bottom of the shield extending below the top of the pipe or utility.
- E. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the pipe and adjacent property.
 - 1. Leave sheeting in place when in the opinion of the Engineer it cannot be safely removed or is within three feet of an existing structure, utility, or pipeline.
 - 2. Cut off any sheeting left in place at least two feet below the surface.
- F. In all cases, excavation protection shall strictly conform to the requirements of the Occupational Safety and Health Act of 1970, as amended.

3.3 TRENCH ROCK EXCAVATION

- A. Trench Rock shall be defined as natural rock giving a ringing sound and which cannot be excavated with conventional excavating equipment with a bucket curling force rated at not less than 33,000 pounds, is removed by drilling and blasting, and occupies an original volume of at least one-half cubic yard. Shale or rotten stone or stratified rock that can be loosened by a pick, or by trenching equipment, shall be construed as rock.
- B. Disposal of Rock: Surplus rock that is not suitable for use as rip rap or backfill material shall be removed from the site and disposed of in accordance with all local laws, codes, and ordinances.
- C. The Contractor shall notify the Owner prior to any blasting or the setting of any charges.

D. Blasting:

- 1. Provide licensed, experienced workmen to perform blasting.
- 2. Conduct blasting operations in accordance with all existing ordinances and regulations.
- 3. Protect all buildings, structures, and utilities from the effects of the blast. Repair any resulting damage.

4. If the Contractor repeatedly uses excessive blasting charges or blasts in an unsafe or improper manner, the Owner may direct the Contractor to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge. All blasting and excavation operations shall be in accordance with OCGA, Chapter 9, Title 25.

E. Mechanical Method:

- 1. Rock removal by mechanical methods may be utilized.
- 2. Excavate and remove rock by mechanical method.
- 3. Drill holes and use expansive tools, or wedges to fracture rock.
- 4. Cut away rock at bottom of excavation to form level bearing.
- 5. Remove shaled layers to provide sound and un-shattered base.
- 6. In utility and conduit trenches, ledge rock, boulders, and large stones shall be removed to provide a clearance of not less than six inches (6") in every horizontal direction from all parts of pipe, fittings, and other appurtenances.
- F. The Contractor shall employ an independent, qualified specialty sub-contractor, approved by the Owner, to monitor the blasting by use of seismograph, identify the areas where light charges must be used, conduct pre-blast and post blast inspections of structures, including photographs or videos, and maintain a detailed written log. A pre-blast and post-blast inspection shall be required for any property, structure, or utility within 500 linear feet of the blast area.
- G. No payment will be made for rock excavation without the Engineer verifying the quantity of rock prior to blasting at each location. When rock is encountered it shall, at the option of the Owner, be measured by one of the following methods.
 - 1. The drill logs generated while preparing the blast area. The drill logs shall at a minimum contain the following elevations: existing ground, top of rock, bottom of trench and bottom of rock.
 - 2. With the Inspector present, the contractor shall employ a track drill or other suitable rock drilling equipment to penetrate the over burden down to solid rock. The top of rock elevation shall be determined by measuring the depth of the drill bit below the ground.
 - 3. The Rock shall be stripped of earth and the inspector notified and given proper time to measure the rock before blasting.

3.4 DEWATERING EXCAVATIONS

- A. In all cases, accumulated water in the trench shall be removed before placing bedding or haunching, laying pipe, placing concrete, or backfilling.
- B. Dewater by use of a well point system when pumping from sumps does not lower the water level two feet below the trench bottom. Where soil conditions dictate, the Contractor shall construct well points cased in sand wicks. The casing, 6 to 10 inches in diameter, shall be jetted into the ground, followed by the installation of the well point, filling casing with sand, and withdrawing the casing.
- C. Dewater excavation continuously to maintain a water level two feet below the bottom of the trench.

- D. Control drainage in the vicinity of excavation so the ground surface is properly pitched to prevent water running into the excavation.
- E. There shall be sufficient pumping equipment, in good working order, available at all times to remove any water that accumulates in excavations. Where the pipeline crosses natural drainage channels, the work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the work will be prevented. Provision shall be made for the satisfactory disposal of surface water to prevent damage to public or private property.
- F. Where dewatering is performed by pumping the water from a sump, crushed stone shall be used as the medium for conducting the water to the sump. Sump depth shall be at least two feet below the bottom of the trench; pumping equipment shall be of sufficient quantity and/or capacity to maintain the water level in the sump two feet below the bottom of the trench. Pumps shall be a type such that intermittent flows can be discharged. A standby pump shall be required in the event the operating pump or pumps clog or otherwise stop operation.

3.5 TRENCH FOUNDATION AND STABILIZATION

- A. The bottom of the trench shall provide a foundation to support the pipe and its specified bedding. The trench bottom shall be graded to support the pipe and bedding uniformly throughout its length and width.
- B. If, after dewatering as specified above, the trench bottom is spongy, or if the trench bottom does not provide firm, stable footing, and the material at the bottom of the trench will still not adequately support the utility, the trench will be determined to be unsuitable and the Engineer shall then authorize payment for trench stabilization. Otherwise, no additional compensation will be authorized for trench stabilization. Payment for crushed stone stabilization will be made at the unit price provided in the Bid Form, measured before placing, and shall include the removal and disposal of unsuitable subgrade materials.
- C. Should the undisturbed material encountered at the trench bottom constitute, in the opinion of the Engineer, an unstable foundation for the utility, the Contractor shall be required to remove such unstable material and fill the trench to the proper subgrade with crushed stone.
- D. Where the replacement of unsuitable material with crushed stone does not provide an adequate trench foundation, the trench bottom shall be excavated to a depth of at least two feet below the specified trench bottom.
 - 1. Place geotextile fabric (Mirafi 140N or approved equal) in the bottom of the trench and support the fabric along the trench walls until the trench stabilization, bedding, haunching and pipe have been placed at the proper grade. The ends of the filter fabric shall be overlapped above the pipe. Payment for installed geotextile fabric shall be made at the unit price provided in the Bid Form.
- E. Where trench stabilization is provided, the trench stabilization material shall be compacted to at least 95 percent of the maximum dry density, unless shown or specified otherwise.

3.6 BEDDING AND HAUNCHING

A. Pipe

- 1. Ductile Iron Pipe
 - Unless otherwise shown on the Drawings or specified, utilize earth materials for bedding and haunching. Type 5 bedding shall be as detailed on the Drawings and as specified.
 - b. Unless specified or shown otherwise, bedding for ductile iron gravity sewers shall meet the requirements of Type 5 Bedding. Utilize Type 5 Bedding as detailed and as needed for deep excavations.

| Maximum Cover, feet – Pipe Bedding | | |
|------------------------------------|--------|--|
| Pipe Size, Inches | Type 5 | |
| 6 | 65 | |
| 8 | 50 | |
| 12 | 44 | |
| 20 | 30 | |
| 24 | 29 | |
| 30 | 27 | |
| 36 | 25 | |

- c. Type 5 Pipe Bedding called for on the Drawings, specified or ordered by the Owner, shall meet requirements for Type 5 Pipe Bedding, utilizing crushed stone bedding and haunching material.
- d. Over excavation: If the width of the trench is over excavated, then the Contractor shall use the next higher class of bedding. The minimum bedding shall be Type 5.
- 2. Polyvinyl Chloride Pipe
 - a. Unless shown otherwise on the Drawings, utilize earth materials for bedding and haunching.
 - b. Unless shown otherwise on the Drawings, bedding and haunching shall meet the requirements for PVC Pipe Bedding, as detailed on the Drawings.
- B. Prior to placement of bedding material, the trench bottom shall be free of any water, loose rocks, boulders or large dirt clods.
- C. Bedding material shall be placed to provide uniform support along the bottom of the pipe and to place and maintain the pipe at the proper elevation.
 - 1. The initial layer of bedding placed to receive the pipe shall be brought to the grade and dimensions indicated on the Drawings.

- 2. All bedding shall extend the full width of the trench bottom. The pipe shall be placed and brought to grade by tamping the bedding material or by removal of the excess amount of the bedding material under the pipe.
- 3. Adjustment to grade line shall be made by scraping away or filling with bedding material.
- 4. Wedging or blocking up of pipe shall not be permitted.
- 5. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted.
- 6. Each pipe section shall have a uniform bearing on the bedding for the length of the pipe, except immediately at the joint.
- 7. All bedding shall extend the full width of the trench bottom.
- 8. Prior to placement of bedding material, the trench bottom shall be free of any water, loose rocks, boulders, or large dirt clods.
- D. At each joint, excavate bell holes of ample depth and width to permit the joint to be assembled properly and to relieve the pipe bell of any load.
- E. After the pipe section is properly placed, add the haunching material to the specified depth.
 - 1. The haunching material shall be shovel sliced, tamped, vigorously chinked or otherwise consolidated to provide uniform support for the pipe barrel and to fill completely the voids under the pipe, including the bell hole.
 - 2. Prior to placement of the haunching material, the bedding shall be clean and free of any water, loose rocks, boulders, or dirt clods.
- F. Gravity Sewers and Accessories: Lay PVC pipe with minimum Class "B" bedding and gravel haunching and backfill to a depth of 12-inches above the top of the pipe as detailed on the Drawings.
 - 1. Class "A" (Bedding Factor 2.8): Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Lay pipe to line and grade on concrete block. Place concrete to the full width of the trench and to a height of one-fourth of the outside diameter of the pipe above the invert.
 - 2. Class "B" (Bedding Factor 1.9): Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Place and compact bedding material to the proper grade. Haunching material shall then be carefully placed by hand and compacted to provide full support under and up to the centerline of the pipe.
 - 3. Class "C" (Bedding Factor 1.5): Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Place and compact bedding material to the proper grade. Haunching material shall then be carefully placed by hand and compacted to provide full support under and up to a height of one-fourth the outside diameter of the pipe above the bottom of the pipe barrel.
- G. Manholes and Appurtenances: Excavate to a minimum of 12-inches below the planned elevation of the base of the manhole. Place and compact crushed stone bedding material to the required grade before constructing the manhole.
- H. Excessive Width and Depth
 - 1. Sewers: If the trench is excavated to excess width, provide the bedding class with the next higher bedding factor. Crushed stone haunching and initial backfill may be used in lieu of Class "A" bedding, where Class "A" bedding is necessitated by excessive trench width.

- 2. If the trench is excavated to excessive depth, provide crushed stone to place the pipe at the proper elevation or grade.
- I. Compaction: Bedding and haunching materials under pipe, manholes and accessories shall be compacted to a minimum of 95 percent of the maximum dry density, unless shown or specified otherwise.

3.7 INITIAL BACKFILL

- A. Initial backfill shall be placed to anchor the pipe, protect the pipe from damage by subsequent backfill and ensure the uniform distribution of the loads over the top of the pipe.
- B. Place initial backfill material carefully around the pipe in uniform layers to a depth of at least 18 inches above the pipe barrel.
- C. Layer depths shall be a maximum of 6 inches for pipe 18 inches in diameter and smaller and a maximum of 12 inches for pipe larger than 18 inches in diameter.
- D. Backfill on both sides of the pipe simultaneously to prevent side pressures.
- E. Compact each layer thoroughly with suitable hand tools or tamping equipment.
- F. Initial backfill shall be compacted to a minimum 95 percent of the maximum dry density, unless shown or specified otherwise.
- G. If materials excavated from the trench are not suitable for use as backfill materials, provide select backfill material conforming to the requirements of this Section.

3.8 FINAL BACKFILL

- A. After initial backfill material has been placed and compacted, backfill with final backfill material. Place backfill material in uniform layers, compacting each layer thoroughly as follows:
 - 1. In 6-inch layers, if using light power tamping equipment, such as a "jumping jack."
 - 2. In 12-inch layers, if using heavy tamping equipment, such as hammer with tamping feet.
 - 3. In 24-inch layers, if using a hydra-hammer.
- B. Final backfill shall be compacted to a minimum 95 percent of the maximum dry density, unless specified otherwise.
- C. Backfill carefully to provide a finished grade at the elevations shown on the Drawings.
- D. The top 6-inches shall be topsoil obtained as specified in these Specifications.
- E. Excavated material, which is unsuitable for backfilling, and excess material, shall be disposed of, at no additional cost to the Owner, in a manner approved by the Owner.
 - 1. Surplus soil may be neatly distributed and spread over the site, if approved by the Owner.
 - 2. If such spreading is allowed, the site shall be left in a clean and sightless condition and shall not affect pre-construction drainage patterns.
 - 3. Surplus rock from the trenching operations shall be removed from the site.

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TRENCH EXCAVATION AND FILL

- F. If materials excavated from the trench are not suitable for use as backfill materials, provide select backfill material conforming to the requirements of this Section.
- G. Settlement: If trench settles refill and grade the surface to conform to the adjacent surfaces.
- H. Remove and dispose of excess or unsuitable materials in accordance with the requirements of these Specifications.

3.9 BACKFILL UNDER ROADS

- A. Compact backfill underlying pavement and sidewalks and backfill under dirt and gravel roads to a minimum 95 percent of the maximum dry density.
- B. The top 12 inches shall be compacted to a minimum of 98 percent of the maximum dry density.

3.10 CONCRETE ENCASEMENT

- A. Where concrete encasement is shown on the Drawings or ordered by the Owner, excavate the trench to provide a minimum of 6 inches clearance from the bell of the pipe.
- B. Lay the pipe to line and grade on concrete blocks.
- C. In lieu of bedding, haunching and initial backfill, place concrete to the full width of the trench and to a height of not less than 6 inches above the pipe bell.
- D. Do not backfill the trench for a period of at least 24 hours after concrete is placed.

3.11 BACKFILL WITHIN GEORGIA DOT RIGHT-OF-WAY

A. Backfill within the Georgia DOT right of way shall meet the requirements stipulated in the "Utility Accommodation Policy and Standards", published by the Georgia Department of Transportation.

3.12 TESTING AND INSPECTION

- A. The soil testing will be performed by an independent testing laboratory selected by the Owner. Payment for soil testing shall be made by the Contractor from the "Soils and Concrete Testing" Cash Allowance.
- B. The soils testing laboratory is responsible for the following:
 - 1. Compaction tests in accordance with Article 1.02 of this Section.
 - 2. Field density tests for each two feet of lift, one test for each 2,000 feet of pipe installed or more frequently if ordered by the Owner.
 - 3. Inspecting and testing stripped site, subgrades and proposed fill materials.
- C. The Contractor's duties relative to testing include:
 - 1. Notifying laboratory of conditions requiring testing.
 - 2. Coordinating with laboratory for field-testing.

TRENCH EXCAVATION AND FILL

- 3. Paying costs for additional testing performed beyond the scope of that required and for re testing where initial tests reveal nonconformance with specified requirements.
- 4. Providing excavation as necessary for laboratory personnel to conduct tests.
- D. Inspection: Earthwork operations, acceptability of excavated materials for bedding or backfill, and placing and compaction of bedding and backfill is subject to inspection by the Owner.
- E. Comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state or federal authorities having jurisdiction.

3.13 WARNING TAPE (DUCTILE IRON SANITARY SEWERS)

A. The Contractor shall provide 6-inch wide warning tape in the backfill above all Ductile Iron Pipe per manufacturer's specifications. The tape shall read "CAUTION BURIED SEWER LINE BELOW" in black letters on a solid green background per American Public Works Association standards. The tape shall be chemically inert polyethylene at least 4 mils thick and colorfast.

3.14 DETECTABLE WARNING TAPE (PLASTIC SANITARY SEWERS)

A. The Contractor shall provide 6-inch wide reinforced, detectable warning tape in the backfill above all non-metallic (PVC, HDPE, etc.) pipe per manufacturer's specifications. The tape shall read "CAUTION BURIED SEWER LINE BELOW" in black letters on a solid green background per American Public Works Association standards. The tape shall be chemically inert polyethylene at least 4 mils thick, colorfast, with bonded (non-adhesive) aluminum backing. Clips shall be used to connect sections of detection tape and provide electrical continuity. The tape shall be detectable by both inductive and conductive means. The tape shall be accessible in vaults for the purpose of connecting a signal generator or transmitter to the tape for use in conductive detection.

SECTION 31 23 16.26

ROCK REMOVAL

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes the requirements for removing discovered rock during trench excavation.
- B. Related Sections:
 - 1. Section 31 10 00 Site Clearing
 - 2. Section 31 23 16 Trench Excavation and Fill

1.2 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 495 Explosive Materials Code.

1.3 DEFINITIONS

A. Rock: Any material, which in the opinion of the Engineer cannot be excavated with conventional excavating equipment and is removed by drilling, blasting, or the use of jackhammers or bullpoints and occupies an original volume of at least one-half (1/2) cubic yard.

1.4 QUALITY ASSURANCE

- A. Seismic Survey Firm: Licensed company in Georgia specializing in seismic surveys with five years documented experience.
- B. Explosives Firm (Blaster): Licensed company in Georgia specializing in explosives for disintegration of rock, with five years documented experience in construction blasting and rock excavation. Company must be able to clearly demonstrate a sufficient amount of proven experience in rock blasting in urban areas for utility construction. Experience requirements include a minimum of five successful blasting projects on which the blaster was responsibly in charge of the rock blasting in the last five years.
- C. Blasting Engineer: Person or company licensed in Georgia with extensive knowledge and experience in construction blasting and rock excavation. The Blasting Engineer may be an employee of the Explosive Firm. Company must be able to clearly demonstrate ten years of proven experience in controlled blasting of rock. Experience requirements include involvement in a minimum of five successful blasting projects on which the Blasting Engineer was responsibly in charge of the development of blasting patterns and controls for blasting in the last ten years.

1.5 PROJECT CONDITIONS

A. Conduct survey and document conditions of buildings near locations of rock removal, prior to blasting and photograph existing conditions identifying existing irregularities.

ROCK REMOVAL

- B. Advise owners of adjacent buildings or structures in writing a minimum of 48 hours prior to executing seismographic survey. Explain planned blasting and seismic operations.
- C. Obtain seismic survey prior to rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties or other work.

1.6 SCHEDULING

A. Schedule Work to avoid disruption to occupied buildings nearby.

PART 2 PRODUCTS - Not used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions and note subsurface irregularities affecting Work of this section.
- B. The Contractor shall be responsible for determining methods required for removal of rock or hard materials.

3.2 PREPARATION

- A. The Contractor shall notify the Owner prior to any blasting. Additionally, Contractor shall notify the Owner before any charge is set.
- B. Identify required lines, levels, contours, and datum.
- C. All blasting supplies shall be stored in a manner approved by the State Fire Marshal and a watchman shall be stationed at all times at the place of storage. In no case shall caps or other exploders be kept at the place where dynamite or other explosives are stored.

3.3 ROCK REMOVAL BY MECHANICAL METHOD

- A. Rock removal by mechanical methods may be utilized.
- B. Excavate and remove rock by mechanical method.
 - 1. Drill holes and use expansive tools, or wedges to fracture rock.
- C. Cut away rock at bottom of excavation to form level bearing.
- D. Remove shaled layers to provide sound and un-shattered base.
- E. In utility and conduit trenches, ledge rock, boulders, and large stones shall be removed to provide a clearance of not less than six inches (6") in every horizontal direction from all parts of pipe, fittings, and other appurtenances.
- F. Dispose of rock off site that is surplus or not suitable for use as riprap or backfill.

3.4 ROCK REMOVAL BY EXPLOSIVE METHODS

- A. Blasting shall be conducted as required, as recommended by the Blasting Engineer.
- B. Provide licensed, experienced workmen to perform blasting.
- C. The Contractor shall use the utmost care so as not to endanger life or property, or disturb materials outside the limits of the excavation. It shall be the Contractor's responsibility to repair in kind at his expense, any utilities, pipelines or other facilities that are disturbed or damaged by blasting. The Contractor will also be responsible for any and all claims for damage to property and surrounding structures as the result of blasting.
- D. Blasting operations shall be conducted in strict accordance with all existing ordinances and regulations and shall be done only with the Blasting Engineer's approval and under his supervision.
- E. Perform blasting only after receiving written approval from the Owner and regulatory agencies.
- F. All structures, buildings and utilities shall be carefully protected from the effects of the blasts and all blasts shall be covered with blasting mats, dirt, heavy timbers or other suitable material. The blasting shall be done by experienced workmen.
- G. All blasting shall be done during daylight hours. No loaded holes shall be left overnight.
- H. All shots shall be delayed so as to minimize ground vibrations with a maximum peak particle velocity, as measured at the nearest structure (pipes, etc.) not to exceed 1.0 inches per second. The overpressure (noise or concussion) shall be minimized and sufficient stemming and matting shall be used to prevent overpressure in excess of 120 db. Precautions shall be taken to minimize flying rock and sufficient matting used to prevent rocks from striking any person or structure.
- I. Provide seismographic monitoring during progress of all blasting operations. The monitoring equipment shall be of the type which records the three (3) components of velocity. The analysis of these recordings is to be signed by a Registered Professional Engineer in Georgia. Blasting is not to be conducted which will produce a Scaled-Distance less than previously recorded for at least three (3) different shots deemed to be safe. The Scaled-Distance is to be determined by the distance from the shot to the nearest structure subject to potential damage from ground vibrations.
 - Overpressure (concussion) is to be recorded, preferably on the same recording as the vibration. The instrument used for measuring concussion shall be the type specifically designed for impact-type overpressure from blasting.
- J. The blaster is to maintain an accurate log of each shot, listing as a minimum the following: date, time, station number, manufacturer and type of explosive, method of firing, total weight of explosive, number of delays, number of holes, depth of overburden, hole depth, maximum weight of explosive per delay, amount of stemmings, type and amount of matting.
- K. Disintegrate rock and remove from excavation.
- L. Remove rock at excavation bottom to form level bearing.

ROCK REMOVAL

- M. Remove shaled layers to provide sound and un-shattered base.
- N. In utility and conduit trenches, ledge rock, boulders, and large stones shall be removed to provide a clearance of not less than six inches (6") in every horizontal direction from all parts of pipe, fittings, and other appurtenances.
- O. Remove excavated material from site.

3.5 UNAUTHORIZED ROCK REMOVAL

A. Correct unauthorized rock removal with lean concrete encasement fill or as directed by Engineer. Concrete shall be as specified elsewhere and shall be provided at no additional cost to the Owner.

DEWATERING

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.1 SCOPE

- A. This Section shall apply to all excavation, except trench excavation.
- B. Construct all permanent work in areas free from water. Design, construct and maintain all wells, pumps, vacuum systems, sumps, dikes, levees, cofferdams and diversion and drainage channels as necessary to maintain the areas free from water and to protect the areas to be occupied by permanent work from water damage. Remove temporary works after they have served their purpose.
- C. The Contractor shall be responsible for the stability of all temporary and permanent slopes, grades, foundations, materials, and structures during the course of the Contract. Repair and replace all slopes, grades, foundations, materials, and structures damaged by water, both surface and subsurface, to the lines, grades and conditions existing prior to the damage, at no additional cost to the Owner.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 CARE OF WATER

- A. Except where the excavated materials are designated as materials for permanent work, material from required excavation may be used for dikes, levees, cofferdams and other temporary backfill.
- B. Furnish, install, maintain, and operate necessary pumping and other equipment for dewatering the various parts of the work and for maintaining the foundation and other parts free from water as required for constructing each part of the work.
- C. Install all drainage ditches, sumps, and pumps to control excessive seepage on excavated slopes, to drain isolated zones with perched water tables and to drain impervious surfaces at final excavation elevation.
- D. Dewater by means that will ensure dry excavations, preserve final lines and grades, do not disturb, or displace adjacent soil.
- E. All pumping and drainage shall be done with no damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic or the work of other contractors, and in accordance with all pertinent laws, ordinances and regulations.

DEWATERING

- F. Do not overload or obstruct existing drainage facilities.
- G. After they have served their purpose, remove all temporary protective work at a satisfactory time and in a satisfactory mariner. All diversion channels and other temporary excavations in areas where the compacted fill or other structures will be constructed shall be cleaned out, backfilled, and processed under the same Specifications as those governing the compacted fill. Fill or grout all temporary dewatering wells unless otherwise directed by the Engineer.
- H. When the temporary works will not adversely affect any item of permanent work or the planned usage of the Project, the Contractor may be permitted to leave such temporary works in place. In such instances, breaching of dikes, levees and cofferdams may be required.

3.2 DEWATERING

- A. By the use of well points, pumps, tile drains or other approved methods, the Contractor shall prevent the accumulation of water in excavated areas. Should water accumulate, it shall be promptly removed.
- B. Excavations shall be continuously dewatered to maintain a ground water level no higher than three to four feet below the lowest point in the excavation. Dewatering systems shall be designed to allow for localized variations in the depth of excavations required to reach a suitable foundation. Dewatering shall be accomplished long enough in advance of excavation to ensure that groundwater is already lowered prior to completing the final excavation to finish subgrade.
- C. All destabilized subgrade conditions caused by inadequate or untimely dewatering operations shall be undercut and backfilled with suitable backfill material at no additional cost to the Owner.
- D. Piezometric observation wells are required to monitor the ground water level to insure proper dewatering prior to excavation below the static water table. The number of wells required will vary depending on the size and depth of structures.
- E. The contractor shall either filter all water pumped from the required dewatering operations or construct a sediment pond on-site of adequate size to limit the turbidity of the water to be discharged to any nearby streams to those turbidity limits required by current State and/or Federal laws. Submit the details of these operations to the owner/engineer for approval prior to the start of construction.

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SCOPE

- A. The work specified in this Section consists of providing and maintaining temporary and permanent erosion and sedimentation controls as shown on the Drawings. This Section also specifies the subsequent removal of temporary erosion and sedimentation controls.
- B. Temporary and permanent erosion and sedimentation controls include grassing and mulching of disturbed areas and structural barriers at those locations which will ensure that erosion during construction will be maintained within acceptable limits. Acceptable limits are as established by the Georgia Erosion and Sedimentation Control Act of 1975, as amended, Section 40 of the Federal Clean Water Act, and applicable codes, ordinances, rules, regulations, and laws of local and municipal authorities having jurisdiction.
- C. Land disturbance activity shall not commence until the Land Disturbance Permit has been issued.
- D. Land disturbance permit shall be obtained and paid for by the Owner.
- E. Where permanent grassing is not appropriate, and where the Contractor's temporary erosion and sedimentation control practices are inadequate, the Owner may direct the Contractor to provide temporary vegetative cover with fast growing seedlings. Such temporary vegetative cover shall be provided by the Contractor in accordance with the Seeding Requirements shown on the Drawings and Section 32 92 19 of these Specifications.

1.2 SUBMITTALS

- A. Submit product data in accordance with the requirements of Section 01 33 23 of these Specifications.
- B. At the Pre-Construction Conference, the Contractor shall submit, for the Engineer's approval, a schedule for the accomplishment of temporary and permanent erosion and sedimentation control work. No work shall be started until the erosion and sedimentation control schedule and methods of operation have been approved by the Engineer.

1.3 QUALITY ASSURANCE

A. The temporary and permanent erosion and sedimentation control measures shown on the Drawings are minimum requirements. Any additional erosion and sedimentation control measures required by the Contractor's means, methods, techniques, and sequence of operation will be installed by the Contractor at no additional cost to the Owner and will be paid for according to the unit price bid for each control measure as approved by the Engineer.

- B. Perform all work under this Section in accordance with all pertinent rules and regulations including, but not necessarily limited to, those stated in these Specifications. Where provisions of pertinent rules and regulations conflict with these Specifications, the more stringent provisions shall govern.
- C. Provide all materials and promptly take all actions necessary to achieve effective erosion and sedimentation control in accordance with the Georgia Erosion and Sedimentation Control Act of 1975, as amended (OCGA §1 7 1, et. seq.) local ordinances, other permits, local enforcing agency guidelines and these Specifications.

D. Basic Principles

- 1. Coordinate the land disturbance activities to fit the topography, soil types and conditions.
- 2. Minimize the disturbed area and the duration of exposure to erosive elements.
- 3. Provide temporary or permanent stabilization to disturbed areas immediately after rough grading is complete.
- 4. Safely convey run off from the site to a stable outlet to prevent flooding and damage to downstream facilities resulting from increased runoff from the site.
- 5. Retain sediment on site that was generated on site.
- 6. Minimize encroachment upon watercourses.
- E. Temporary Erosion and Sedimentation Control: In general, temporary erosion and sedimentation control procedures shall be directed toward:
 - 1. Preventing soil erosion at the source.
 - 2. Preventing silt and sediment from entering any waterway if soil erosion cannot be prevented.
 - 3. Preventing silt and sediment from migrating downstream in the event it cannot be prevented from entering the waterway.

F. Implementation

- 1. The Contractor is solely responsible for the control of erosion within the Project site and the prevention of sedimentation from leaving the Project site or entering waterways.
- 2. The Contractor shall install temporary and permanent erosion and sedimentation controls which will ensure that runoff from the disturbed area of the Project site shall pass through a filter system before exiting the Project site.
- 3. The Contractor shall provide temporary and permanent erosion and sedimentation control measures to prevent silt and sediment from entering the waterways. The Contractor shall maintain an undisturbed vegetative buffer a minimum of 25 feet from the top of the bank. The Contractor will be provided with a Land Disturbance Permit that allows encroachments on the 25-foot vegetative buffer in specific areas.
- 4. The Contractor shall limit land disturbance activity to those areas shown on the Drawings.
- 5. The Contractor shall maintain erosion and sedimentation control measures within disturbed areas on the entire site at no additional cost to the Owner until the acceptance of the Project. Maintenance shall include mulching, re seeding, clean out of sediment barriers and sediment ponds, replacement of washed out or undermined riprap and erosion control materials, to the satisfaction of the Engineer.
- 6. All fines imposed for improper erosion and sedimentation control shall be paid by the Contractor.

- G. Permanent Erosion Control: Permanent erosion control measures shall be implemented to prevent sedimentation of the waterways and to prevent erosion of the Project site.
- H. Worksite Erosion Control Supervisor Certification: All supervisors are required to have successfully completed the Worksite Erosion Control Supervisor Certification Training as approved by Georgia Environmental Protection Division. This training shall be completed within thirty days of Notice of Award of the Contract. All certified supervisors shall have their training card or proof of certificate on their persons at all times.

PART 2 PRODUCTS

2.1 SEDIMENT BARRIER

- A. Silt Fence: Silt Fence shall be Sensitive Type "S".
 - 1. Silt fence shall meet the requirements of Section 171 of the Georgia Department of Transportation Standard Specifications, latest edition.
 - 2. Type Sensitive with woven wire reinforcement silt fence is a combination of Type Sensitive silt fence fabric with woven wire reinforcement.
 - 3. Silt fence fabric shall be an approved product on the Georgia DOT Qualified Product List No. 36, latest edition.
- B. Stone Check Dams: Stone shall conform to the requirements of Section 805.01 of the Georgia Department of Transportation Standard Specification, latest edition, for Stone Dumped Riprap except the stone shall be 8 inches or less at the greatest dimension.
- C. Hay Bales: Hay bales shall be clean, seed free cereal hay, rectangular in shape and contain five cubic feet or more of material.
- D. Concrete Blocks: Concrete blocks shall be hollow, non-load bearing type.
- E. Plywood shall be 3/4-inch-thick exterior type.

2.2 CONSTRUCTION EXIT STONE

A. Use sound, tough, durable stone resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Aggregate size shall be in accordance with the National Stone Association Size R-3 or Type 3 riprap stone conforming to Section 805.2.01 of the Georgia Department of Transportation Standard Specifications.

2.3 CONCRETE

A. Concrete shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. Ready mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

2.4 RIP RAP

- A. Stone Riprap: Use sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Specific gravity shall be 2.0 or greater. Riprap shall have less than 66 percent wear when tested in accordance with AASHTO T 96. Unless shown or specified otherwise, stone rip-rap shall be Type 3 rip-rap.
 - 1. Type 1 Riprap: Riprap size shall conform to Section 805.2.01 of the Georgia Department of Transportation Standard Specification for Type 1 Stone Dumped Riprap.
 - 2. Type 3 Rip-Rap: The largest pieces shall have a maximum approximate volume of one cubic foot. At least 35 percent of the mass shall be comprised of pieces, which weigh 15 pounds or more. The remainder shall be well graded down to the finest sizes. Rock fines shall comprise a maximum of 10 percent of the total mass. Rock fines are defined as material passing a No. 4 sieve. Rip-rap size shall conform to Georgia Department of Transportation Section 805.2.01 Stone Dumped Rip-Rap, Type 3.
 - 3. 200 Pound Riprap: Minimum weight of individual stones shall be 200 pounds
 - 4. NSA No. R-4 Type Rip Rap shall be used in drainage ditches unless specified otherwise.

2.5 PLASTIC FILTER FABRIC

- A. Plastic filter fabric shall conform to the Georgia Department of Transportation Standard Specifications, Section 881.2.05 for woven fabrics.
- B. Plastic filter fabric shall be an approved product on the Georgia Department of Transportation Qualified Product List No. 8, latest edition.

2.6 GRASSING

- A. All references to grassing unless otherwise noted, shall relate to establishing permanent vegetative cover as specified in Section 32 92 19 of these Specifications.
- B. Seed species shall be provided as shown on the Drawings or in the Specifications.
- C. Mulch Binder: Mulch on slopes exceeding 3 (horizontal) to 1 (vertical) shall be held in place by the use of a mulch binder, as approved by the Engineer. The mulch binder shall be nontoxic to plant and animal life and shall be approved by the Engineer.
- D. Water: Water shall be free of excess and harmful chemicals, organisms and substances which may be harmful to plant growth or obnoxious to traffic. Salt or brackish water shall not be used. Water shall be furnished by the Owner.

2.7 SILT ROCK BAG

A. The silt rock bag shall be Engineered Fabric Specialist's Silt Stop Rock Bag, as shown on Drawings, or others approved by Owner.

PART 3 EXECUTION

3.1 GENERAL

- A. Temporary and permanent erosion and sedimentation control measures shall prevent erosion and prevent sediment from exiting the site. If, in the opinion of the Engineer, the Contractor's temporary erosion and sedimentation control measures are inadequate, the Contractor shall provide additional maintenance for existing measures or additional devices to control erosion and sedimentation on the site at no additional cost to the Owner.
- B. All erosion and sedimentation control devices and structures shall be inspected by the Contractor at least once a day and immediately prior to each rainfall occurrence. Any device or structure found to be damaged will be repaired or replaced by the end of the day.
- C. All erosion and sedimentation control measures and devices shall be constructed and maintained as indicated on the Drawings or specified herein until adequate permanent disturbed area stabilization has been provided and accepted by the Engineer. Once adequate permanent stabilization has been provided and accepted by the Engineer, all temporary erosion and sedimentation control structures and devices shall be removed.
- D. Permanent erosion control measures shall be implemented as soon as practical after the completion of pipe installation or land disturbance for each segment of the Project. In no event shall grassing occur more than one day after the pipe has been installed. Grassing shall be done daily. Failure to grass daily will result in a delay to install water main until such grassing is completed. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.
- E. Where permanent grassing is not appropriate, and where the Contractor's temporary erosion and sedimentation control practices are inadequate, the Owner may direct the Contractor to provide temporary vegetative cover with fast growing seedlings. Such temporary vegetative cover shall be provided by the Contractor in accordance with the Seeding Requirements shown on the Drawings and Section 32 92 19 of these Specifications.

3.2 SEDIMENT CONTROL

A. Construction Exit

- 1. Construction exit(s) shall be placed as shown on the Drawings and as directed by the Engineer. A construction exit shall be located at any point traffic will be leaving a disturbed area to a public right of way, street, alley, sidewalk or parking area.
- 2. Placement of Construction Exit Material: The ground surface upon which the construction exit material is to be placed shall be prepared to a smooth condition free from obstructions, depressions, or debris. The plastic filter fabric shall be placed to provide a minimum number of overlaps and a minimum width of one foot of overlap at each joint. The stone shall be placed with its top elevation conforming to the surrounding roadway elevations. The stone shall be dropped no more than three feet during construction.
- 3. Construction Exit Maintenance: The Contractor shall regularly maintain the exit with the top dressing of stone to prevent tracking or flow of soil onto public rights of way and paved surfaces as directed by the Engineer.

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EROSION AND SEDIMENTATION CONTROL

4. Construction Exit Removal: Construction exit(s) shall be removed and properly disposed of when the disturbed area has been properly stabilized, the tracking or flow of soil onto public rights of way or paved surfaces has ceased and as directed by the Engineer.

B. Sediment Barriers

- 1. Sediment barriers shall include, but are not necessarily limited to, silt fences, hay bales, check dams, and any device which prevents sediment from exiting the disturbed area.
- 2. Silt fences, hay bales, and rock check dams shall not be used in any flowing stream, creek, or river.
- 3. Sediment barriers shall be installed as shown on the Drawings and as directed by the Engineer.
- 4. Sediment barriers shall be maintained to ensure the depth of impounded sediment is no more than one half of the original height of the barrier or as directed by the Engineer. Torn, damaged, destroyed or washed out barriers shall be repaired, reinforced, or replaced with new material and installed as shown on the Drawings and as directed by the Engineer.

5. Sediment Barrier Removal

- a. Sediment barriers shall be removed once the disturbed area has been stabilized with a permanent vegetative cover and the sediment barrier is no longer required as directed by the Engineer.
- b. Accumulated sediment shall be removed from the barrier and spread over the site.
- e. All non-biodegradable parts of the barrier shall be disposed of properly. The hay bales may be spread evenly across disturbed areas as a mulching material.
- d. The disturbed area created by barrier removal shall be permanently stabilized.

3.3 EROSION CONTROL

A. Riprap

- 1. Riprap shall be placed as shown on the Drawings and as directed by the Engineer. Riprap shall be placed in drainage ditches as detailed on the Drawings. Riprap shall be placed at all points where natural vegetation is disturbed on the banks of streams or drainage ditches. Compact backfill and place riprap to prevent subsequent settlement and erosion. This requirement applies equally to construction alongside a stream or drainage ditch as well as crossing a stream or drainage ditch.
- 2. When trenching across a stream or drainage ditch, place riprap over the entire disturbed area upstream and downstream of the trench excavation. Place riprap across creek bottom, across creek banks, and extend riprap placement five feet beyond the top of each creek bank. Embed stone rip-rap by hand so as to form a compact layer at least 24-inches thick. Place rip-rap in such a way that the smaller stones are not segregated but evenly distributed. Place chinking stones in the crevices between the larger stones so that a dense, well-graded mass is produced.
- 3. Preparation of Foundations: The ground surface upon which the riprap is to be placed shall be brought to the correct lines and grades before placement is commenced. Where filling of depressions is required, the new material shall be compacted with hand or mechanical tampers. Unless at creek banks or otherwise shown or specified, riprap shall begin in a toe ditch constructed in original ground around the toe of the fill or the cut slope. The toe ditch shall be two feet deep in original ground, and the side next to the fill or cut shall have that same slope. After the riprap is placed, the toe ditch shall be

backfilled, and the excess dirt spread neatly within the construction easement and hauled off of the site and disposed of properly.

- 4. Placement of Plastic Filter Fabric
 - a. Plastic filter fabric shall be placed under all riprap unless shown or specified otherwise.
 - b. Filter fabric shall not be placed under riprap on stream or drainage ditch crossings.
 - c. The surface to receive filter fabric shall be prepared to a smooth condition free from obstructions, depressions and debris. The filter fabric shall be installed with the long dimension running up the slope and shall be placed to provide a minimum number of overlaps. The fabric shall be placed to provide a minimum width of one foot of overlap at each joint. The fabric shall be placed so that the upstream strip overlaps the downstream strip. The fabric shall be anchored in place with securing pins of the type recommended by the fabric manufacturer. Pins shall be placed on or within 3 inches of the centerline of the overlap. The fabric shall be placed loosely to avoid stretching and tearing during placement of the stone. The fabric shall be protected at all times during construction from clogging due to clay, silts, chemicals or other contaminants. Contaminated fabric or fabric damaged during installation or during placement of riprap shall be removed and replaced with uncontaminated and undamaged fabric at no additional cost to the Owner.
- 5. Placement of Riprap: Riprap shall be placed on a 6-inch layer of soil, crushed stone or sand overlaying the filter fabric. Riprap shall be placed with its top elevation conforming with the finished grade or the natural existing slope of the stream bank and stream bottom. The stone shall be dropped no more than three feet during construction. Stone riprap shall be placed to provide a uniform surface a minimum of 4 inches thick. The thickness tolerance for the course shall be 3 inches and +6 inches.

B. Grassing

- 1. Grassing shall meet the requirements of Section 700 of the Georgia Department of Transportation Standard Specifications, latest edition, and Section 32 92 19 of these Specifications unless specified otherwise.
- 2. Seed rate, fertilization and other requirements shall be provided as shown on the Drawings.
- 3. Temporary Stabilization: Temporary stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site. Temporary stabilization shall be provided to any area which will not receive permanent stabilization within the next 14 calendar days. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.
- 4. When final grade has been established, all bare soil, unless otherwise required by the Contract Documents, shall be seeded, fertilized, and mulched in an effort to restore to a protected condition. Provide sod in areas where sod existed prior to being disturbed by the Contractor and in areas ordered by the Owner to be provided with sod.
- 5. Specified permanent grassing shall be performed at the first appropriate season following establishment of final grading in each section of the site.
- 6. Permanent Stabilization
 - a. Permanent stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site. Permanent stabilization shall be provided to all areas of land disturbance within seven calendar days of the completion of land disturbance for any area greater than 0.5 acre. Partial payment

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- requests may be withheld for those portions of the Project not complying with this requirement.
- b. Where permanent stabilization cannot be immediately established because of an inappropriate season, the Contractor shall provide temporary stabilization. The Contractor shall return to the site at the appropriate season to provide permanent stabilization in areas that received only temporary stabilization.
- 7. Replant grass removed or damaged in residential areas using the same variety of grass and at the first appropriate season. Where sod is removed or damaged, replant such areas using sod of the same species of grass at the first appropriate season. Outside of residential or landscaped areas, grass the entire area disturbed by the work on completion of work in any area. In all areas, promptly establish successful stands of grass.

3.4 CLEAN-UP

- A. Dispose of all excess erosion and sedimentation control materials in a manner satisfactory to the Engineer.
- B. Final clean up shall be performed in accordance with the requirements of Section 01 77 00 of these Specifications.
- C. Clean-up and grassing operations shall be maintained within 200 feet of the pipe laying operation. Grassing shall be done on a daily basis in conjunction with pipe laying operations.

AGGREGATE BASE COURSES

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this section.
- B. Applicable requirements of Georgia Department of Transportation, Standard Specifications for Construction of Roads and Bridges.
- C. Section Includes:
 - 1. Aggregate subbase.
 - 2. Aggregate base course.
- D. Related Sections:
 - 1. Section 31 23 16 Trench Excavation and Fill.
 - 2. Section 32 12 16 Asphalt Concrete Paving.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M288 Standard Specification for Geotextile Specification for Highway Applications.
 - 2. AASHTO T180 Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

- 1. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
- 2. ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
- 3. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
- 4. ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- ASTM D2922 Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- 6. ASTM D2940 Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.
- 7. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data and Samples.
- B. Product Data:
 - 1. Submit Aggregate gradation for base material.
 - 2. Submit data for geotextile fabric.
- C. Materials Source: Submit name of aggregate materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform Work in accordance with applicable requirements of Georgia Department of Transportation, Standard Specifications for Construction of Roads and Bridges.
- C. All testing shall be done by an independent laboratory. No field laboratory shall be required. No payment for field testing shall be paid for by the Owner.

PART 2 PRODUCTS

2.1 BACKFILL MATERIAL

A. Backfill material shall meet the following requirements:

| Class | 4 inch | No. 60 | No. 200 | Clay | Volume | Maximum |
|-------|-----------|----------|-----------|-------|--------|-------------|
| | Sieve | Sieve | Sieve | | Change | Dry Density |
| | % Passing | %Passing | % Passing | % | % | Lb./ft.3 |
| I-A | 100 | 15-85 | 0-35 | 0-16 | 0-10 | 100+ |
| I-B | 100 | 15-85 | 16-45 | 16-30 | 0-12 | 110+ |

2.2 AGGREGATE MATERIALS

A. Subbase Aggregate: ASTM D2940; graded type.

| Sieve Size | Percent Passing |
|------------|-----------------|
| 2 inches | 100 |
| No. 4 | 30 to 60 |
| No. 200 | 0 to 12 |

- B. Base Aggregate: ASTM D2940; graded type.
 - 1. An 8-inch aggregate base shall be used unless otherwise shown on the drawings.
 - 2. The aggregate to be used shall conform to the following gradations;

| Sieve Size | Percent Passing |
|--------------|-----------------|
| 1-1/2 inches | 100 |
| 3/4 inches | 60 to 90 |
| No. 10 | 25 to 45 |
| No. 60 | 5 to 30 |
| No. 200 | 4 to 11 |

- 3. The aggregate shall be clean and free of vegetable matter and be of such nature that it can be compacted to a dense and firm course capable of supporting loaded trucks without leaving excessive indentations.
- 4. The aggregate base shall conform to the following requirements:

| Test | Individual Test Results | Test Method |
|------------------|-------------------------|--------------|
| Sand Equivalent | 30 minutes | GHD #63 |
| Durability index | | AASHTO T-210 |

C. Subdrains

1. Where subdrains are to be used, aggregate used for drainage should meet gradation of No. 89 aggregate.

2.3 ACCESSORIES

A. Geotextile Fabric where used to separate subbase from sub grade: AASHTO M288; non-woven, polypropylene.

2.4 SOIL STERILANTS

A. Soil sterilants will be applied to those areas shown on the Drawings. Only certified non-toxic sterilants will be approved. The rate of application will be that recommended by the manufacturer and shall be sufficient to effect sterilization for a period of 2 years or more. The Contractor shall take whatever precautions necessary to prevent contamination of adjacent areas with the sterilant and for the protection of all personnel in the area.

AGGREGATE BASE COURSES

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 31 00 Project Management and Coordination: Verification of existing conditions before starting work.
- B. Verify compacted substrate is dry.
 - 1. Proof roll substrate with two perpendicular passes to identify soft spots.
 - 2. Remove soft substrate and replace with compacted fill.
- C. Verify substrate has been inspected, gradients and elevations are correct.

3.2 PREPARATION OF SUBGRADE

A. General:

- 1. All debris and vegetation shall be removed from the site. Scarify all cut areas and areas to receive fill material to a depth of 6 inches, and DISC OR BLADE UNTIL MATERIAL IS FREE FROM LARGE CLODS. Remove from the scarified soil any deleterious material, roots, etc.
- B. The scarified soil will then be moisture conditioned to not less than 2 percent below optimum moisture and compacted to 98 percent of maximum density as determined by AASHTO T-l80.
 - 1. Unsuitable Material:
 - a. All areas indicating soft spots or unsuitable material will be removed to whatever depth necessary and rebuilt to grade with compacted fill, as directed by the Engineer.
 - 2. Requirements
 - a. All trench areas within the traveled way will be backfilled in accordance with the requirements of this Specification.

C. Fine Grading:

1. After the subgrade has been compacted to the specific, density, the area shall be fine graded with smooth slopes to allow drainage with a tolerance of 0.1 foot from the grades established by the Contractor from the contract drawings.

3.3 AGGREGATE PLACEMENT

- A. The aggregate shall be delivered to the site in a thoroughly blended condition and shall be handled in such a manner that there will be no excessive segregation and no mixing of the underlying soil or sub-base with the base rock material.
- B. Place aggregate equal thickness layers to total compacted thickness 15 inches unless noted otherwise on the Drawings.
 - 1. Maximum Layer Compacted Thickness: 6 inches.
 - 2. Minimum Layer Compacted Thickness: 3 inches.
- C. Roller compact aggregate to 95 percent maximum density.

- D. Level and contour surfaces to elevations, profiles, and gradients indicated.
 - 1. Aggregate base shall be placed to within 0.05 feet of the grade established by the Engineer.
- E. Maintain optimum moisture content of fill materials to attain specified compaction density.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 COMPACTION

- A. The aggregate base shall be compacted to a relative density of no less than 95 percent of maximum density as determined by AASHTO T-180D.
- B. Field relative compaction testing shall be performed by use of the applicable portions of ASTM D-2922 (nuclear density gage), AASHTO T-191 (sandcone apparatus), AASHTO T-205 (balloon method) as determined by the Engineer.

3.5 TOLERANCES

- A. Maximum Variation From Flat Surface: 1/4 inch measured with 10 foot straight edge.
- B. Maximum Variation From Thickness: 1/4 inch.
- C. Maximum Variation From Elevation: 0.05 feet.

3.6 FIELD QUALITY CONTROL

- A. Section 01 77 00 Closeout Procedures: Field inspecting, testing, adjusting, and balancing.
- B. Compaction testing will be performed in accordance with AASHTO T180.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Tests: As deemed necessary by the Engineer or one test for every 1000 square yards of each layer of compacted aggregate.

ASPHALT CONCRETE PAVEMENT

SECTION 32 12 16

ASPHALT CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to construct asphalt concrete pavements to the grades and cross-sections shown on the Drawings and as necessary for:
 - 1. Removing and replacing existing asphalt pavement as shown on the Drawings,
 - 2. Replacing any damaged paving due to or during construction,
 - 3. Constructing new asphalt paving where shown on the Drawings.

B. Related Sections:

- 1. Section 03 30 00 Cast-In-Place Concrete
- 2. Section 31 00 00 Earthwork
- 3. Section 31 23 16 Trench Excavation and Fill

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this section.
- B. Applicable requirements of Georgia Department of Transportation, Standard Specifications for Construction of Roads and Bridges.

1.3 QUALITY ASSURANCE

- A. Use only materials which are furnished by a bulk asphalt concrete producer regularly engaged in production of hot-mix, hot-laid asphalt concrete.
- B. Comply with applicable requirements of Georgia Department of Transportation, Standard Specifications for Construction of Roads and Bridges.

1.4 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data and Samples.
- B. Product Data:
 - 1. Submit product information for asphalt and aggregate materials.
 - 2. Submit mix design with laboratory test results supporting design.
 - a. Mix designs shall be tested by a laboratory independent of the asphalt supplier and shall have been prepared within 12 months prior to construction.

1.5 CONDITIONS

A. Weather Limitations:

- 1. Apply bituminous prime and tack coats only when the ambient temperature in the shade has been at least 40 degrees F.
- 2. Do not conduct paving operations when surface is wet, frozen or contains excess moisture which would prevent uniform distribution and required penetration.
- 3. Construct asphaltic courses only when atmospheric temperature in the shade is above 35 degrees F, when the underlying base is dry and when weather is not rainy.
- 4. Place base course when air temperature is above 35 degrees F and rising. No base course shall be placed on a frozen or muddy subgrade.
- B. Grade Control: Establish and maintain the required lines and grades for each course during construction operations.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with minimum five (5) years documented experience.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Graded Aggregate Base Course:
 - 1. Graded aggregate base course shall be quality throughout and shall meet the requirements of Section 815.01 of the GA Department of Transportation Standard Specifications.

B. Binder Course:

 Binder course shall be of uniform quality throughout and conform to the requirements of Section 828, Type 19mm Superpave of the Georgia Department of Transportation Standard Specifications.

C. Surface Course:

1. Surface course shall be of uniform quality throughout and shall conform to the requirements of Section 828, Type 2 9.5mm Superpave Level B of the Georgia Department of Transportation Standard Specifications.

D. Tack Coat:

1. Tack coat shall conform to the requirements of Section 413 of the Georgia Department of Transportation Standard Specifications.

ASPHALT CONCRETE PAVEMENT

EXECUTION

2.2 SURFACE PREPARATION

A. Graded Aggregate Base Course:

- 1. Check sub-grade for conformity with elevations and section immediately before placing aggregate base material.
- 2. Place aggregate base material in compacted layers not more than 6-inch thick, unless continuing tests indicate that the required results are being contained with thicker layers.
- 3. In no case shall more than 8-inches of compacted base be placed in one lift.
- 4. Spread, shape, and compact all aggregate base material deposited on the subgrade during the same day.
- 5. The compacted base shall have sufficient stability to support construction traffic without pumping.
- 6. If compacted base becomes unstable as a result of too much moisture, the base material and underlying subgrade, if necessary, shall be dried and reworked to a moisture content that can be recompacted.

B. Loose and Foreign Material:

- 1. Remove loose and foreign material from surface immediately before application of paving.
- 2. Use power brooms or blowers, and hand brooming as required.
- 3. Do not displace surface material.

C. Tack Coat:

- 1. Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphalt concrete or Portland cement concrete and similar surfaces.
- 2. Apply at a rate of 0.04 to 0.06 gallon per square yard of surface.
- 3. Apply tack coat by brush to contact surfaces of curbs, gutters, manholes, and other structures projecting into or abutting asphalt concrete pavement.
- 4. Allow surfaces to dry until material is at condition of tackiness to receive pavement.

2.3 EQUIPMENT

- A. Provide size and quantity of equipment to complete the work specified within the Project time schedule.
- B. Bituminous pavers shall be self-propelled, spread hot asphalt concrete mixtures without tearing, shoving or gouging surfaces, and control pavement edges to true lines without use of stationary forms.
- C. Rolling equipment shall be self-propelled, steel-wheeled and pneumatic-tired rollers that can reverse direction without backlash.
- D. Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools to complete the work specified.

2.4 ASPHALTIC CONCRETE PLACEMENT

A. Place asphalt concrete mix on prepared surface, spread and strike-off using paving machine.

- B. Spread mixture at a minimum temperature of 270 degrees F.
- C. Inaccessible and small areas may be placed by hand.
- D. Place each course at a thickness such that when compacted it will conform to the indicated grade, cross-section, finish thickness, and density indicated.

E. Pavement Placing:

- 1. Unless otherwise directed, begin placing along centerline of areas to be paved on crowned section, and at high side of sections on one-way slope, and in direction of traffic flow.
- 2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips by minimum of 6".
- 3. Complete base courses for a section before placing surface courses.
- 4. Place mixture in as continuous an operation as practical.

F. Hand Placing:

- 1. Spread, tamp, and finish mixture using hand tools in areas where machine spreading is not possible, as acceptable to Engineer.
- 2. Place mixture at a rate that will ensure handling and compaction before mixture becomes cooler than acceptable working temperature.

G. Joints:

- 1. Carefully make joints between old and new pavements, or between successive days of work, to ensure a continuous bond between adjoining work.
- 2. Construct joints to have same texture, density and smoothness as adjacent sections of asphalt concrete course.
- 3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat.
- 4. Offset transverse joints in succeeding courses not less than 24-inches.
- Cut back edge of previously placed course to expose an even, vertical surface for full course thickness
- 6. Offset longitudinal joints in succeeding courses not less than 6-inches.
- 7. When the edges of longitudinal joints are irregular, honeycombed, or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness.

2.5 ASPHALTIC CONCRETE COMPACTION

- A. Provide sufficient rollers to obtain the required pavement density.
- B. Begin rolling operations as soon after placing as the mixture will bear the weight of the roller without excessive displacement.
- C. Do not permit heavy equipment, including rollers, to stand on finished surface before it has thoroughly cooled or set.
- D. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

- E. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs.
- F. Do not roll centers of sections first under any circumstances.

G. Breakdown Rolling:

- 1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge.
- 2. Operate rollers as close as possible to paver without causing pavement displacement.
- 3. Check crown, grade, and smoothness after breakdown rolling.
- 4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling.

H. Second Rolling:

- 1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction.
- 2. Continue second rolling until mixture has been thoroughly compacted.

I. Finish Rolling:

- 1. Perform finish rolling while mixture is still warm enough for removal roller marks.
- 2. Continue rolling until roller marks are eliminated and course is of specified density.

J. Patching:

- 1. Remove and replace defective areas.
- 2. Cut out and fill with fresh, hot asphalt concrete.
- 3. Compact by rolling to specified surface density and smoothness.
- 4. Remove deficient areas for full depth of course.
- 5. Cut sides perpendicular and parallel to direction of traffic with edges vertical.
- 6. Apply tack coat to exposed surfaces before placing new asphalt co concrete mixture.

2.6 CLEANING AND PROTECTION

A. Cleaning: After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of the Engineer.

B. Protection:

- 1. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened, and in no case, no sooner than six hours.
- 2. Provide barricades and warning devices as required to protect pavement the general public.
- C. Maintenance: The Contractor shall maintain the surfaces of pavements until the acceptance of the Project. Maintenance shall include replacement, overlay, milling and reshaping as necessary to prevent raveling of the road material, the preservation of smooth surfaces and the repair of damaged or unsatisfactory surfaces, to the satisfaction of the Engineer.

CONCRETE SIDEWALKS

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CONCRETE SIDEWALKS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this section.

1.2 DESCRIPTION OF WORK

- A. The extent of concrete walks is indicated on the Drawings.
- B. Related Work Specified Elsewhere:
 - 1. Earthwork, Section 31 00 00.
 - 2. Concrete Work, Sections 03 10 00, 03 20 00, and 03 30 00.

PART 2 PRODUCTS

2.1 FORMS

A. Use either full depth steel or wood forms of a size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use forms that are straight and free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends.

2.2 CONCRETE

A. Ready-mix concrete of indicated strength conforming to section 03 30 00.

2.3 JOINT FILLER

A. Preformed joint filler meeting AASHTO MI53 or AASHTO M213.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

A. Remove loose material from compacted subgrade immediately before placing concrete.

3.2 FORM CONSTRUCTION

- A. Set forms to the required grades and lines rigidly braced and secured.
- B. Check completed form work for grade and alignment to the following tolerances:
 - 1. Top of form: Within 1/8 inch of design line and grade.

CONCRETE SIDEWALKS

- 2. Vertical face: Not more than 1/4 inch in 10 feet from vertical.
- C. Thoroughly clean forms and coat with form release agent as required to ensure form separation from concrete without damage before placing concrete.
- D. Slip form placement methods will be permitted provided completed walks meet requirements herein specified. Should slip form method not produce a product conforming to these specifications, the unacceptable work is to be removed and reconstructed, at no additional cost to the Owner, using fixed forms.

3.3 REINFORCEMENT

A. Locate, place and support reinforcement, as indicated or specified.

3.4 CONCRETE PLACEMENT

- A. Do not place concrete until subgrade and forms have been checked for line and grade. Moisten subgrade as required to provide a uniform dampened condition at the time concrete is placed. Do not place concrete on muddy or frozen subgrade.
- B. Place concrete in one course, monolithic construction, for the full width and depth of walks.
- C. Spread concrete as soon as it is deposited on the subgrade using methods that prevent segregation and separation of the mix, and with as little re-handling as possible. Consolidate concrete along the face of forms and adjacent to transverse joints.

3.5 JOINTS

A. General:

- 1. Construct expansion and weakened plane contraction joints true to line with face perpendicular to surface of the walk, unless otherwise shown.
- 2. Construct transverse joints at right angles or radial to the walk centerline, unless otherwise shown.
- 3. When the walkway is abutting existing walks, place transverse joints to align with previously paved joints, unless otherwise indicated.
- B. Contraction Joints: Provide weakened plane transverse joints at intervals equal to walk width, unless otherwise shown. Construct joints for a depth equal to at least 1/3 the walk thickness, using one of the following procedures:
 - 1. Tooled Joints: Form joints in the fresh concrete by grooving the top portion of slabs and finishing edges to a 1/4 inch radius.
 - 2. Sawed Joints: Cut joints, approximately 3/16 inch wide, into hardened concrete as soon as the surface will not be torn, abraded, or otherwise damaged by the cutting action.
- C. Expansion Joints: Form expansion joints with 1/2 inch thick premolded joint filler. Locate transverse expansion joints no more than 50 feet apart. Where walks abut curbs, existing walks, walls, catch basins, manholes, or other structures, provide expansion joint.
 - 1. Furnish joint fillers in one-piece, which extends the full width and depth of the joint. After concrete is finished, trim any protruding joint material flush with concrete surface.

CONCRETE SIDEWALKS

3.6 CONCRETE FINISHING

- A. After striking off and consolidating concrete, smooth the exposed surface to a uniform finish by screeding and floating.
- B. Before the surface is given the final finish, test the surface for trueness with a 10-foot straightedge. Correct any irregularities more than 1/4 inch in 10 feet.
- C. Round all edges to 1/4-inch radius.
- D. After completion of floating, and when excess moisture or surface sheen has disappeared, complete surface finishing as follows:
 - 1. Broom finish, by drawing a stiff bristle broom across the concrete surface, perpendicular to walk centerline.
 - 2. Ramp finish, raised truncated domes with a diameter of nominal 0.9 inches, a height of nominal 0.2 inches and a center to center spacing of nominal 2.35 inches produced by "stamping" pattern on wet concrete.

3.7 REPAIR AND PROTECTION

- A. Repair or replace broken or defective walks using methods acceptable to the Engineer. Where removal is required, remove and replace complete panels.
- B. Protect completed walks from damage until final acceptance.
- C. Clean concrete walks free of stains, discoloration, dirt, trash, leaves and other foreign material just prior to substantial completion and final acceptance.

SEEDING

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 SCOPE

- A. The work covered by this Section consists of furnishing all labor, equipment and material required to place topsoil, seed, commercial fertilizer, agricultural limestone, and mulch material, including seedbed preparation, harrowing, compacting and other placement operations on graded earthen areas as described herein and/or shown on the Drawings. In general, seeding operations shall be conducted on all newly graded earthen areas not covered by structures, pavement or sidewalks; all cleared or grubbed areas which are to remain as finish grade surfaces; and on all existing turf areas which are disturbed by construction operations and which are to remain as finish grade surfaces. Areas disturbed by borrow activities shall also be seeded according to these Specifications.
- B. The work shall include temporary seeding operations to stabilize earthen surfaces during construction or inclement weather and to minimize stream siltation and erosion. Temporary seeding shall be performed at the times and locations as directed by the Owner.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this section.

1.3 QUALITY ASSURANCE

- A. Prior to seeding operations, the Contractor shall furnish to the Owner labels or certified laboratory reports from an accredited commercial seed laboratory or a state seed laboratory showing the analysis and germination of the seed to be furnished. Acceptance of the seed test reports shall not relieve the Contractor of any responsibility or liability for furnishing seed meeting the requirements of this Section.
- B. Prior to topsoil operations, the Contractor shall obtain representative samples and furnish soil test certificates including textural, pH and organic analysis from the State University Agricultural Extension Services or other certified testing laboratory.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. All materials shall conform to the requirements and standards of this Section.
- B. Wood cellulose fiber mulch shall be equal to that manufactured by Weyerhauser Company or Conway Corporation.

SEEDING

2.2 MATERIALS AND CONSTRUCTION

A. Topsoil

- 1. The Contractor shall place a minimum of 6 inches of topsoil over all graded earthen areas and over any other areas to be seeded. Sources of topsoil shall be approved by the Owner prior to disturbance. Importing topsoil from offsite sources shall be at the discretion of the Owner and shall be justification for additional compensation to the Contractor. A change order properly authorized by the Owner shall be agreed upon prior to importing offsite topsoil. No additional compensation will be allowed for spreading of topsoil.
- 2. Topsoil shall be a friable loam containing a large amount of humus and shall be original surface soil of good, rich, uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, pebbles larger than ½ inch in diameter, lime, cement, bricks, ashes, cinders, slag, concrete, bitumen or its residue, boards, sticks, chips or other undesirable material harmful or unnecessary to plant growth. Topsoil shall be reasonably free from perennial weeds and shall not contain objectionable plant material, toxic amounts of either acid or alkaline elements or vegetable debris undesirable or harmful to plant life.
- 3. Topsoil shall be natural topsoil without admixture of subsoil material, and shall be classifiable as loam, silt loam, clay loam, sandy loam or a combination thereof. The pH shall range from 5.5 to 7.0. Topsoil shall contain not less than five percent nor more than 20 percent, by weight, of organic matter as determined by loss on ignition of oven dried samples to 65 degrees C.

B. Seed

- 1. Seed shall be delivered in new bags or bags that are sound and labeled in accordance with the U.S. Department of Agriculture Federal Seed Act.
- 2. All seed shall be from the last crop available at time of purchase and shall not be moldy, wet, or otherwise damaged in transit or storage.
- 3. Seed shall bear the growers analysis testing to 98 percent for purity and 90 percent for germination. At the discretion of the Owner, samples of seed may be taken for verification against the grower's analysis.
- 4. Species, rate of seeding, fertilization and other requirements are shown on the Drawings.

C. Fertilizer and Liming Materials

- 1. Fertilizer and liming materials shall comply with applicable state, local and federal laws concerned with their production and use.
- 2. Commercial fertilizer shall be a ready mixed material equivalent to the grade or grades specified in the Seeding Requirements shown on the Drawings. Container bags shall have the name and address of the manufacturer, the brand name, net weight and chemical composition.
- 3. Agricultural limestone shall be a pulverized dolomitic limestone having a calcium carbonate content of not less than 85 percent by weight. Agricultural limestone shall be crushed so that at least 85 percent of the material will pass a No. 10 mesh screen and 50 percent will pass a No. 40 mesh screen.

D. Mulch Material

1. All mulch materials shall be air-dried and reasonably free of noxious weeds and weed seeds or other materials detrimental to plant growth.

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- 2. Mulch shall be composed of wood cellulose fiber, straw, or stalks, as specified herein. Mulch shall be suitable for spreading with standard mulch blowing equipment.
- 3. Straw mulch shall be partially decomposed stalks of wheat, rye, oats or other approved grain crops.
- 4. Stalks shall be the partially decomposed, shredded residue of corn, cane, sorghum or other approved standing field crops.

E. Mulch Binder

- 1. Mulch on slopes exceeding a 3 to 1 ratio shall be held in place by the use of an approved mulch binder. The mulch binder shall be non-toxic to plant life and shall be acceptable to the Owner.
- 2. Emulsified asphalt binder shall be Grade SS 1, ASTM D 977. Cutback asphalt binder shall be Grade RC 70 or RC 250.
- F. Inoculates for Legumes: All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen fixing bacteria that is adapted to the particular seed involved.
- G. Water: Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

PART 3 EXECUTION

3.1 SECURING AND PLACING TOPSOIL

- A. Topsoil shall be secured from areas from which topsoil has not been previously removed, either by erosion or mechanical methods. Topsoil shall not be removed to a depth in excess of the depth approved by the Owner.
- B. The area, or areas, from which topsoil is secured, shall possess such uniformity of soil depth, color, texture, drainage and other characteristics as to offer assurance that, when removed the product will be homogeneous in nature and will conform to the requirements of these Specifications.
- C. All areas from which topsoil is to be secured, shall be cleaned of all sticks, boards, stones, cement, ashes, cinders, slag, concrete, bitumen or its residue and any other refuse which will hinder or prevent growth.
- D. In securing topsoil from a designated pit, or elsewhere, should strata or seams of material occur which do not come under the requirements for topsoil, such material shall be removed from the topsoil or if required by the Owner, the pit shall be abandoned.
- E. Before placing or depositing topsoil upon any areas, all improvement within the area shall be completed, unless otherwise approved by the Owner.
- F. The areas in which topsoil is to be placed or incorporated shall be prepared before securing topsoil for use.

3.2 SEEDBED PREPARATION

- A. Before fertilizing and seeding, the topsoil surfaces shall be trimmed and worked to true line from unsightly variation, bumps, ridges and depressions and all detrimental material, roots and stones larger than 3 inches in any dimension shall be removed from the soil.
- B. Not earlier than 24 hours before the seed is to be sown, the soil surface to be seeded shall be thoroughly cultivated to a depth of not less than 4 inches with a weighted disc, tiller, pulvimixer or other equipment, until the surface is smooth and in a condition acceptable to the Owner.
- C. If the prepared surface becomes eroded as a result of rain or for any other reason, becomes crusted before the seed is sown, the surface shall again be placed in a condition suitable for seeding.
- D. Ground preparation operations shall be performed only when the ground is in a tillable and workable condition, as determined by the Owner.

3.3 FERTILIZATION AND LIMING

- A. Following seedbed preparation, fertilizer shall be applied to all areas to be seeded so as to achieve the application rates shown on the Drawings.
- B. Fertilizer shall be spread evenly over the seedbed and shall be lightly harrowed, raked, or otherwise incorporated into the soil for a depth of 1 inch.
- C. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment. The seed shall not remain in water containing fertilizer for more than 30 minutes when a hydraulic seeder is used.
- D. Agricultural limestone shall be thoroughly mixed into the soil according to the rates as shown on the Drawings. The Owner may reduce the specified rate of application of limestone if pH tests indicate this to be desirable. It is the responsibility of the Contractor to obtain such tests and submit the results to the Owner for adjustment in rates.
- E. It is the responsibility of the Contractor to make one application of a maintenance fertilizer according to the recommendations listed in the Seeding Requirements shown on the Drawings.

3.4 SEEDING

- A. Seed of the specified group shall be sown as soon as preparation of the seedbed has been completed. No seed shall be sown during high winds, nor until the surface is suitable for working and is in a proper condition. Seeding shall be performed during the dates as shown on the Drawings unless otherwise approved by the Owner. Seed mixtures may be sown together provided they are kept in a thoroughly mixed condition during the seeding operation.
- B. Seed shall be uniformly sown by any approved mechanical method suitable for the slope and size of the areas to be seeded, preferably with a broadcast type seeder, windmill hand seeder or approved mechanical power drawn seed drills. Hydro seeding and hydro mulching may be

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used, provided full coverage is obtained. Care shall be taken to adjust the seeder for seedings at the proper rate before seeding operations are started and to maintain their adjustment during seeding. Seed in hoppers shall be agitated to prevent segregation of the various seeds in a seeding mixture.

- C. Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 to 3/8 inch by a cultipacker or suitable roller.
- D. Leguminous seeds shall be inoculated prior to seeding with an approved and compatible nitrogen fixing inoculate in accordance with the manufacturer's mixing instructions.

3.5 MULCHING

- A. All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding. The mulch shall be applied evenly so as to permit sunlight to penetrate and the air to circulate and at the same time shade the ground, reduce erosion and conserve soil moisture. Approximately 45 percent of the ground shall be visible through the mulch blanket.
- B. One of the following mulches shall be spread evenly over the seeded areas at the following application rates:
 - 1. Wood Cellulose Fiber: 1,400 pounds/acre
 - 2. Straw: 4,000 pounds/acre
 - 3. Stalks: 4,000 pounds/acre
 - 4. These rates may be adjusted at the discretion of the Owner at no additional cost to the Owner, depending on the texture and condition of the mulch material and the characteristics of the seeded area.
- C. For slopes greater than a 3 to 1 ratio, the mulch shall be held in place by the use of an approved mulch binder. Binder shall be thoroughly mixed and applied with the mulch. Emulsified asphalt or cutback asphalt shall be applied at the approximate rate of five gallons per 1,000 square feet as required to hold the mulch in place.
- D. The Contractor shall cover structures, poles, fences, and appurtenances if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.
- E. Mulch and binder shall be applied by suitable blowing equipment at closely controlled application rates in a manner acceptable to the Owner.

3.6 WATERING

- A. The Contractor shall be responsible for maintaining the proper moisture content of the soil to insure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain adequate water content in the soil.
- B. Watering shall be accomplished by hoses, tank truck or sprinklers in such a way to prevent erosion, excessive runoff and over watered spots.

3.7 GRASSING SCHEDULE AND SATISFACTORY STAND OF GRASS

A. Grassing shall be done on a daily basis in conjunction with construction operations.

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B. A satisfactory stand of grass is defined as a full cover, over the seeded area, of live and growing grass with no bare spots larger than two square feet.

3.8 MAINTENANCE

- A. Upon completion of seeding operations, the Contractor shall clear the area of all equipment, debris and excess material and the premises shall be left in a neat and orderly condition.
- B. The Contractor shall maintain all seeded areas without additional payment until final acceptance of the work by the Owner, and any re-grading, re-fertilizing, re-liming, reseeding, or re-mulching shall be done at Contractor's own expense. Seeding work shall be repeated on defective areas until a satisfactory uniform stand is accomplished. Damage resulting from erosion, gullies, washouts or other causes shall be repaired by filling with topsoil, compacting and repeating the seeding work at Contractor's expense.

SEWER AND MANHOLE TESTING

SECTION 33 01 32

SEWER AND MANHOLE TESTING

PART 1 GENERAL

1.1 SUMMARY

- A. This section outlines the requirements for acceptance testing of gravity sewers and sanitary sewer manholes
- B. Testing shall be accomplished through the combination of visual inspections, deflection tests, leakage tests, vacuum testing and where specified by television inspection.
- C. Acceptance tests shall only be performed after all work adjacent to and over the gravity sewers and manholes has been completed. Backfilling, placement of fill, grading, concrete work and any other superimposed loads shall be completed and in place prior to any testing.
- D. Where gravity sewers or manholes fail to pass any acceptance test, the Contractor shall determine the source of the failure, make the necessary repairs, and retest the segment of pipe and manhole in question until a successful test is completed. Repairs and retest shall be completed at no cost to the Owner.

E. Related Sections:

- 1. Section 33 05 61 Manholes and Structures.
- 2. Section 33 31 00 Sanitary Sewerage Piping.

1.2 REFERENCES

A. ASTM International:

- 1. ASTM C924 Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
- 2. ASTM F1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
- 3. ASTM C1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
- 4. ASTM D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
- 5. ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

1.3 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data and Samples: Requirements for submittals.
- B. Submit the following prior to start of testing:
 - 1. Testing procedures.
 - 2. List of test equipment.

SEWER AND MANHOLE TESTING

- 3. Testing sequence schedule.
- 4. Provisions for disposal of flushing and test water.
- 5. Certification of test gauge calibration.
- 6. Deflection mandrel drawings and calculations.
- C. Test Reports: Indicate results of manhole and piping tests.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 31 00 Project Management and Coordination: Verification of existing conditions before starting work.
- B. Verify manholes and piping are ready for testing.
- C. Verify trenches are backfilled.

3.2 FIELD QUALITY CONTROL

- A. All testing shall be performed in the presence of the Engineer or Owner.
- B. Notify Engineer or Owner a minimum of 72 hours in advance of tests.
- C. Tests performed in the absence of the Engineer or Owner shall be considered invalid and shall be repeated at the Contractor's expense.

3.3 VISUAL INSPECTION

- A. Gravity sewer pipe shall be flushed and cleaned before it is inspected.
- B. All gravity sewer pipe installed shall be inspected by the Engineer or Owner to verify alignment and to ensure the pipe is free from obstructions and debris.
- C. Sun light and mirrors or other suitable light source shall be used to lamp each section of sewer between manholes. Pipe sections that are installed with sags or debris and are not installed with uniform line and grade shall be rejected. If a segment of pipe fails the visual inspection, the pipe shall be cleaned and/or replaced and re-tested until the pipe section achieves uniform line and grade and is clean.

3.4 TESTING GRAVITY SEWER PIPING

A. All tangents of all sewer lines, including house service lines, shall be tested for leakage.

- B. All visible leaks shall be repaired regardless of whether infiltration, exfiltration or air test is within allowable limits.
- C. No sewer will be accepted until leakage tests demonstrate compliance with one of the leakage test methods.

D. Low-pressure Air Test

- 1. The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured, and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing sewer lines.
- 2. Test each section of gravity sewer piping between manholes.
- 3. Introduce air pressure slowly to approximately 4 psig.
- 4. Allow pressure to stabilize for at least five minutes.
- 5. Disconnect the air supply and decrease the pressure to 3.5 psig before starting the test.
- 6. Determine test duration for sewer section with single pipe size. Do not make allowance for laterals.
- 7. Minimum test time for various pipe sizes for PVC pipe is given in Table 1, which is based on ASTM F1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air. For testing of long test sections of PVC pipe and/or sections of larger diameter pipes, a timed pressure drop of 0.5 psig may be used in lieu of the 1.0 psig time pressure drop, upon approval by the Engineer and Owner. If a 0.5 psig pressure drop is used, the appropriate required times shall be exactly half as long as those values outlined in Table 1.
- 8. Minimum test times for various diameter Ductile Iron Pipe and Fiberglass Gravity Sewer Pipe is given in Table 2, which is based on ASTM C924.

Table 1- Minimum Specified Time Required for a 1.0 psig Pressure Drop for Size and Length of PVC Pipe

| Nominal Pipe Size, inches | Min. Time min:sec | Length for min. Time, ft | Time for Longer Length, sec. | 100 ft. | 200 ft. | 300 ft. | 400 ft. |
|---------------------------|-------------------------|--------------------------|---------------------------------------|---------|---------|---------|---------|
| 6 | 5:40 | 398 | 0.854 L | 5:40 | 5:40 | 5:40 | 5:42 |
| 8 | 7:34 | 298 | 1.520 L | 7:34 | 7:34 | 7:36 | 10:08 |
| 10 | 9:26 | 239 | 2.374 L | 9:26 | 9:26 | 11:52 | 15:49 |
| 12 | 11:20 | 199 | 3.148 L | 11:20 | 11:24 | 17:05 | 22:47 |
| 15 | 14:10 | 159 | 5.342 L | 14:10 | 17:48 | 26:42 | 35:36 |

(Adapted from ASTM F1417)

Table 2 - Minimum Specified Time Required for a 1.0 psig Pressure Drop for Size and Length of Ductile Iron Pipe and Fiberglass Gravity Sewer Pipe

| Nominal Pipe Size, inches | Minimum Test Time, min/ 100 feet |
|---------------------------|-------------------------------------|
| 6 | 0.7 |
| 8 | 1.2 |
| 10 | 1.5 |
| 12 | 1.8 |
| 15 | 2.1 |
| 18 | 2.4 |
| 21 | 3.0 |
| 24 | 3.6 |
| 27 | 4.2 |
| 30 | 4.8 |
| 33 | 5.4 |
| 36 | 6.0 |
| 42 | 7.3 |

(Adapted from ASTM C924)

- 9. Record drop in pressure during test period; when air pressure has dropped more than 1.0 psig during test period, piping has failed; when 1.0 psig air pressure drop has not occurred during test period, discontinue test and piping is accepted.
- 10. When piping fails, determine source of air leakage, make corrections and retest; test section in incremental stages until leaks are isolated; after leaks are repaired, retest entire section between manholes.
- 11. Low-pressure air test shall be the primary method for leak testing gravity sewers.

E. Infiltration Test

1. Infiltration Test:

- a. Use only when gravity piping is submerged in ground water minimum of two (2) feet above crown of pipe for entire length being tested.
- b. The water surface elevation shall be established during construction and verified by the Engineer or Owner.
- c. Maximum Allowable Infiltration: 100 gallons per inch of pipe diameter for each mile per day for section under test, include allowances for leakage from manholes.
- d. The amount of leakage shall be determined from measurements made at the lower end of the sewer section under test.
- e. Sewers above the test section shall be closed before testing by installation of suitable watertight bulkheads.
- f. The average of six readings at five-minute intervals will be used to determine the rate of infiltration for any one test section.

F. Exfiltration Tests

- a. Uses only where natural ground water levels are less than two (2) feet above crown of pipe for entire length being tested.
- b. The test shall be performed up to an average maximum hydrostatic head of ten (10) feet.

- c. The test shall be conducted in the following manner:
 - 1. The ends of the pipe in the test section shall be closed with suitable watertight bulkheads.
 - 2. Inserted into each bulkhead at the top of the sewer pipe shall be a 2-inch pipe nipple with an elbow.
 - 3. At the upper end of the test section a riser pipe shall be installed.
 - 4. The test section of pipe shall be filled through the pipe connection in the lower bulkhead which shall be fitted with a tight valve, until all air is exhausted and until water overflows the riser pipe at the upper end.
 - 5. During the test period, which shall extend over a period of thirty (30) minutes, water shall be introduced into the riser pipe from measured containers at such intervals as are necessary to maintain the water level at the top of the riser pipe.
 - 6. The total volume of water added during the thirty (30) minute test period shall not exceed 100 gallons per inch of pipe diameter for each mile per day for section under test, include allowances for leakage from manholes.
- d. Water may be introduced into the pipe twenty-four (24) hours prior to the test period to allow complete saturation.
- e. House service lines, if installed, shall also be fitted with suitable bulkheads having provisions for the release of air while the test section is being filled with water

G. Testing Manholes:

- 1. All manholes shall be tested by vacuum test to show that they are watertight.
- 2. Test manholes prior to backfilling.
- 3. Test manholes with manhole frame set in place.
- 4. Vacuum test in accordance with ASTM C1244 and as follows:
 - a. Plug pipe openings; securely brace plugs and pipe.
 - b. Inflate compression band to affect seal between vacuum base and structure; connect vacuum pump to outlet port with valve open; draw vacuum to 10 inches of Hg; close valve; start test.
 - c. Determine test duration for manhole from the following table:

| Manhole Diameter | Test Period |
|------------------|-------------|
| 4 feet | 60 seconds |
| 5 feet | 75 seconds |
| 6 feet | 90 seconds |
| 7 feet | 105 seconds |
| 8 feet | 120 seconds |
| 10 feet | 150 seconds |

- d. Record vacuum drop during test period; when vacuum drop is greater than 1 inch of Hg during test period, repair and retest manhole; when vacuum drop of 1 inch of Hg does not occur during test period, discontinue test and accept manhole.
- e. When vacuum test fails to meet 1-inch Hg drop in specified time after repair, repair and retest manhole.

END OF SECTION

MANHOLES AND STRUCTURES

SECTION 33 05 61

MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SCOPE

A. The work described by this Section consists of furnishing all materials and equipment and performing all labor necessary for the installation of precast concrete manholes and structures, as shown or specified, or both.

1.1 QUALIFICATIONS

A. If requested by the Owner, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.

1.2 REFERENCES

A. ASTM International:

- 1. ASTM A48/A48M Standard Specification for Gray Iron Castings.
- 2. ASTM A185/A185M Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- 3. ASTM A536 Standard Specification for Ductile Iron Castings.
- 4. ASTM A615/A615M Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- 5. ASTM C33 Standard Specification for Concrete Aggregates.
- 6. ASTM C39 Standard Specification for Compressive Strength of Cylindrical Concrete Specimens.
- 7. ASTM C150 Standard Specification for Portland Cement.
- 8. ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete.
- 9. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- 10. ASTM C443 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- 11. ASTM C478 Standard Specification for Precast Reinforced Concrete Manhole Sections.
- 12. ASTM C497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
- 13. ASTM C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
- 14. ASTM C913 Standard Specification for Precast Concrete Water and Wastewater Structures.
- 15. ASTM C990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joints Sealants.

1.3 DESIGN REQUIREMENTS

- A. Precast concrete manholes shall consist of precast reinforced concrete base section, riser section, and eccentric top section conforming to the details as shown on the Contract Drawings.
- B. Precast concrete sections shall meet the requirements of ASTM C 478 and these specifications.
- C. The minimum compressive strength of the concrete in precast sections shall be 4,000 psi when tested in accordance with ASTM C39.
- D. Steel reinforcement shall be as specified in ASTM C478 and as specified in these specifications.
- E. Bottom sections shall have a minimum thickness of five (5) inches or one twelfth (1/12) of the inside diameter of the base section, whichever is greater.
- F. The minimum wall thickness shall be five (5) inches or one twelfth (1/12) of the inside diameter of the base, riser, or the largest cone diameter, whichever is greater. Additionally, the wall thickness shall be sufficient for the proper installation of the rubber boots.
- G. Flat slab top sections shall be designed by the manhole manufacturer to carry the live and dead loads exerted on the section.
- H. Precast concrete manholes shall be designed for a minimum HS20 loading and the soil load equivalent to the depth of the manhole as shown on the Drawings.
- I. Seal joints between precast sections by means of rubber O-ring gaskets or flexible butyl rubber sealant. Butyl rubber sealants shall meet the requirements of AASHTO M-198. Sealant shall be pre-formed type with a minimum nominal diameter of 1-inch.
- J. Honeycombed or re-tempered concrete is not permitted.
- K. Pipe connections to manholes to be the flexible type only. Masonry connections may not be used for sanitary sewer service.

1.4 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data and Samples: Requirements for Submittals.
- B. Indicate plan, location, and inverts of connecting piping.
- C. The manhole manufacturer shall provide a schedule showing the following for each manhole to be installed:
 - 1. Manhole number and station.
 - 2. Invert elevation of the inlet/outlet pipes and manhole bottom.
 - 3. Top elevation of the manhole frame.
 - 4. Manhole frame and cover details.
 - 5. Manhole frame connection to precast concrete.

MANHOLES AND STRUCTURES

- 6. Manufacturer's part number of catalog number of each component.
- 7. Each pipe size and type and the type of connector to be provided.
- 8. Total height of manhole components.
- 9. Weight of each component.
- 10. Inside diameter and wall thickness.
- 11. Top slab thickness.
- 12. Base slab thickness.
- 13. Orientation of each pipe entering and exiting the manhole relative to the manhole centerline.
- D. Detailed design calculations, which shall include calculations for wall stresses, floatation (safety factor of 1.5), depth calculations, reinforcement calculations, and all others necessary parameters for design, performance, and manufacture of precast concrete manhole products. These calculations shall be completed and sealed by a registered professional Engineer licensed in the state where the work will be performed.
- E. Submit Statement of Compliance, supporting data, from materials suppliers attesting that precast concrete structures provided meet or exceed ASTM Standards and specification requirements.
- F. Submit special procedures for installation.
- G. Submit manhole covers, component construction, features, configuration, weight and dimensions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 66 00 Product Storage and Handling Requirements.
- B. Comply with precast concrete manufacturer's instructions for unloading, storing, and moving precast manholes.
- C. Store precast concrete manholes to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- D. Transport and handle precast concrete units with equipment designed to protect units from damage.
- E. Do not place concrete units in a position that would cause overstress, warp, or twist.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record location of pipe runs, connections, manholes, services, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

- A. All precast manhole components shall be manufactured, supplied, and warranted by a single manufacturer.
- B. Each precast structure shall be marked in accordance with ASTM C478 with name of manufacturer, date of manufacturer, identifying symbols or numbers that correspond to the Contract Drawings and with the plant certification.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

- A. Manufacturers:
 - 1. Foley Products Company.
 - 2. Tindall Corporation.
 - 3. Substitutions: Section 01 25 13
- B. Manholes shall be cylindrical and constructed of steel reinforced precast concrete.
- C. Precast sections shall consist of a base section, riser section, and eccentric cone top or flat slab top section, as conditions require. The sections shall form a continuous uniform assembly.
- D. All interior surfaces of all new concrete manholes shall be coated with a concrete coating as outlined in Section 09 97 23 Specialty Concrete Coatings.
- E. Precast concrete sections shall meet the requirements of ASTM C 478. The minimum compressive strength of the concrete in precast sections shall be 4,000 psi.
- F. The minimum wall thickness shall be one twelfth of the inside diameter of the base, riser or the largest cone diameter. Additionally, the wall thickness shall be sufficient for the proper installation of the rubber boots.
- G. Transition slabs which convert bases larger than four feet in diameter to four-foot diameter risers shall be designed by the manhole manufacturer to carry the live and dead loads exerted on the slab.
- H. Seal joints between precast sections by means of rubber O-ring gaskets or flexible butyl rubber sealant. Butyl rubber sealants shall meet the requirements of AASHTO M-198. Sealant shall be pre-formed type with a minimum nominal diameter of 1 inch. Butyl rubber sealant shall be equal to E-Z Stik as manufactured by Concrete Supply Company, Kent Seal No. 2 or Concrete Sealants CS202.

I. Manhole Base Sections

- 1. Base sections for precast concrete manholes shall have a bottom poured monolithically with the walls.
- 2. Base sections shall be furnished with inside diameters sized to provide structurally sound bases at all pipe deflections and sized to provide a watertight pipe connection.
- 3. Minimum manhole diameters are identified on the Contract Drawings. To ensure the integrity of the manhole base is maintained or to provide sufficient wall thickness for the

MANHOLES AND STRUCTURES

- pipe connector, where required, the manhole manufacturer shall provide larger diameter manholes than those detailed.
- 4. Base sections shall be furnished with a minimum height of 20 inches for pipes having a diameter of 8, 10 or 12 inches, a minimum height of 24 inches for pipes having a diameter of 15 or 16 inches, and a minimum of 60 inches for pipe having a diameter of 24 inches or greater.
- 5. The openings in the base section for the accommodation of the pipe shall be cast to closely conform to job conditions and shall be sized specifically for the type of pipe and connector being used.
- 6. Unless otherwise required, a minimum clearance (i.e., sump) of three (3) inches shall be provided between the inside bottom of the base and outside bottom of the pipe barrel. Inverts, which are poured monolithically, will not require the required "sump".
- 7. Where calculations indicate the manholes will float, the base sections shall be constructed with an extended base slab to resist floation.

J. Riser Sections:

- 1. The riser sections shall be furnished in a minimum of sixteen (16) inch increments and shall be a minimum of four (4) feet in diameter with,
- 2. -tongue and groove joint to be sealed with approved butyl rubber or bitumastic material, or
- 3. -O-ring gasket type joint conforming to ASTM C 443, as amended to date.
- 4. No manhole riser sections shall be altered by the Contractor.
- K. Brick and Mortar: Brick shall be whole and hard burned, conforming to ASTM C 32 Grade MS. Mortar shall be made of one-part Portland cement and two parts clean sharp sand. Cement shall be Type 1 and shall conform to ASTM C 150. Sand shall meet ASTM C 53.

L. Iron Castings:

- 1. Cast iron manhole frames, covers and steps shall meet the requirements of ASTM A 48 for Class 35B gray iron and all applicable local standards. All castings shall be tough, close grained, smooth and free from blowholes, blisters, shrinkage, strains, cracks, cold shots and other imperfections. No casting will be accepted which weighs less than 95 percent of the design weight. Shop drawings must indicate the design weight and provide sufficient dimensions to permit checking. All castings shall be thoroughly cleaned in the shop and given two coats of approved bituminous paint before rusting begins.
- 2. Manhole frames and covers shall have the word "SEWER," cast on top. See drawings for additional manhole casting requirements.

| Type | Design Weight | Manufacturer |
|------------|------------------|--|
| | weight | _ |
| Traffic | 270# | U.S. Foundry USF No. 924 Ring & US Cover |
| Watertight | 115# | U.S. Foundry USF No. 275 Ring & RO Cover |
| Traffic | 236# | EJIW Hinged Manhole Assembly Product #00104023L01 |
| Watertight | 152# | EJIW Bolt Revolution Assembly Product #00104016R01 |

- 3. All frames and covers shall have machined and matched horizontal bearing contact surfaces.
- 4. All manholes shall have standard frames and covers except where specifically shown otherwise on the Drawings.

MANHOLES AND STRUCTURES

- 5. Manhole covers required to be bolt down shall be secured with not less than four (4) stainless steel bolts as provided by the manufacturer.
- 6. Covers rated for traffic shall have a weight of at least 335 pounds and shall be as manufactured by Vulcan or U.S. Foundry.
- 7. Manhole frame and cover clear openings shall be 32 inches for sanitary sewers 18 inches and larger.
- 8. Where required, the manhole frame shall be adjusted to the required grade with precast grade rings. All joints between the cone, adjusting rings, and manhole frame shall be sealed with a butyl sealant rope and sheet. Grade rings shall conform to ASTM C478 and shall be no less than four (4) inches in height. No more than ten (10) vertical inches of grade rings will be allowed per manhole.
- M. Watertight covers shall be bolt down type and shall be equipped with four 1/2-inch stainless steel bolts and a 1/8-inch red rubber or rubber O-ring gasket. Covers shall be rotatable and interchangeable. Bolt holes shall be bored through so that debris entering the bolt hole will fall into the manhole. Bolt holes shall have the full 360-degree circle within the cover's radius when bored through the cover.

N. Access Steps:

- 1. Manhole steps shall be Grade 60 #4 steel reinforcing bars covered with Polypropylene Plastic or rubber and shall be supplied with depth rings and other necessary appurtenances. Steps shall be similar to and of equal quality to the "PSI-PF" by M.A. Industries, Inc. of Peachtree City, Ga. The step shall be factory built into the precast section. See detail sheets in the Drawings.
- 2. Manhole steps shall be uniformly spaced along a vertical centerline.
- O. Rubber Boots: Provide preformed rubber boots and fasteners equal to those manufactured by Kor-N-Seal, Press Seal Corporation, or equal.
 - 1. The joint system shall be a synthetic rubber boot or sleeve, either cast or core drilled hole of the proper diameter into the wall of the manhole.
 - 2. The boot or sleeve shall be clamped and seated to the pipe with a stainless-steel band.
- P. The design of the connector shall provide a flexible, watertight seal between the pipe and the manhole. The connector shall be sized specifically for the type of pipe being used and shall be installed in accordance with manufacturer's recommendation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify piping connection, size, location, and inverts are as indicated on Drawings.
- B. Inspect precast concrete manholes prior to placement in excavation to verify manholes are internally clean and free from damage. Remove and replace damaged units.

3.2 CONNECTIONS TO EXISTING MANHOLES

A. Where indicated, complete connections to existing manholes. Manhole connections shall be as specified and as detailed on the Drawings.

3.3 INSTALLATION – GENERAL

A. Excavation and Backfill

- 1. Excavate for manholes in location and to depth shown. Provide clearance around sidewalls of manhole for construction operations and backfill.
- 2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes in dry trench.
- B. Install manholes supported at proper grade and alignment on crushed stone bedding as shown on Details.
- C. Place bedding material level in one continuous layer not exceeding 12 inches compacted depth, compact to 95 percent of maximum dry density.
- D. Place manhole plumb and level, to correct dimensions and elevations.
- E. No field cutting of manhole is allowed.
- F. Backfill around sides of manholes tamped in place and compacted to 95 percent of maximum dry density.

3.4 PRECAST CONCRETE MANHOLES

- A. Lift precast manholes at lifting points designated by manufacturer. Handle sections carefully to prevent cracking or chipping.
- B. When lowering manholes into excavations and joining pipe to units, take precautions to ensure interior of pipeline and manhole remains clean.
- C. Precast Concrete: Provide uniform bedding of the bottom section to prevent uneven loading. Install gaskets and joint sealants in accordance with manufacturer's recommendations to produce a watertight structure.
- D. Pipe Connections: All pipes shall be connected to precast concrete manholes by a rubber boot provided in a cored or precast hole of the proper diameter.
- E. Inverts: Manhole invert shall be constructed of solid concrete Class "A" concrete with no brick or sand fill; special care shall be taken to lay the channel and adjacent pipes to the proper grade. Channels shall be properly formed, rounded, and troweled smooth. Maintain consistent grade through the invert.
- F. Top Elevations: Build manholes outside of paved areas to a minimum of 18 inches above finished grade unless otherwise shown on the Drawings or directed by the Owner. Build manholes in paved areas to existing grades.

- G. Drop Connections: Manholes requiring drop connections are shown on the Drawings. Construct drop connections of the same materials as the upstream sewer and in accordance with the details shown on the Drawings.
- H. Frames and Covers: Unless frame and cover is at grade, the frame shall be cast into the cone section.
- I. Seal all manhole joints and lift holes, both inside and out, with grout. Between precast sections, this is in addition to joint sealant.
- J. Remove foreign materials from joint surfaces and verify sealing materials are placed properly.
- K. The gasket joint shall be thoroughly cleaned of all loose materials and brushed with an approved epoxy to give a smooth surface free of any honeycomb.
- L. Invert Elevations: Prior to setting the laser or other vertical alignment control system for the sewer upstream of the manhole, the Contractor shall verify the elevation of the sewer installed at the manhole. Should the elevation differ from that shown on the Drawings, the Contractor shall take the following corrective action:
 - 1. If the sewer is laid at negative grade, the Contractor shall remove and reinstall the sewer at the correct grade at no additional cost to the Owner.
 - 2. If the sewer is laid at a grade less than that shown on the Drawings, thus reducing the sewer's capacity, the Owner may require the sewer to be removed and re-laid at the correct grade at no additional cost to the Owner. As a minimum, the grade to the next upstream manhole shall be adjusted such that the next upstream manhole shall be set at the correct elevation.
 - 3. If the sewer is laid at a grade greater than that shown on the Drawings, and if the Contractor can show that there are no conflicts with upstream existing utilities or obstructions, the Contractor shall adjust the grade of the next upstream manhole such that the next upstream manhole shall be set at the correct elevation. If such an adjustment, in the Owner's opinion, is substantial, the grade adjustment shall be spread over multiple sections of the sewer. If such an adjustment, in the Owner's opinion, significantly reduces the sewer's capacity, the Owner may require the Contractor to remove and relay that portion of the sewer laid at the improper grade.
- M. Manholes shall be constructed such that their walls are plumb.

3.5 CASTINGS INSTALLATION

- A. Set frames and covers level to correct elevations.
- B. Frames shall be anchored in place with four stainless steel anchors bolts with stainless steel washers and nuts.
- C. Sealant for manhole frames shall be bitumastic material.
- D. Complete width of frame between frame and concrete manhole shall be sealed to provide a positive watertight seal between the manhole and frame and exterior of frame grouted.

3.6 INSPECTION AND TESTING

- A. Manholes: Prior to testing manholes for water tightness, all liftholes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and properly braced. Each manhole shall pass one of the following tests:
 - 1. Exfiltration Tests: The manhole, after proper preparation as noted above, shall be filled with water. The maximum allowable leakage shall be eight gallons per foot of depth per 24 hours for 48-inch diameter manholes. Tests shall last a minimum of eight hours. The manholes may be backfilled prior to testing.
 - 2. Vacuum Tests: The manhole, after proper preparation as noted above, shall be vacuum tested prior to backfilling. The test head shall be placed at the inside of the top of the cone section and the compression head inflated to 40 psi to affect a seal between the vacuum base and the manhole structure. Connect the vacuum pump to the outlet port with the valve open. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than 60 seconds for 48-inch diameter manholes. Refer to the table below for the required test duration for larger diameter manholes. If the manhole fails the initial test, necessary repairs shall be made with non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained. Vacuum testing equipment shall be equal to that as manufactured by P.A. Glazier, Inc.
 - 3. Determine test duration for manholes from the following table:

| Manhole Diameter | Test Period |
|------------------|-------------|
| 4 feet | 60 seconds |
| 5 feet | 75 seconds |
| 6 feet | 90 seconds |
| 7 feet | 105 seconds |
| 8 feet | 120 seconds |
| 10 feet | 150 seconds |

3.7 FIELD QUALITY CONTROL

- A. Request inspection by Engineer prior to backfilling around manhole.
- B. Compaction Testing: In accordance with these specifications around manholes in paved areas.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- D. Repaired and patched sections will not be acceptable unless each individual section so repaired or patched shall have first been inspected and approved by the Engineer for repair and patching at the manhole plant.
- E. Repairs to and patching of "O"-ring grooves and shoulders will not be permitted.

3.8 PROTECTION AND RESTORATION OF WORK AREA

- A. General: Return all items and all areas disturbed, directly or indirectly by work under these Specifications, to their original condition or better, as quickly as possible after work is started.
 - 1. The Contractor shall plan, coordinate, and prosecute the work such that disruption to personal property and business is held to a practical minimum.
 - 2. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly. Backfilling of underground facilities, ditches, and disturbed areas shall be accomplished on a daily basis as work is completed. Finishing, dressing, and grassing shall be accomplished immediately thereafter, as a continuous operation within each area being constructed and with emphasis placed on completing each individual yard or business frontage. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.
 - 3. Handwork, including raking and smoothing, shall be required to ensure that the removal of roots, sticks, rocks, and other debris is removed in order to provide a neat and pleasing appearance.
 - 4. The Georgia Department of Transportation or the Owner shall be authorized to stop all work by the Contractor when restoration and cleanup are unsatisfactory and to require appropriate remedial measures.
- B. Man Made Improvements: Protect, or remove and replace with the Owner's approval, all fences, walkways, mailboxes, pipe lines, drain culverts, power and telephone lines and cables, property pins and other improvements that may be encountered in the work.
- C. Cultivated Growth: Do not disturb cultivated trees or shrubbery unless approved by the Owner. Any such trees or shrubbery which must be removed shall be heeled in and replanted under the direction of an experienced nurseryman.
- D. Cutting of Trees: Do not cut trees for the performance of the work except as absolutely necessary. Protect trees that remain in the vicinity of the work from damage by equipment. Do not store spoil from excavation against the trunks. Remove excavated material stored over the root system of trees within 30 days to allow proper natural watering of the root system. Repair any damaged tree over 3 inches in diameter, not to be removed, under the direction of an experienced nurseryman. All trees and brush that require removal shall be promptly and completely removed from the work area and disposed of by the Contractor. No stumps, wood piles, or trash piles will be permitted on the work site.
- E. Disposal of Rubbish: Dispose of all materials cleared and grubbed during the construction of the project in accordance with the applicable codes and rules of the appropriate county, state and federal regulatory agencies.
- F. Swamps and Other Wetlands
 - 1. The Contractor shall not construct permanent roadbeds, berms, drainage structures or any other structures which alter the original topographic features within the easement.
 - 2. All temporary construction or alterations to the original topography will incorporate measures to prevent erosion into the surrounding swamp or wetland. All areas within the easement shall be returned to their original topographic condition as soon as possible after work is completed in the area. All materials of construction and other non-native materials shall be disposed by the Contractor.

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- 3. The Contractor shall provide temporary culverts or other drainage structures, as necessary, to permit the free migration of water between portions of a swamp, wetland or stream which may be temporarily divided by construction.
- 4. The Contractor shall not spread, discharge or dump any fuel oil, gasoline, pesticide, or any other pollutant to adjacent swamps or wetlands.

END OF SECTION

PUBLIC WATER UTILITY DISTRIBUTION PIPING

SECTION 33 11 13

PUBLIC WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. This section includes the requirements to install all public potable water piping systems, valves, and other appurtenances, complete, as shown on the Drawings or as specified. The Contractor shall furnish the material and construct the pipe work and other appurtenances shown and specified, and put in complete working order, the specified pipelines and associated structures.

B. Related Sections:

- 1. Section 01 33 00 Submittal Procedures
- 2. Section 01 40 00 Quality Requirements
- 3. Section 01 70 00 Execution and Closeout Requirements
- 4. Section 03 20 00 Concrete Reinforcing
- 5. Section 03 30 00 Cast-In-Place Concrete
- 6. Section 15 30 00 Butterfly Valves
- 7. Section 15 40 00 Pump Check Valves
- 8. Section 31 23 17 Trenching
- 9. Section 33 12 16 Water Utility Distribution Valves
- 10. Section 33 12 19 Water Utility Distribution Fire Hydrants
- 11. Section 33 13 00 Disinfecting of Water Utility Distribution

1.2 MEASUREMENT AND PAYMENT

- A. Basis of Payment: See Bid Form.
 - 1. Payment for all work under this section shall be included in the lump sum bid.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings.

B. ASTM International:

- 1. ASTM A36/A36M Standard Specification for Carbon Structural Steel.
- 2. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- 3. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- 4. ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
- 5. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
- 6. ASTM D1785 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

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- 7. ASTM D2922 Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- 8. ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- 9. ASTM D3139 Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- 10. ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. American Water Works Association:

- 1. AWWA C104 ANSI Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- 2. AWWA C105 ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- 3. AWWA C110 ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1,219 mm), for Water.
- 4. AWWA C111 ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- 5. AWWA C115 ANSI Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
- 6. AWWA C151 ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
- 7. AWWA C153 ANSI Standard for Ductile-Iron Compact Fittings for Water Service.
- 8. AWWA C500 Gate Valves for Water and Sewage Systems.
- 9. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.
- 10. AWWA C605 Water Treatment Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.
- 11. AWWA C700 Cold-Water Meters Displacement Type, Bronze Main Case.
- 12. AWWA C706 Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
- 13. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. through 12 In. (100 mm through 300 mm), for Water Distribution.
- 14. AWWA C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 36 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution.
- 15. AWWA M6 Water Meters Selection, Installation, Testing, and Maintenance.

D. Manufacturer's Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joint between Tapping Sleeves and Tapping Valves.

E. National Fire Protection Agency:

1. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate piping layout, including piping specialties.
- B. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories.

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- C. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.
- D. Pre-Construction Photographs.

1.5 CLOSEOUT SUBMITTALS

- A. Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Certification

- 1. The manufacturer of pipe and fittings shall furnish both the Engineer and the Owner with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable ANSI/AWWA Specifications for each
- 2. Testing of ductile iron pipe shall include hydrostatic, tensile and impact tests as specified in ANSI/AWWA C151/A21.51.
- 3. Testing shall include physical testing of ductile iron fittings as specified in ANSI/AWWA C110/A21.10.
- 4. Written transcripts of test results shall be furnished to the Engineer and Owner after pipe and fitting fabrication.
- 5. Maintain one copy of each document on site.
- 6. Manufacturer to provide certification that all pipe and fittings are NSF approved (ANSI/NSF Standard 61) for potable water use.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver and store valves in shipping containers with labeling in place.
- C. Block individual and stockpiled pipe lengths to prevent moving.
- D. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 WATER PIPING

A. Ductile Iron Pipe: AWWA C151. Bituminous outside coating: AWWA C151. Pipe Mortar Lining: AWWA C104, standard thickness.

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- 1. Pipe Class:
 - a. Pressure Class 250 (minimum, unless otherwise specifically indicated on the construction drawings) Ductile Iron (push on) pipe in accordance with AWWA C 151, ANSI A21.51.
 - b. Class 53 Ductile Iron (flanged) pipe in accordance with AWWA C 115, ANSI A21.15.
- 2. Fittings: Ductile iron, AWWA C153 or AWWA C110.
 - a. Fittings shall have standard mechanical, restrained joint or flanged joints as called for or shown on the Drawings.
 - b. Mechanical joint fittings for size 3-inch through 24-inch shall be Class 350 for Ductile Iron.
 - c. Mechanical joint fittings for size 30-inch through 48-inch shall be Class 250 for Ductile Iron.
 - d. Flanged fittings up to twelve (12) inches in size shall have a minimum pressure rating of 350 psi. Flanged fittings over twelve (12) inches in size shall have a minimum pressure rating of 250 psi.
- 3. Coating and Lining:
 - 1) Pipe and fittings that are not to be painted shall be coated on the exterior with bituminous coating. Lining and coating shall be in accordance with AWWA C104 and ANSI A21.4.
 - 2) Pipe and fittings shall be cement-lined (standard thickness), with a bituminous seal coat: AWWA C104, standard thickness.
 - 3) All pipe and fittings shall be NSF approved (ANSI/NSF Standard 61) for potable water use.
 - 4) Ductile iron pipe and fittings placed on or beneath the ground surface shall have an exterior coating of asphalt in accordance with AWWA C151 and ANSI A21.10.
 - 5) Ductile iron pipe and fittings placed above the ground shall be factory primed and field coated as required in these Specifications or outlined on the Drawings.
 - a) Submit primer data sheets with shop drawings.
 - b) Finish coat of paint must be compatible with primer coat.
 The Contractor shall provide written documentation that
 finish coat is compatible with the primer coat of the pipe.
 - c) Finish coat shall be applied to meet the requirements of the paint manufacturer's printed instructions.
 - 6) Ductile iron pipe that crosses or runs parallel to a gas transmission main, which may be cathodically protected, shall be encased in polyethylene encasement, eight (8) mil minimum thickness, and taped in accordance with AWWA C105 and ANSI A21.5.
 - 7) Ductile iron fittings in lieu of an asphalt coating and cement lining maybe coated and lined with five (5) to eight (8) mills of fusion bonded epoxy in accordance with AWWA C550 and C121 and ANSI A21.16.
 - a) Fittings shall be listed by a certifying agency that the coating complies with NSF 61.
- 4. Lead Free:
 - a. All pipe material, solder and flux shall be lead free.
 - b. Lead free with respect to solders and flux shall be not more than 0.2 percent lead.

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- c. Lead free with respect to pipes and pipe fittings shall contain no more than 8 percent lead.
- 5. Weights of Pipe:
 - a. Weights of pipe and fittings shall conform strictly to the requirements of ANSI/AWWA Specifications.
 - b. The weights and class designations for all pipes and fittings shall be plainly and conspicuously painted and/or labeled on the outside of each joint of pipe and each fitting after the exterior coating has hardened.
 - c. For pipe 16" and smaller in diameter, pipe will not be accepted in which the weight is less than the standard weight by more than 5%.
 - d. For pipe, which is more than 16" in diameter, pipe will not be accepted in which the weight is less than the standard weight by more than 4%.

6. Joints:

- a. Mechanical and Push-On Joints: AWWA C111. Yard piping shall be furnished with mechanical or Push-On joints and mechanical joint fittings, as shown on the Drawings.
- b. Flanged Joints: AWWA C115.
 - 1) Interior piping and other locations shown on the drawings shall be furnished with mechanical joints or flange connections.
 - 2) Flanges for pipe and fittings shall be Class 125 flanges, unless otherwise shown on the Drawings or specified, and shall be in accordance with ANSI A21.10 (AWWA C 115), drilled and faced in accordance with American Standard B17.1.
 - 3) Flanges for ductile iron pipe and fittings shall be ductile iron.
- c. Restrained Joints:
 - 1) Concrete blocking is shown on the Drawings at the desired locations and may also be detailed in some locations with restrained joints.
 - Where concrete blocking is not used for joint restraint, restrained joints shall be installed for ALL pressure pipe and fittings.
 - 2) Restrained joint fittings shall have a minimum pressure rating of 250 psi.
 - a) Slip Joint:
 - (1) Manufacturers:
 - (a) American Cast Iron Pipe Company. "Fast Grip" Gaskets for pipe diameters of 4" to 18". Restrained joint pipe having a diameter of 20" to 36" shall be "Flex Ring" and "Lok-Ring" for piping with diameter larger than 36".
 - (b) U.S. Pipe. "Field Lok" Gaskets for pipe diameters of 4" to 18". Restrained joint pipe having a diameter of 20" and larger shall be "TR. Flex".
 - b) Mechanical Joint:
 - (1) The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.
 - (2) Retaining gland "MEGALUG" for use with standard mechanical joint fittings shall include gripping wedges with torque limiting twist-off nuts

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- and shall be in accordance with AWWA C 110 through C 153 and ANSI A21.10 through A21.53.
- (3) Manufacturers:
 - (a) EBAA Iron, Inc., "MEGALUG"
 - (b) Substitutions: Permitted
- 3) Field welding rings to the pipe barrel of ductile iron pipe to be used in restrained joint applications will not be permitted.
- d. Gaskets and Bolted Connections
 - 1) Gaskets for Push-On and standard mechanical joints shall be plain rubber (Styrene Butadiene Copolymer) in accordance with AWWA C111 and ANSI A211.
 - 2) Gaskets (Field Lok) used to restrain Push-On joint pipe shall be plain rubber (Styrene Butadiene Copolymer) modified with stainless steel teeth in accordance with AWWA C111 and ANSI A211.
 - Gaskets for restrained joint pipe of the flex-ring type and restrained joint fittings of the flex-ring type shall be plain rubber (Styrene Butadiene Copolymer) modified with ductile iron segments in accordance with AWWA C111 and ANSI A211.
 - 4) Gaskets for flanged joints shall be 1/8-inch thick, full-faced, clothed reinforced rubber in accordance with AWWA C110 and C115, ANSI A21.10 and A21.15.
 - 5) Gaskets made of natural rubber or any other materials that will support microbial growth are not acceptable.
 - 6) Lubricants which will support microbial growth shall not be used and the use of vegetable shortening to lubricate joints is prohibited.
- e. Bolts for Ductile Iron Piping
 - 1) Bolts and nuts used for standard mechanical connections shall be tee head type with heavy hex nut conforming to ASTM A563 in accordance with AWWA C111.
 - 2) Bolts and nuts used for flanged connections shall be hex type of low carbon steel; cadmium plated or zinc plated conforming to ASTM A307 in accordance with AWWA C110 and C115.
- 7. Concrete Blocking:
 - a. Concrete blocking shall be installed for all pressure lines according to details shown on the Contract Drawings.
 - b. All pressure pipes shall be restrained either using concrete blocking, installed with restrained joints or a combination of both.
 - 1) The Engineer shall determine the number of restrained joints before and after each fitting.
- 8. Manufacturers:
 - a. Ductile iron pipe shall be manufactured by American Cast Iron Pipe Company or U.S. Pipe.
 - b. Ductile iron fittings shall be manufactured or supplied by American Cast Iron Pipe Company or U.S. Pipe.
- B. Polyvinyl Chloride (PVC) Water Line Pipe:
 - 1. PVC pipe shall be AWWA C-900, as amended to date, with standard dimension ratio DR-18 (PC 235) with cast iron pipe equivalent OD's.
 - 2. The pipe shall include an integral bell with factory-installed gaskets meeting the requirements of ASTM F-477.

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- 3. Gasketed joints shall meet the requirements of ASTM D-3139. Lubricants which will support microbial growth shall not be used for slip-on joints. The use of vegetable shortening is expressly prohibited.
- 4. Pipe shall be furnished in standard 20 ft. laying lengths.
- 5. All PVC piping shall bear the approval of the National Sanitation Foundation (NSF).
- 6. All fittings shall be ductile iron.
- 7. Pipe shall bear identification markings in accordance with AWWA C 900, as amended to date, that will remain legible during normal handling, storage and installation and which have been applied in a manner that will not reduce the strength of the pipe or coupling or otherwise damage them.
- 8. The manufacturer shall furnish both the Engineer and the Owner with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable AWWA and ANSI Specifications.

C. PVC Small Diameter Water Lines

- 1. Small diameter water lines 3-inches and below, ASTM D1785, SCH 80 for 250 psig rating, or as shown on the construction drawings.
- 2. For fittings 3 inches and below: ASTM D 2467 and threaded fittings ASTM D 2464.
- 3. Solvent cement for socket type fittings: ASTM D2564.
- 4. All PVC pipe and fittings shall have the approval of the National Sanitation Foundation (NSF).

D. Copper Pipe and Fittings

1. Pipe:

- a. Buried pipe three-quarter (3/4) to one (1) inch in diameter shall be seamless, annealed copper tube conforming to the requirements of ASTM B-88, Type "K".
- b. Buried pipe greater than one (1) inch in diameter shall be hard-drawn copper tube conforming to the requirements of ASTM B-88, Type "L".
- c. All exposed or above ground pipe shall be hard-drawn copper tube conforming to the requirements of ASTM B-88, Type "L".

Fittings

- a. Fittings for soft annealed copper pipe shall be cast bronze flared tube type conforming to ASTM B-16 or B-124.
- b. Fittings for hard-drawn copper tube shall be wrought copper conforming to ASTM B-75 and ANSI B16.22 for silver brazed joints. Lead free solder and flux shall be used in making connections. Solder for the solder joint type shall be in accordance with ANSI/ASTM B 32 and shall be 95% tin and 5% antimony.
- c. Meter couplings and tail pieces shall be cast brass threaded type.

3. Casing for Copper Pipe

- a. PVC pipe shall be used as a casing for copper water service lines that are to cross under road and/or installed under pavement.
- b. PVC pipe used as a casing shall be a minimum of Schedule 40, Class 200.
- c. PVC casing pipe shall have a minimum diameter of two (2) inches

2.2 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves:

- 1. Tapping sleeves shall be of the split type and manufactured of ductile iron or stainless steel.
- 2. Tapping sleeves shall conform to requirements of AWWA C223.
- 3. Stainless steel sleeve shall be type 304 (18-8).

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- 4. Gaskets shall be virgin nitrile (Buna-N, NBR).
- 5. Sleeve outlet shall be flanged in accordance with AWWA C110. Outlet Flange Dimensions and Drilling: ASME B16.1, Class 125 and MSS SP-60.
- 6. All tapping sleeves shall be hydrostatically tested to the same test pressure of the new pipe.
- 7. The manufacturer of the tapping sleeve shall supply the tapping valve or verification provided by the valve and sleeve manufacturer that the valve and sleeve are compatible.
- 8. Manufacturers:
 - a. U.S. Pipe.
 - b. American Flow Control.
 - c. Smith Blair Part No. 663 (stainless steel) or 665 (stainless steel).
 - d. Substitutions: Permitted.

B. Tapping Valves:

- 1. AWWA C509, iron-body, resilient-seated gate valve with non-rising stem.
 - a. Inlet flanges shall conform to ANSI B16.1, Class 125 and MSS SP-60.
 - b. Mechanical joint outlets shall conform to AWWA C111.
- 2. The valve shall have a flanged connection to the tapping sleeve and a mechanical joint connection to the branch pipe.
- 3. Tapping valves shall permit the use of full size shell cutters.
- 4. All interior and exterior ferrous surfaces shall be protected against corrosion by fusion-bonded-epoxy coating.
 - a. Coating shall be applied prior to assembly to assure coverage of all exposed areas, including bolt holes.
- 5. All valves shall open left.
 - a. Valves shall be operated by nut.
 - b. Operating nuts shall conform to the present standard of the Owner, and shall have an arrow cast on them, indicating the direction for opening the valve.
 - c. Provide extensions stems as specified elsewhere.
- 6. Manufacturers:
 - a. Mueller Co.
 - b. Substitutions: Permitted.

2.3 VALVES

A. Valves: As specified elsewhere.

2.4 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, blue, continuously printed with the words "Caution Buried Water Line Below", minimum 6 inches wide by 4 mils thick, manufactured for direct burial service, installed for all pipe.

B. Detectable Tracer Wire

- 1. Required for ALL buried PVC and HDPE pipe installations, regardless of length.
- 2. Wire shall have a minimum overall gage of 10 ga. mils.
- 3. "Blue" for potable water and associated lines.

PUBLIC WATER UTILITY DISTRIBUTION PIPING

2.5 PIPE SUPPORTS AND ANCHORING

- A. Metal for pipe support brackets: stainless steel.
- B. Metal tie rods and clamps or lugs: stainless steel.

2.6 CONCRETE

- A. Concrete Encasement and Cradles: Class "C" as specified elsewhere.
- B. Concrete Blocking for Thrust Restraints (un-reinforced): Class "B" as specified elsewhere. Conform to details shown on Drawings.
- C. Concrete for Thrust Restraints (straddle blocking): Class "A" as specified elsewhere. Conform to details shown on Drawings.
- D. Concrete Reinforcement: As specified elsewhere.

2.7 BEDDING AND COVER MATERIALS

A. Bedding, cover and soil backfill from above pipe to finish grade as specified elsewhere.

2.8 ACCESSORIES

A. Steel rods, bolt, lugs and brackets: stainless steel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing utility water main size, location, and inverts are as indicated on Drawings.

3.2 PREPARATION

- A. Take pre-construction photographs along centerline of proposed pipe trench as specified elsewhere.
- B. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare pipe connections to equipment with flanges or unions.
- E. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
 - 1. Notify Owner and Engineer not less than 7 days in advance of proposed utility interruption.
 - 2. Do not proceed without written permission from the Owner.

3.3 BEDDING

- A. Excavate pipe trench. Hand trim excavation for accurate placement of pipe to elevations indicated on Drawings.
- B. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.
- C. Provide sheeting and shoring as specified elsewhere.

3.4 INSTALLATION - PIPE

- A. Install pipe in accordance with AWWA C600 for ductile iron pipes and fittings.
- B. PVC pipe shall be installed in accordance with AWWA C605 and manufacturer's written instructions.
- C. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated on Drawings.
- D. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.
- E. Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer or force main.
 - 1. The distance shall be measured from edge to edge.
 - 2. Water mains crossing sewers and force mains shall be laid to provide a minimum vertical distance of 18 inches between the invert of the water main and the top of the sewer or force main.
- F. Where a new water line crosses a new sewer line, both the water and sewer lines must be ductile iron and the crossing shall be arranged so that the joints of each line will be as far away as possible from the point of crossing.
 - 1. Where a new water main crosses an existing sewer, the water main must be ductile iron and the water main shall be installed so both joints will be as far from the sewer line crossing as possible.
 - 2. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the water main.
- G. No water line may pass through or come in contact with any part of a sewer manhole.
- H. Water mains shall be installed with a minimum of 25 feet separation horizontally from any portion of a waste-water tile-field or spray-field.
- I. Water mains may not be installed in contaminated areas. If contaminated areas are encountered during water main installation, contact Engineer for possible revisions to the pipe and gasket material.
- J. Install pipe to indicated elevations where shown on the drawings, while maintaining minimum cover as specified in Section 31 23 17 TRENCHING.

PUBLIC WATER UTILITY DISTRIBUTION PIPING

- K. Flanged Joints: Not to be used in underground installations except within structures.
- L. Route pipe in straight line. Relay pipe that is out of alignment or grade.
- M. Install pipe with no high points. If unforeseen field conditions arise which necessitate high points, notify the Engineer, as air release valves and/or blow-offs may be required.
- N. Install pipe to have bearing along entire length of pipe.
- O. Do not lay pipe in wet or frozen trench.
- P. Prevent foreign material from entering pipe during placement.
- Q. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- R. Close pipe openings with watertight plugs during work stoppages.
- S. Install access fittings to permit disinfection of water system.
- T. Establish elevations of buried piping with minimum cover as specified in Section 31 23 17 TRENCHING. Measure depth of cover from final surface grade to top of pipe barrel.

3.5 INSTALLATION - VALVES

A. Install valves as specified elsewhere.

3.6 INSTALLATION - TAPPING SLEEVES AND VALVES

- A. Prior to ordering any tapping equipment, the piping size and geometry shall be measured and measurements submitted along with shop drawings.
- B. Install tapping sleeves and valves in accordance with Drawings and in accordance with manufacturer's instructions.
- C. The Contractor shall provide a schedule as to the start date and time, location and duration for each wet tap.
- D. The Engineer shall be notified at least 48 hours prior to the Contractor making a wet tap.
- E. The Engineer shall be present for each wet tap. The Contractor cannot proceed without the Engineer present.
- F. The Contractor shall inventory, in the presence of the Engineer, all materials required for the wet tap prior to commencing installation.
- G. The Contractor shall excavate around the existing water line and clean and prepare the pipe for wet tapping.
- H. Prior to installing the tapping sleeve, the Engineer shall inspect and approve this work up to this point.

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- I. After the tapping sleeve and valve are installed, the Contractor shall make a pressure test on the complete assembly.
 - 1. All pressure tests made by the Contractor shall be logged in a pressure test form suitable to the Engineer.
- J. After wet tap is complete, the Contractor shall turn the complete and entire coupon over to the Owner.
 - 1. If the Contractor does not turn the complete and entire coupon over to the Owner, the Contractor does not get paid for the wet tap and is responsible for all costs to retrieve the coupon from the existing water lines.
 - 2. The wet tap pit shall be properly backfilled in the same day the tap was made.
- K. If during a wet tap of a PVC line, the existing PVC water line splits or fails, the Contractor shall repair the PVC water line with two (2) ductile iron solid sleeves with transition gaskets (if required) and install a suitable length of ductile iron pipe between the two sleeves.
 - 1. The Owner or Engineer shall determine the suitable length of ductile iron pipe.
 - 2. The Contractor shall be responsible for all costs for these repairs.

3.7 POLYETHYLENE ENCASEMENT

- A. Encase piping in polyethylene where indicated on Drawings to prevent contact with surrounding backfill material.
- B. Install in accordance with AWWA C105.
- C. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

3.8 THRUST RESTRAINT

- A. Provide valves, tees, bends, caps, and plugs with concrete thrust blocks.
- B. Pour concrete thrust blocks against undisturbed earth.
- C. Locate thrust blocks at each elbow or change of pipe direction to resist resultant force.
- D. Install thrust blocks, tie rods, and joint restraint as detailed on the Drawings.

3.9 BACKFILLING

- A. Backfill around sides and to top of pipe as specified elsewhere.
- B. Maintain optimum moisture content of bedding material to attain required compaction density.

3.10 DISINFECTION OF POTABLE WATER PIPING SYSTEM

A. Flush and disinfect system as specified elsewhere.

3.11 TESTING WATER LINES (PRESSURE TESTS)

- A. Pressure test system in accordance with AWWA C600 and the following:
 - 1. Test Pressure: Shall be 150 psi as measured at the lowest point in the pipeline.

PUBLIC WATER UTILITY DISTRIBUTION PIPING

- 2. The Contractor shall provide a chart recorder to insure the pipe line segment being tested has the test pressure applied for at least 24 continuous hours.
 - a. The Contractor shall maintain a test pressure for at least 24 hours on the pipe line to test the thrust blocking.
 - b. The concrete thrust blocking shall have had time to fully set prior to testing the water line.
 - c. After the Owner has determined the pipeline has been fully tested for blocking, the hydrostatic or leakage test shall commence immediately afterwards.
- 3. Conduct hydrostatic test for at least two-hour duration.
 - a. If in the opinion of the Engineer, additional testing is required, such additional testing shall be performed for at least two (2) additional hours.
- 4. Fill section to be tested with water slowly, expel ALL air from piping at high points.
 - a. Install corporation cocks at high points.
 - b. Close air vents and corporation cocks after air is expelled.
 - c. Raise pressure to specified test pressure.
- 5. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure.
 - a. Differential pressure at valves and hydrants shall equal the maximum possible, but shall not exceed manufacturer's pressure rating.
- 6. Observe joints, fittings and valves under test.
 - a. Remove and replace cracked pipe, joints, fittings, and valves showing visible leakage.
 - b. Then, restart the test after leaking components have been replaced.
- 7. Correct visible deficiencies and continue testing at same test pressure for additional 2 hours to determine leakage rate.
 - a. Maintain pressure within plus or minus 5.0 psig of test pressure.
- 8. Provide an accurate pressure gage with graduation not greater than 5 psi to be used during pipe testing.
- 9. Leakage shall be defined as the quantity of water that must be pumped into the test section: equal to the sum of the water to maintain pressure within 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test.
 - a. Leakage shall be the total cumulative amount measured on a water meter.
- 10. No test section shall be accepted if the leakage exceeds the limits determined under Section 4 of AWWA C600
- 11. Compute maximum allowable leakage by the following formula:
 - a. For Ductile Iron Pipe:

| L = | (SD∀ | P)/14 | 48,000 |
|-----|------|-------|--------|
|-----|------|-------|--------|

L = testing allowance, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of pipe, in inches

P = average test pressure during hydrostatic test, in psig

When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

b. For PVC Pipe:

 $Q = (LD \sqrt{P})/148,000$

Q = quantity of makeup water, in gallons per hour

L = length of pipe section being tested, in feet

D = nominal diameter of pipe, in inches

P = average test pressure during hydrostatic test, in psig

When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

- 12. When test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections and perform a complete retest (including a blocking test) until leakage is within allowable limits.
 - a. Correct visible leaks regardless of quantity of leakage.
 - b. Repairs and retest shall be completed at no additional cost to the Owner.

END OF SECTION

WATER DISTRIBUTION VALVES

SECTION 33 12 16

WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Valves.
 - 2. Valve boxes.
- B. Related Sections:
 - 1. Section 03 30 00 Cast-In-Place Concrete.
 - 2. Section 31 23 17 Trenching.
 - 3. Section 33 11 13 Public Water Utility Distribution Piping.
 - 4. Section 33 12 19 Water Utility Distribution Fire Hydrants.
 - 5. Section 33 13 00 Disinfecting of Water Utility Distribution.

1.2 MEASUREMENT AND PAYMENT

- A. Basis of Payment: See Bid Form.
 - 1. Payment for all work under this section shall be included in the lump sum bid.

1.3 REFERENCES

- A. American Water Works Association:
 - 1. AWWA C500 Metal-Seated Gate Valves for Water Supply Service.
 - 2. AWWA C509 Resilient-Seated Gate Valves for Water-Supply Service.
 - 3. AWWA C550 Protecting Epoxy Interior Coating for Valves and Hydrants.
 - 4. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.
- B. National Sanitation Foundation:
 - 1. NSF 61 Drinking Water System Components Health Effects

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawing:
 - 1. Installation Plan: Submit description of proposed installation.
- C. Design Data: Submit manufacturer's latest published literature including illustrations, installation instructions, maintenance instructions and parts lists.
- D. Manufacturer's Certificates: Submit Statement of Compliance, supporting data, from material suppliers attesting that valves and accessories provided meet or exceed AWWA Standards and specification requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of valves.
- C. Provide Operation and Maintenance Data for valves.

1.6 QUALITY ASSURANCE

- A. The following information shall be cast in or stamped on each gate valve.
 - 1. Manufacturer's identifying mark.
 - 2. Pressure rating.
 - 3. Place of manufacturing.
- B. Manufacturer to provide certification stating that valve is manufactured per applicable AWWA standard for each valve type and size.

1.7 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum 5 years experience.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Prepare valves and accessories for shipment according to AWWA Standards and seal valve and ends to prevent entry of foreign matter into product body.
- C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.10 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

1.11 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

PART 2 PRODUCTS

2.1 RESILIENT WEDGE GATE VALVES

- A. All gate valves shall be resilient seated.
 - Resilient seated gate valves size 2-inch through 20 inch shall comply with AWWA C 509 as amended to date, and 24 inch valves shall conform to AWWA C-509 as amended to date and shall be equipped with O-ring packing.
- B. Gate valves shall be used for buried service in sizes 2-inch through 12-inch except as noted on the Drawings.

C. General Construction:

- 1. Resilient seated gate valves shall embody the best class of workmanship and finish, and shall open and close freely and easily.
- 2. With the valve open, an unobstructed waterway shall be afforded, the diameter, which shall not be less than the full nominal diameter of the valve.
- 3. If guides or guide lugs are used, the design shall be such that corrosion in the guide area does not affect sealing.
- 4. Resilient seats may be applied to the body or gate and shall seat against a corrosion resistant surface.
 - a. The surface may be either metallic or non-metallic.
- 5. Resilient seats shall be bonded or mechanically attached to either the gate or valve body.
- 6. The mating surface of the resilient seat shall be machined to a smooth even finish.
- 7. All stems shall be forged bronze stems.
- 8. All exposed fasteners, nuts and bolts shall be stainless steel.
- 9. Two inch valves shall be female by female threads.

D. Working Pressure:

1. Water working pressure for valves shall be minimum 200 psi.

E. Test Pressure

1. Test pressure for valves shall be a minimum of 200 psi.

F. Operation:

- 1. All valves shall open left (counterclockwise).
- 2. Valves shall be operated by nut.
 - a. Operating nuts shall conform to the present standard of the Owner, and shall have an arrow cast on them, indicating the direction for opening the valve.
- 3. Extend operating nut to within 6" of the valve box lid using an extension stem.
 - a. Extension stem shall be of carbon steel.
 - b. Extension stem shall be pinned to valve to prevent unauthorized removal of stem.

G. Marking:

1. Each valve shall be plainly marked with the manufacturer's name or particular mark, the year of manufacture, the size of the valve, and designation indicating working pressure, all cast on the bonnet or body.

H. Jointing:

- 1. All gate valves shall be furnished with mechanical joints or flanges and necessary bolts, glands and gaskets unless otherwise shown on the Drawings or specified.
- 2. Gate valves used in conjunction with tapping sleeves shall be flanged at the end connecting to the tapping sleeve.
 - a. End connection to accept pipe shall be mechanical joint
- I. Coating: AWWA C550; interior/exterior.
- J. Manufacturers:
 - 1. American Darling.
 - 2. U.S. Pipe Company.
 - 3. Mueller Company (2-inch valves shall be CAT A-2360-8).
 - 4. Clow (2-inch valves shall be Type 2640)
 - 5. M&H Valve Company (2-inch valves shall be Type 4067-07).
 - 6. Substitutions: Section 01 60 00 Product Requirements.

2.2 VALVE BOXES

- A. Valve boxes shall be of the two-piece type and manufactured of cast iron.
- B. Valve boxes shall have an internal diameter of 5.25 inches.
- C. Cast iron lid marked "Water".
- D. Manufacturers:
 - 1. Bingham-Taylor.
 - 2. Substitutions: Section 01 60 00 Product Requirements.

2.3 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type specified in Section 03 30 00.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Determine exact location and size of valves from Drawings; obtain clarification and directions from Engineer prior to execution of work.
- C. Verify invert elevations of existing work prior to excavation and installation of valves.

3.2 PREPARATION

A. Identify required lines, levels, contours and datum locations.

- B. Locate, identify, and protect utilities to remain from damage.
- C. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
 - 1. Notify Owner and Engineer not less than two (2) days in advance of proposed utility interruption.
 - 2. Do not proceed without written permission from the Owner.
- D. Perform trench excavation, backfilling and compaction in accordance with Section 31 23 17.

3.3 INSTALLATION

- A. Install valves plumb with valve stems in the vertical direction.
- B. Provide buried valves with valve boxes installed flush with finished grade as shown on the Drawings.
- C. Install concrete pad around valve box.

3.4 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform pressure test on domestic site water distribution system in accordance with AWWA C600.

END OF SECTION

DISINFECTING OF WATER SYSTEMS

SECTION 33 13 00

DISINFECTING OF WATER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes disinfection of potable water system, testing, and reporting results.
- B. The water supply line and the hot and cold water lines detailed on the Construction Drawings and as specified herein shall be cleaned, a pressure and leakage test performed and sterilized.
- C. The control lines detailed on the Construction Drawings and as specified herein shall be cleaned and a pressure and leakage test performed.
- D. Lines that are not subject to cleaning, testing and sterilization, as covered in other sections of these Specifications, shall comply with the requirements herein.

E. Related Sections:

1. Section 33 11 13 – Public Water Utility Distribution Piping.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Disinfection:

- 1. Basis of Measurement: Payment for disinfecting shall be included in the pipe costs.
- 2. No additional payment will be made for this work. The contractor is responsible for all work in this section including preparing, disinfecting, testing, and reporting.

1.3 REFERENCES

- A. American Water Works Association:
 - 1. AWWA B300 Hypochlorites.
 - 2. AWWA B301 Liquid Chlorine.
 - 3. AWWA B302 Ammonium Sulfate.
 - 4. AWWA B303 Sodium Chlorite.
 - 5. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - 6. AWWA C651 Disinfecting Water Mains.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit procedures, proposed chemicals, and treatment levels for review.
- C. Test Reports: Indicate results comparative to specified requirements.
- D. Certificate: Certify cleanliness of water system meets or exceeds specified requirements.

- E. Prior to testing and cleaning the Contractor shall furnish a written procedure outlining his flushing, pressure testing and sterilization procedure.
- F. Prior to final acceptance by the Owner, the Contractor shall submit a written report detailing the results of the pressure testing and sterilization procedure.
- G. Copies of the Contractor's Procedure and Results shall be submitted as required by Section 01 33 00 of these Specifications

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Disinfection Report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Name of person collecting samples.
 - 5. Initial and 24 hour disinfectant residuals in treated water in ppm for each outlet tested.
 - 6. Date and time of flushing start and completion.
 - 7. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological Report:

- 1. Date issued, project name, and testing laboratory name, address, and telephone number.
- 2. Time and date of water sample collection.
- 3. Name of person collecting samples.
- 4. Test locations.
- 5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
- 6. Coliform bacteria test results for each outlet tested.
- 7. Certify water conforms, or fails to conform, to bacterial standards of the City of Woodstock, Georgia.
- D. Water Quality Certificate: Certify water conforms to quality standards of Owner and Georgia EPD and is suitable for human consumption.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C651.
- B. The Contractor shall furnish all equipment, materials, and labor of every nature to disinfect new lines and any line contaminated during construction.

1.7 OWNER REQUIREMENTS

- A. All newly installed water piping and piping affected during construction shall be disinfected in accordance with AWWA C651.
- B. All disinfection procedures shall be coordinated with the Owner and Engineer.

- C. A State approved laboratory shall analyze the samples.
- D. The results shall include both coliform and non-coliform growth.
- E. The Owner shall operate ALL valves during disinfection procedures.
- F. The Owner and Engineer shall be informed of all disinfecting the following in-place piping;
 - 1. Water mains.
 - 2. Building service connections up to and including water meters and back flow prevention devices.
- G. The Contractor shall supply an appropriate chlorine solution and complete disinfection procedures.
- H. Water for disinfection shall be provided by the Owner at no expense to the Contractor. Excessive use of water during disinfection procedures, as determined by the Owner, may be reason for charges to be levied against the Contractor.
- I. The Contractor shall be responsible for hiring an independent testing laboratory firm to collect and test the water samples. The Contractor shall submit the name and qualifications of the proposed firm for approval by the Owner and Engineer.
- J. No water piping system shall be placed in service until written approval is received from the Owner and Engineer.
- K. The Contractor shall be responsible for preventing soil erosion associated with disinfecting procedures.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. The contractor shall supply an appropriate chlorine solution and complete disinfection procedures.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify piping system has been cleaned, inspected, and pressure tested.
- C. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

D. All potable water lines and appurtenances shall be sterilized after testing and flushing of the lines has been completed. Newly constructed and existing lines that have been exposed to contamination by reason of this construction shall be sterilized.

3.2 INITIAL FLUSHING

- A. Prior to disinfection, the Contractor shall flush piping system with sufficient water to create a minimum velocity in the pipe of 2.5 ft/s.
- B. Flushing shall be performed by pushing water through a laid section of pipe with one end of section open to the atmosphere above existing grade.
- C. Piping shall be flushed until water sampled from the piping yields a turbidity measurement of 0.5 NTUs or less.
- D. All piping and components associated with service connections shall be thoroughly flushed with fresh potable water prior to installation.
- E. Upon completion of flushing, laid pipe with one end open to atmosphere shall be re-laid to depth indicated in Construction Drawings.
- F. Flushing shall be accomplished such that there is no soil erosion due to flushing activities. The contractor shall be responsible for providing the means and methods to properly and adequately flush the pipes without eroding soil.
- G. Lines that cannot be cleaned shall be removed and replaced

3.3 CHLORINATION AND FLUSHING

- A. Lines shall be filled with water to completely exhaust all air, and a pressure and leakage test made.
- B. The Contractor shall furnish a test pump, and means for accurate measurement of water introduced into a line during testing, and shall furnish and install corporation stops in the lines as required for blowing lines free from air and at the test pump location.
- C. Corporation stops will not be allowed in copper water lines or PVC chlorine lines.
- D. The Contractor shall furnish, install and remove all temporary bulkheads, flanges or plugs, to permit the required pressure and leakage test, and shall furnish all equipment and labor to properly carry out such tests and to replace defective material.
- E. The test pressure shall be 150 pounds per square inch or as otherwise noted. Lines not rated for 150 psi shall have the test pressure reduced as required so as not to damage the line.
- F. The minimum time for the leakage test shall be two (2) hours. However, if in the opinion of the Engineer, additional testing is required, such additional testing shall be performed.

- G. The Contractor shall fill the line with water to the required pressure. After 2 hours the pressure in the line shall be checked and the line inspected for leaks. Lines that do not hold pressure or exhibit signs of leaks shall be repaired and re-tested.
- H. Any cracked or broken line shall be removed and replaced with sound pieces. Joints that leak shall be carefully remade. Remade joints and replaced materials shall be re-tested under the same conditions. This procedure shall be repeated until the line passes the required test.
- I. The contractor shall introduce a chlorine solution having a concentration of 50 to 100 milligrams per liter (mg/l) into the water lines.
- J. Allow the pipe to stand for a period of 24 hours
- K. Upon introducing the chlorine solution, all valves associated with the water main shall be fully operated to ensure complete disinfection.
- L. All piping and components associated with service connections shall be thoroughly flushed with a 200 mg/l chlorine solution.
- M. Water main shall have minimum 25 mg/l chlorine residual after a 24-hour retention period.
- N. During the test, chlorine residuals shall be checked every 1200 feet on new lines, at the end of each new line, and at the end of all new service lines or connections
- O. The discharge of the chlorinated water shall be chemically treated to remove the residual chlorine to requirements suitable for discharge (See appendix of ANSI/AWWA C 651-05 for chemicals and amounts to dissipate the chlorine).
 - 1. After the 24-hour retention period, flush heavy chlorinated water from system through fire hydrants. The Contractor shall provide a dechlorinating agent such as sodium thiosulfate to neutralize the chlorine residual. Contractor shall apply all dechlorinating agents such as sodium thiosulfate in accordance with manufacturer's recommendations.
 - 2. The Contractor shall be responsible for providing the means and methods to dechlorinate the highly chlorinated water from the pipes.
- P. Flushing shall continue until water in main has a residual chlorine concentration of 1 mg/l.

3.4 DISINFECTION TESTING

- A. After chlorination and flushing is complete, the independent lab shall collect water samples from the system and perform 24-hour analyses in accordance with the Georgia Rules for Safe Drinking Water.
- B. Lines that do not show effective sterilization, as determined from bacteriological examination, shall be re-sterilized before being placed into service.
- C. After the initial 24-hour analysis is complete and acceptable, a volume of water shall be flushed from the water system and water samples shall be collected for a second 24-hour analysis.

- D. At least one set of samples shall be collected from each 1200 foot section of new line, plus one set at the end of each line and the number of samples taken must be representative of the water in the newly constructed water lines.
- E. All samples shall be tested for bacteriological quality in accordance with *Standard Methods for the Examination of Water and Waste Water* (Latest edition), and shall show the absence of total coliform organisms.
 - 1. The chlorine residual must also be measured and reported.
 - 2. If the membrane filter method of analysis is used for the coliform analysis, non-coliform growth must also be reported.
 - a. If the non-coliform growth is greater than eighty (80) colonies per one hundred (100) milliliters, the sample result is invalid and must be repeated.
- F. If the bacteriological tests do not pass, the procedure shall be repeated until they are successful
- G. After the second 24-hour analysis is complete and acceptable, the water main may be put into service.
- H. Disinfection of the water main shall be repeated until testing is acceptable.
- I. Laboratory analyses shall be performed and certified. All lab analysis shall be submitted to the Owner and Engineer.

3.5 CONNECTIONS

- A. After the pipe and appurtenances have been flushed, tested, chlorinated, have passed the bacteriological test and have been approved to be placed in service, they may be connected to the existing system.
 - 1. Connections Equal to or Less than One Pipe Length (18 feet): The new pipe, fittings, and valves required for the connections shall be spray disinfected or swabbed with a minimum 1 % solution of chlorine just prior to being installed, if the length of connection from the new main to the existing main is equal to or less than 18 feet.
 - 2. Connections Greater Than One Pipe Length: The pipe required for the connection must be set up above ground, chlorinated and bacteriological samples taken as described above if the length of the connection is greater than 18 feet. After the bacteriological tests have proven satisfactory, the new pipe can be used in connecting the new main to the existing system. After the samples have been taken, the ends of the new pipe must be closed with water-tight plugs or caps until the connections are made.

3.6 FIELD QUALITY CONTROL

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting and testing.
- B. Disinfection, Flushing, and Sampling:
 - 1. Disinfect pipeline installation in accordance with AWWA C651.
 - 2. All disinfection procedures shall be coordinated with the Owner.
 - 3. Cross connections shall not be allowed during testing, flushing, chlorinating, or dechlorinating of the new lines.

END OF SECTION

SECTION 33 31 00

SANITARY SEWERAGE PIPING

PART 1 GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment, and incidentals required, and install centrifugal cast ductile iron pipe or polyvinyl chloride pipe and appurtenances as shown on the drawings and as specified herein.
- B. Section 1 Gravity Sewer Pipe and Accessories This Section describes products to be incorporated into sewers and accessories, and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.
- C. <u>Section 2 Sewer Service Connections</u> The work covered by this Section shall consist of furnishing and installing service connections in the sewers, of the size and type shown on the Drawings and specified herein.

1.2 SUMMARY

- A. This section includes centrifugal cast ductile iron and polyvinyl chloride pipe and appurtenances for gravity sewer construction.
- B. Related Sections:
 - 1. Section 31 23 16 Trench Excavation and Fill
 - 2. Section 33 05 61 Manholes and Structures.

SECTION 1 GRAVITY SEWER PIPE AND ACCESSORIES

PART 1 GENERAL

1.1 SCOPE

A. Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), or other recognized standards. Latest revisions of all standards are applicable.

1.2 QUALIFICATIONS

A. If requested by the Owner, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.

1.3 REFERENCES

A. ASTM International:

- 1. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus.
- 2. ASTM G95 Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings.
- 3. ASTM D714 Standard Test Method for Evaluating Degree of Blistering of Paints.
- 4. ASTM G22 Standard Practice for Determining Resistance of Plastics to Bacteria.
- 5. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

B. American Water Works Association:

- 1. AWWA C104 American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- AWWA C105 American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- 3. AWWA C110 American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
- 4. AWWA C111 American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- 5. AWWA C150 ANSI Standard for the Thickness Design of Ductile Iron Pipe.
- 6. AWWA C151 American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- 7. AWWA C153 American National Standard for Ductile-Iron Compact Fittings for Water Service.
- C. American National Standards Institute (ANSI).
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product data submittals to include the following, as a minimum:
 - 1. Details of the proposed pipe installation.
 - 2. Properties and strengths of the pipes.
 - 3. Details of the joints.
 - 4. Instructions on storage, handling, transporting and installation.
 - 5. Material certifications.
 - 6. Pipe and joint samples.
 - 7. Details of pipe/manhole connections.
- C. Shop drawings showing the complete laying plan of ALL pipes and manhole structures, including all fittings, adaptors, valves, and specials along with the manufacturer's drawings and specifications indicating complete details of all items. The pipe details shall include a pipe class and pipe bedding laying schedule which specifies pipe class, bedding type, class coding, joints, station limits, and transition stations; and a list of abbreviated terms with their full meaning. Trench type and pipe class shall not change between manholes. Provide details of fittings to be furnished, if any. The above shall be submitted to the Engineer for approval

before fabrication and shipment of these items. The locations of all pipes shall conform to the locations indicated on the drawings.

D. Furnish in duplicate to the Engineer, prior to each shipment of pipe, sworn certificates that all tests and inspections specified herein under which the pipe is manufactured have been satisfied.

1.5 TRANSPORTATION AND HANDLING

- A. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification.
- B. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front loader. Do not use material damaged in handling.

1.6 STORAGE AND PROTECTION

- A. Section 01 66 00 Product Storage and Handling Requirements: Product storage and handling requirements.
- B. Store all pipes which cannot be distributed along the route. Make arrangements for the use of suitable storage areas.
- C. Stored materials shall be kept safe from damage. The interior of all pipes, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times. Valves shall be drained and stored in a manner that will protect them from damage by freezing.
- D. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least two rows of timbers shall be placed between tiers and chocks, affixed to each other in order to prevent movement. The timbers shall be large enough to prevent contact between the pipes in adjacent tiers.
- E. Store joint gaskets in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first in, first out basis.
- F. Any pipe or fitting showing a crack, or which has received a blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed from the work.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record location of pipe runs, connections, manholes, services and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

- A. Product manufacturers shall provide the Owner with written certification that all products furnished comply with all applicable provisions of these Specifications.
- B. If ordered by the Owner, each pipe manufacturer shall furnish the services of a competent factory representative to supervise and/or inspect the installation of pipe. This service will be furnished for a minimum of five days during initial pipe installation.
- C. Inspections of the pipe will be made by the Engineer or other representative of the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipe may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE

- A. Manufacturers:
 - 1. American Cast Iron Pipe
 - 2. U.S. Pipe

B. Pipes:

- 1. Ductile iron pipe shall be manufactured in the United States.
- Pipe shall be centrifugal cast and shall conform to ANSI Specification A21.51 (AWWA C151) as amended to date, with mechanical or push on joints, furnished in normal laying lengths of 18 or 20 feet, and shall be Pressure Class 350 unless otherwise specified or shown on the drawings.
- 3. Ductile iron pipe shall have the following information cast or stamped on each pipe: weight, class or nominal thickness; casting period; manufacturer's identifying mark; year the pipe was manufactured; and the letters DI or DUCTILE.
- 4. Pressure Class shall be determined by trench depth, type of bedding, and trench width in accordance with the following table for pipe with flexible linings:

Rated Working Pressure and Maximum Depth of Cover for D.I. Pipe with Flexible Linings

| Dino | Drocouro | | e Lillings | | | | |
|--------------|-------------------|------------------|---------------|-------------------|---------------|-------------------|-------------------|
| Pipe Size | Pressure Class | Nominal | Type 1 | Type 2 | Type 2 | Type 4 | Type 5 |
| | | Thickness | Type 1 | Type 2 | Type 3 | Type 4 | Type 5 |
| ln. | psi | ln. | Trench Not | Trench Acceptable | Trench Not | Trench Acceptable | Trench Acceptable |
| | | | acceptable | Acceptable | Acceptable | Acceptable | Acceptable |
| | | | | Maximum | n Depth of C | over (ft.) | |
| 8 | 350 | 0.25 | | 20 | • | 34 | 50 |
| 10 | 350 | 0.26 | | 15 | | 28 | 45 |
| 12 | 350 | 0.28 | | 15 | | 28 | 44 |
| 14 | 250 | 0.28 | | 11* | | 23 | 41 |
| | 300 | 0.30 | | 13 | | 26 | 43 |
| | 350 | 0.31 | | 14 | | 27 | 44 |
| 16 | 250 | 0.30 | | 11* | | 24 | 41 |
| | 300 | 0.32 | | 13 | | 26 | 43 |
| | 350 | 0.34 | | 15 | | 28 | 45 |
| 18 | 250 | 0.31 | | 10* | | 23 | 40 |
| | 300 | 0.34 | | 13 | | 26 | 43 |
| | 350 | 0.36 | | 15 | | 28 | 45 |
| 20 | 250 | 0.33 | | 10 | | 23 | 40 |
| | 300 | 0.36 | | 13 | | 26 | 43 |
| | 350 | 0.38 | | 15 | | 28 | 44 |
| 24 | 200 | 0.33 | | 8* | | 20 | 37 |
| | 250 | 0.37 | | 11 | | 23 | 41 |
| | 300 | 0.40 | | 13 | | 26 | 43 |
| | 350 | 0.43 | | 15 | | 28 | 45 |
| 30 | 150 | 0.34 | | | | 17 | 33 |
| | 200 | 0.38 | | 8* | | 20 | 37 |
| | 250 | 0.42 | | 11 | | 23 | 40 |
| | 300 | 0.45 | | 12 | | 25 | 42 |
| 00 | 350 | 0.49 | | 15 | | 28 | 44 |
| 36 | 150 | 0.38 | | <u> </u> | | 17 | 33 |
| | 200 | 0.42 | | 8* | | 20 | 37 |
| | 250 | 0.47 | | 10 | | 23 | 40 |
| | 300 | 0.51 | | 12 15 | | 25 | 42 45 |
| 40 | 350 150 | 0.56 0.41 | | 15 | | 28 16 | 45 |
| 42 | 200 | 0.41 | | 8 | | 20 | 32 37 |
| | 250 | 0.52 | | 10 | | 23 | 40 |
| | 300 | 0.52 | | 12 | | 25 25 | 42 |
| | 350 | 0.63 | | 15 | | 28 | 42 45 |
| 48 | 150 | 0.46 | | — | | 17 | 33 |
| 70 | 200 | 0.52 | | 8 | | 20 | 37 |
| | 250 | 0.58 | | 10 | | 23 | 40 |
| | 300 | 0.64 | | 12 | | 25 | 42 |
| | 350 | 0.70 | | 15 | | 28 | 44 |
| 54 | 150 | 0.51 | | | | 17 | 33 |
| J 1 | 200 | 0.58 | | 8 | | 20 | 37 |
| | 250 | 0.65 | | 10 | | 23 | 40 |
| | 300 | 0.72 | | 13 | | 25 | 43 |
| | 350 | 0.79 | | 15 | | 28 | 45 |
| Minimum | | enth of cover is | s 3 feet | | | | |

^{*} Minimum allowable depth of cover is 3 feet

- C. Lining: Ductile iron pipe and fittings shall be lined as specified below:
 - 1. Linings shall cover all exposed surfaces of pipe and fittings subject to contact with sewer liquid or gas. The lining of the pipe barrel shall extend from spigot end through the socket to the edge of the gasket sealing area or recess for pipe using push on gaskets, and to the edge of the gasket seat for mechanical joints. The lining shall also cover the exterior of the spigot end from the end of the pipe to beyond the gasket sealing area. The lining in fittings shall cover the interior surfaces including the socket areas as defined above. All linings shall be hermetically sealed at the ends.
 - 2. Lining Materials:
 - a. Epoxy: The lining material shall be Protecto 401 Ceramic Epoxy, a two component, modified epoxy formulated for corrosion control with the following requirements:
 - 1) A permeability rating of 0.0 perms when measured by ASTM E 96, Procedure A. Duration of the test shall be six weeks.
 - 2) A direct impact resistance of 125 inch-pounds with no cracking when measured by ASTM D 2794.
 - 3) The ability to build at least 50 mils dry one coat.
 - 4) The material shall be recoatable with itself for at least seven days with no additional surface preparation when exposed to direct summer sun and a temperature of 90 degrees F.
 - 5) The material shall contain at least 20 percent by volume of ceramic quartz pigment.
 - 6) A test and service history demonstrating the ability of the material to withstand the service expected.
 - 7) Possess a minimum solids volume content of 88 percent, + one percent.
 - 8) Possess a maximum drying time to allow recoating as follows: 50 degrees F 72 hours; 75 degrees F 18 hours; 90 degrees F 8 hours. If recoating cannot be accomplished within 7 days, a light brush blast shall be performed to improve intercoat adhesion.
 - 3. All surfaces to be lined with polyethylene shall be blast cleaned equal to the requirements of SSPC SP6. All surfaces to be lined with epoxy shall be blasted and cleaned to remove all loose laitance, scale, or other loose material. No lining shall take place over grease, oil, etc., that would be detrimental to the adhesion of the compound to the substrate.
 - 4. Application
 - a. Lining of pipe barrel and fittings shall be 40 mils nominal thickness; minimum lining thickness shall be 30 mils. Lining thickness for exterior of spigot and interior of socket shall be 8 to 10 mils.
 - b. The lining shall be applied using a centrifugal lance applicator by applicators certified by the lining manufacturer. The workers shall be experienced and competent in the surface preparation, application and inspection of the lining to be applied. The compound shall not be applied when the substrate temperature is below 40 degrees F or in adverse atmospheric conditions, which will cause detrimental blistering, pinholing or porosity of the film.
 - 5. All pipe and fitting linings shall be tested for pinholes in accordance with ASTM G 62, Method B and shall be holiday free.
 - 6. All pipe linings shall be checked for thickness using a magnetic film thickness gauge.
 - 7. Each pipe joint and fitting shall be marked with the date of application of the lining system and with the numerical sequence of application of that date.

D. Exterior Coating:

- 1. Buried pipe and fittings shall be bituminous coated outside, in accordance with the applicable provisions of ANSI Specification A 21.4 (AWWA C 104) and ANSI A 21.51 (AWWA C 151), as amended to date.
- 2. Ductile iron pipe and fittings placed above the ground shall be factory primed and field coated as required in these specifications or as outlined on the drawings.
- E. Ductile iron pipe that crosses or runs parallel to a gas transmission main at the locations shown on the drawings, which may be catholically protected, shall be encased in polyethylene encasement, eight (8) mil minimum thickness, and taped in accordance with AWWA C105 and ANSI A21.5.
- F. Fittings shall be ductile iron and shall conform to AWWA C110 or AWWA C153 with a minimum rated working pressure of 250 psi.
- G. Joints: Unless shown or specified otherwise, joints shall be push on joint type for pipe and standard mechanical type for fittings. Joints shall conform to AWWA C111.
- H. Provide the appropriate gaskets for joints. Gaskets for mechanical and push-on joints shall conform to ANSI A 21.11 (AWWA C 111). Gaskets for flange joints shall be made of 1/8-inch-thick, cloth reinforced rubber; gaskets may be ring type or full-face type.
- I. Provide the necessary bolts for mechanical and flange connections. Bolts for flange connections shall be steel with American Regular unfinished square or hexagon heads. Nuts shall be steel with American Standard Regular hexagonal dimensions, all as specified in ANSI B17.2. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A and 2B fit. Mechanical joint glands shall be ductile iron.
- J. Detection Tape: Provide detection tape over all DIP sewers.

K. Certifications:

- 1. The manufacturer of iron pipe and fittings shall furnish both the Engineer and the Owner with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable ANSI Specifications for each.
- 2. Testing of ductile iron pipe shall include hydrostatic, tensile and impact tests as specified in ANSI/AWWA C151/A21.51.
- 3. Testing shall include physical testing of ductile iron fittings as specified in ANSI/AWWA C110/A21.10.
- 4. Foundry records shall be provided to the Engineer for review of all acceptance testing as required by AWWA standards.
- 5. Written transcripts of test results shall be furnished to the Engineer in duplicate prior to each shipment of pipe and fittings.
- L. Acceptance: Acceptance will be on the basis of the Owner's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

A. Acceptability of PVC pipe for gravity sewers is indicated in the following table:

| SDR | ASTM | Cell Classification | Wall | Manufacturers | 6" to 15" | 18" and larger | Bedding Class Depth 0-20 |
|-----|-------|---------------------|------|---|--------------|-------------------|-----------------------------|
| 26 | D3034 | 12454B | SW | Certainteed, J-M Eagle, and Diamond Plastic | Yes | No | В |
| 26 | F679 | 12594B | SW | Certainteed, J-M Eagle, and Diamond Plastic | No | YES | В |

B. PVC gravity sewer pipe shall be supplied in lengths not longer than 14 feet.

C. Fittings

- 1. Fittings 15 inches in diameter and less shall be manufactured in accordance with ASTM D 3034. PVC compound shall be 12454B or 12454C as specified in ASTM D 1784.
 - a. For sizes 8-inches and less in diameter, fittings shall be molded in one piece with solvent welded joints. Minimum socket depths shall be as specified in ASTM D 3034, Table 2.
 - b. For sizes 10-inches to 15-inches in diameter, fittings shall be fabricated from pipe conforming to ASTM D 3034 using solvent welding. No field fabrication of fittings will be allowed. All such fabrication shall be performed at the factory and the fittings shall be delivered ready for use.
- 2. Fittings 18 inches in diameter and larger shall be fabricated from pipe conforming to ASTM F 679 using solvent welding. No field fabrication of fittings will be allowed. All such fabrication shall be performed at the factory and the fittings shall be delivered ready for use.
- D. Joints: Joints for pipe and fittings shall be of the integral bell and spigot type with a confined elastomeric gasket having the capability of absorbing expansion and contraction without leakage, when tested in accordance with ASTM D 3212. Gaskets shall meet the requirements of ASTM F 477. The joint system shall be subject to the approval of the Owner and shall be identical for pipe and fittings.
- E. Manhole Connections: The sewer shall be connected to manholes utilizing a standard pipe section.
- F. Detection Tape: Provide detection tape over all PVC sewers.

Acceptance: Acceptance will be on the basis of the Owner's inspection and the manufacturer's written certification that the pipe and fittings were manufactured and tested in accordance with the applicable standards.

2.3 CONCRETE

A. Concrete shall have a compressive strength of not less than 4000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. For job mixed concrete, submit the concrete mix design for approval by the Owner. Ready mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

2.4 MISCELLANEOUS ACCESSORIES

A. Detection Tape: Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket. Tapes shall be color coded in accordance with APWA color codes with the following legends: Sanitary Sewerage Systems, Safety Green, "Caution: Sewer Line Buried Below". Colors may be solid or striped. Tape shall be permanently printed with no surface printing allowed. Tape width shall be minimum 2-inches when buried less than 10-inches below the surface. Tape width shall be minimum 3-inches when buried greater than 10-inches and less than 20-inches. Detection tape shall be equal to Lineguard Type III Detectable or Allen Systems Detectatape.

PART 3 EXECUTION

3.1 EXISTING UTILITIES AND OBSTRUCTIONS

- A. The Drawings indicate utilities or obstructions that are known to exist according to the best information available to the Owner. The Contractor shall call the Utilities Protection Center (UPC) (325 5000 or 1 800 282 7411) as required by Georgia law (Code Section 25 9 1 through 25 9 13) and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site, at least 72 hours (three business days) prior to construction, to verify the location of the existing utilities.
- B. Existing Utility Location: The following steps shall be exercised to avoid interruption of existing utility service.
 - 1. Provide the required notice to the utility owners and allow them to locate their facilities according to Georgia law. Field utility locations are valid for only ten days after original notice. The Contractor shall ensure, at the time of any excavation, a valid utility location exists at the point of excavation.
 - 2. Expose the facility to verify its true location and grade for a distance of at least 200 feet in advance of pipeline construction. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.
 - 3. Avoid utility damage and interruption by protecting it with means or methods recommended by the utility owner.
 - 4. Maintain a log identifying when phone calls were made, who was called, area for which utility relocation was requested and work order number issued, if any. The Contractor shall provide the Owner an updated copy of the log bi-weekly, or more frequently if required.

C. Conflict with Existing Utilities

1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed water main does not permit safe installation of the sewer by the use of sheeting, shoring, tying back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the sewer to avoid horizontal conflicts if the new alignment remains within the available right of way or easement and complies with regulatory agency requirements after a written request to and subsequent approval by the Owner. Where such relocation of the sewer is not approved by the Owner, the Contractor shall arrange to have the utility, main, or service relocated.

- Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed sewer does not permit the crossing without immediate or potential future damage to the utility, main, service, or the sewer. The Contractor may change the proposed grade of the sewer to avoid vertical conflicts if the changed grade provides minimum required capacity, maintains adequate cover and complies with regulatory agencies requirements, after written request to and subsequent approval by the Owner. Where such relocation of the sewer is not approved by the Owner, the Contractor shall arrange to have the utility, main, or service relocated.
- D. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipe lines or other obstructions.
- E. Abandonment of Existing Utilities: Sewers shall be abandoned where shown on the Drawings or as directed by the Engineer. If Sewers are shown to be filled with grout, then filling work shall consist of furnishing and placing Flowable fill in accordance with Section 600 of the Georgia DOT Standard Specifications and as directed by the Engineer.

F. Water and Sewer Separation

- 1. Sewers should maintain a minimum 10-foot edge-to-edge separation from water mains. Where the sewer crosses a water main, an 18-inch vertical separation shall be maintained where possible. Where possible, a full joint of sewer pipe shall be centered over the water main. Any deviation shall be requested in writing to the Engineer.
- 2. Where the sewer crosses over a water main, the water main shall be encased in concrete to the first joint in each direction.
- 3. No water main shall be permitted to pass through or come in contact with any part of a manhole.

3.2 CONNECTIONS TO EXISTING MANHOLES

A. Where indicated, complete connections to existing manholes. Manhole connections shall be as specified and as detailed on the Drawings.

3.3 CONSTRUCTION ALONG HIGHWAYS, STREETS, AND ROADWAYS

- A. Install pipelines and appurtenances along highways, streets and roadways in accordance with the applicable regulations of, and permits issued by, the Georgia Department of Transportation and Dawson County, with reference to construction operations, safety, traffic control, road maintenance and repair.
- B. The Contractor shall obtain the approval of the Georgia Department of Transportation and/or Dawson County at least 24 hours in advance before closing any roads or streets. The Owner will work with the Contractor to schedule said road and street closing with said agencies.

C. Traffic Control

 The Contractor shall: provide, erect, and maintain all necessary barricades; suitable and sufficient lights and other traffic control devices; provide qualified flagmen where necessary to direct traffic; take all necessary precautions for the protection of the work and the safety of the public. Flagmen shall be certified by a Georgia DOT approved flagman-training program.

- 2. Construction traffic control devices and their installation shall be in accordance with the current Manual on Uniform Traffic Control Devices for Streets and Highways.
- 3. Placement and removal of construction traffic control devices shall be coordinated with the Georgia Department of Transportation and Dawson County a minimum of 48 hours in advance of the activity.
- 4. Placement of construction traffic control devices shall be scheduled ahead of associated construction activities. Construction time in street right of way shall be conducted to minimize the length of time traffic is disrupted. Construction traffic control devices shall be removed immediately following their useful purpose. Traffic control devices used intermittently, such as "Flagmen Ahead", shall be removed and replaced when needed.
- 5. Existing traffic control devices within the construction work zone shall be protected from damage. Traffic control devices requiring temporary relocation shall be located as near as possible to their original vertical and horizontal locations. Original locations shall be measured from reference points and recorded in a log prior to relocation. Temporary locations shall provide the same visibility to affected traffic as the original location. Relocated traffic control devices shall be reinstalled in their original locations as soon as practical following construction.
- 6. Construction traffic control devices shall be maintained in good repair and shall be clean and visible to affected traffic for daytime and nighttime operation. Traffic control devices affected by the construction work zone shall be inspected daily.
- 7. Construction warning signs shall be black legend on an orange background. Regulatory signs shall be black legend on a white background. Construction sign panels shall meet the minimum reflective requirements of the Georgia Department of Transportation and Dawson County. Sign panels shall be of durable materials capable of maintaining their color, reflective character and legibility during the period of construction.
- 8. Channelization devices shall be positioned preceding an obstruction at a taper length as required by the current Manual on Uniform Traffic Control Devices for Streets and Highways, as appropriate for the speed limit at that location. Channelization devices shall be patrolled to ensure that they are maintained in the proper position throughout their period of use.

D. Construction Operations

- 1. Perform all work along highways, streets and roadways to minimize interference with traffic.
- 2. Stripping: Where the pipeline is laid along road right of way, strip and stockpile all sod, topsoil and other material suitable for right of way restoration.
- 3. Trenching, Laying, and Backfilling: Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.
- 4. Shaping: Reshape damaged slopes, side ditches, and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.
- E. Excavated Materials: Do not place excavated material along highways, streets and roadways in a manner that obstructs traffic. Sweep all scattered excavated material off the pavement in a timely manner.

- F. Drainage Structures: Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.
- G. Landscaping Features: Landscaping features shall include, but are not necessarily limited to: fences; property corners; cultivated trees and shrubbery; manmade improvements; subdivision and other signs within the right of way and easement. The Contractor shall take extreme care in moving landscape features and promptly reestablishing these features.
- H. Maintaining Highways, Streets, Roadways and Driveways
 - 1. Maintain streets, highways, roadways and driveways in suitable condition for movement of traffic until completion and final acceptance of the work.
 - 2. During the time period between pavement removal and completing permanent pavement replacement, maintain highways, streets and roadways by the use of steel running plates. The edges of running plates shall have asphalt placed around their periphery to minimize vehicular impact. The backfill above the pipe shall be compacted, as specified elsewhere up to the existing pavement surface to provide support for the steel running plates.
 - 3. Furnish a road grader or front-end loader for maintaining highways, streets, and roadways. Make the grader or front-end loader available at all times.
 - 4. Immediately repair all driveways that are cut or damaged. Maintain them in a suitable condition for use until completion and final acceptance of the work.

3.4 PIPE DISTRIBUTION

- A. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.
- B. No pipe shall be strung further along the route than 1,000 feet beyond the area in which the Contractor is actually working without written permission from the Owner. The Owner reserves the right to reduce this distance to a maximum distance of 200 feet in residential and commercial areas based on the effects of the distribution to the adjacent property owners.
- C. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.
- D. No distributed pipe shall be placed inside drainage ditches.
- E. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than five feet from the roadway pavement, as measured edge to edge.

3.5 LOCATION AND GRADE

- A. The Drawings show the alignment and grade of the gravity sewer and the position of manholes and other appurtenances. The slope shown on the profile and/or called for in the Specifications is the slope of the invert of the pipe.
- B. From the information on the Drawings and the survey points found on the Project site, the Contractor shall perform all surveys necessary for the establishment of the horizontal and vertical alignment of the sewer.

C. Reference Points

- 1. The Contractor shall take all precautions necessary, which includes, but is not necessarily limited to, installing reference points, in order to protect and preserve the centerline or baseline established by the Owner.
- 2. Reference points shall be placed, at or no more than three feet, from the outside of the construction easement or right of way. The location of the reference points shall be recorded in a log with a copy provided to the Owner for use prior to his verifying reference point locations. Distances between reference points and the manhole centerlines shall be accurately measured to the nearest 0.01-foot.
- 3. The Contractor shall give the Owner reasonable notice that reference points are set. The reference point locations must be verified by the Owner prior to commencing clearing and grubbing operations.
- D. After the Contractor locates and marks the manhole centerlines or baselines of the sewer, the Contractor shall perform clearing and grubbing.
- E. Cut sheets shall be prepared and submitted as required in Section 01 73 23.13 of these Specifications.
- F. Construction shall begin at the low end of the sewer and proceed upstream without interruption. Multiple construction sites shall not be permitted without written authorization from the Owner for each site. As a minimum, cut sheets between construction sites shall be submitted and approved before multiple construction sites will be permitted.
- G. The Contractor shall be responsible for any damage done to reference points, base lines, center lines and temporary bench marks, and shall be responsible for the cost of reestablishment of reference points, base lines, center lines and temporary bench marks as a result of the operations.
- H. Survey Cash Allowance: The survey cash allowance is solely for the use of the Owner for verification of the Contractor's reference points, centerlines and work performed and is not to be used by the Contractor to provide cut sheets. The presence of this cash allowance in no way relieves the Contractor of the responsibility of installing reference points, centerlines, temporary bench marks or verifying that the work has been performed accurately.

3.6 LAYING AND JOINTING PIPE AND ACCESSORIES

A. Lay all pipe and fittings to accurately conform to the lines and grades established by the Owner.

B. Pipe Installation

- Proper implements, tools and facilities shall be provided for the safe performance of the Work. All pipe, fittings and valves shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to sewer materials and protective coatings and linings. Under no circumstances shall sewer materials be dropped or dumped into the trench.
- 2. All pipes, fittings, valves and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Owner, who may prescribe corrective repairs or reject the materials.

- 3. All lumps, blisters and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe which contains dirt shall be laid.
- 4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.
- 5. As each length of pipe is placed in the trench, the joint shall be assembled, and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
- 6. It is common practice to lay pipe with the bells facing the direction in which work is progressing; however, it is not mandatory.
- 7. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted.
- 8. Detection tape shall be buried 4 to 10 inches deep. Should detection tape need to be installed deeper, the Contractor shall provide 3-inch-wide tape. In no case shall detection tape be buried greater than 20 inches from the finish grade surface.

C. Alignment and Gradient

- 1. Lay pipe straight in alignment and gradient.
- 2. All pipe shall be laid with the barrel in full contact with the bottom of the ditch. After laying and properly bedding the pipe, the pipe shall be backfilled along the sides and over the top of the pipe eighteen (18) inches with select material compacted in six-inch layers. The remaining portion of the ditch shall be filled with general backfill as specified to 95% standard proctor.
- 3. Maintain a transit, level and accessories on the job to lay out angles and ensure that deflection allowances are not exceeded.
- 4. The Contractor shall check the invert elevation of the gravity sewer at each manhole and the pipe invert elevation at least three times daily, start, mid-day and end of day. Elevations shall be checked more frequently if more than 100 feet of pipe is installed in a day or if the pipe is being constructed at minimum slope.
- 5. The Contractor shall check the horizontal alignment of the sewer at the same schedule as for invert elevations.
- D. Expediting of Work: Excavate, lay the pipe, and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push on, mechanical joint, restrained joint or as approved by the Owner.
- E. Joint Assembly: Push on, mechanical and flange type joints shall be assembled in accordance with the manufacturer's recommendations.

F. Cutting Pipe

- 1. Cut ductile iron pipe using an abrasive wheel saw. Use of a cold chisel or oxyacetylene torch will not be permitted. Welding of ductile iron pipe is not permissible.
- 2. Cut PVC pipe using a suitable saw.
- 3. Remove all burrs and smooth the end before jointing.

4. The Contractor shall cut the pipe and bevel the end, as necessary, to provide the correct length of pipe necessary for installing the fittings, valves, accessories and closure pieces in the correct location.

3.7 CLEANING

- A. At the conclusion of the work but prior to performance of leakage and acceptance testing, thoroughly clean all piping by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. Debris cleaned from the lines shall be removed from the lowest outlet. If, after this cleaning, obstruction remains, they shall be removed.
- B. When pipe installation is not in progress, the end of the pipe shall be sealed to prevent foreign material from entering the pipe.

3.8 INSPECTION AND TESTING

- A. Clean and test lines before requesting final acceptance. Where any obstruction is met, clean the sewers by means of rods, swabs, or other instruments. When requested by the Owner, flush out lines and manholes before final inspection.
- B. Gravity Sewers: Pipelines shall be straight and show a uniform grade between manholes. Correct any discrepancies discovered during inspection.
 - 1. Infiltration Tests: Use only when groundwater is two feet above the top of the pipe.
 - a. Install suitable weirs in manholes selected by the Owner to determine the leakage of ground water into the sewer. The maximum length of line for each infiltration test shall be 5,000 feet. Measure leakage only when all visible leaks have been repaired and the ground water is two feet above the top of the pipe. If leakage in any section of the sewer line exceeds 25 gpd/inch of diameter/mile, locate and repair leaks. Repair methods must be approved by the Owner. After repairs are completed, re test for leakage.
 - b. Furnish, install, and remove the necessary weirs, plugs, and bulkheads required to perform the leakage tests. Where continuous monitoring of flow level is required, the Owner will provide and operate monitoring equipment.
 - 2. Exfiltration Tests: Choose one of the following when groundwater is not two feet above the top of the pipe.
 - a. Hydrostatic Test
 - 1) Test pipe between manholes with a minimum of 10 feet hydrostatic pressure, measured at the center of the pipe at the upstream manhole.
 - 2) The ends of the pipe in the test section shall be closed with suitable watertight bulkheads. Inserted into the top of each bulkhead shall be a 2-inch pipe nipple with an elbow. At the upper end of the test section, a 12-inch riser pipe shall be connected to the 2-inch nipple. The test section of pipe shall be filled through the pipe connection in the lower bulkhead which shall be fitted with a valve, until all air is exhausted and until water overflows the riser pipe at the upper end. Water may be introduced into the pipe 24 hours prior to the test period to allow complete saturation. House service lines, if installed, shall also be fitted with suitable bulkheads having provisions for the release of air while the test section is being filled with water.

3) During the test period, which shall extend over a period of two hours, water shall be introduced into the riser pipe from measured containers at such intervals as are necessary to maintain the water level at the top of the riser pipe. The total volume of water added during the test period shall not exceed that specified for infiltration.

b. Low Pressure Air Test

Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections (25 feet or less) using inflatable balls pulled through the line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.0 psi. After this pressure is reached and the pressure allowed to stabilize (approximately two to five minutes), the pressure may be reduced to 3.5 psi before starting the test. If a 1.0 psi drop does not occur within the test time, then the line has passed the test. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test, and the Contractor will be required to locate the failure, make necessary repairs, and retest the line. Minimum test time for various pipe sizes, in accordance with ASTM C 828 is as follows:

| Nominal Pipe | Time (Min / 100 feet) | | |
|--------------|-----------------------|--|--|
| Size, Inches | DIP / PVC | | |
| 8 | 7.6 | | |
| 10 | 9.4 | | |
| 12 | 11.3 | | |
| 15 | 14.2 | | |
| 18 | 17 | | |
| 21 | 19.8 | | |
| 24 | 22.8 | | |
| 36 | 51.28 | | |

- 1) Required test equipment, including inflatable balls, braces, air hose, air source, timer, rotameter as applicable, cut off valves, pressure reducing valve, 0-15 psi pressure gauge, 0-5 psi pressure gauge with gradations in 0.1 psi and accuracy of ± two percent, shall be provided by the Contractor. Testing equipment shall be equal to Cherne Air-Loc Testing Systems.
- 2) The Contractor shall keep records of all tests made. Copy of such records will be given to the Owner. Such records shall show date, line number and stations, operator, and such other pertinent information as required by the Owner.
- 3) The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured, and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over pressurizing the sewer line.

3. Deflection Test

a. Test PVC gravity sewer for excessive deflection by passing a mandrel through the pipe. Deflection of the pipe shall not exceed the following:

| Nominal Pipe Diameter | Maximum Allowable Deflection |
|-----------------------|------------------------------|
| ≤ 12-inches | 5% |
| 15 - 36 inches | 4% |

- b. The mandrel size shall be based upon the maximum possible inside diameter for the type of pipe being tested, taking into account the allowable manufacturing tolerances of the pipe. The mandrel shall have an odd number of legs, or vanes, with a quantity of such equal to or greater than nine. The legs of the mandrel shall be permanently attached to the mandrel. A mandrel with variable sizes shall not be allowed. The mandrel shall be constructed of steel aluminum or other material approved by the Owner, and shall have sufficient rigidity so the legs of the mandrel will not deform when pulling through a pipe. The mandrel dimensions shall be checked by the Owner before use by the Contractor.
- c. Excavate and install properly any section of pipe not passing this test. Re test until results are satisfactory.
- d. This test shall be performed within the first 30 days of installation and during final inspection, at the completion of this contract.
- C. Force Mains: Pipelines shall be tested by the Contractor in the presence of the Owner until all leaks have been made tight to the satisfaction of the Owner.
 - 1. Pressure and Leakage Test: Before applying the specified test pressure, all air shall be expelled from the pipe. Prior to pressure testing pipe laid in trenches shall be backfilled adequately to secure the pipe during the test. Any observed leakage shall require corrective measures to pipelines and /or joints to the satisfaction of the Owner. The Owner will furnish the necessary water for testing force mains. All lines shall be tested to a pressure of 250 PSI for Ductile Iron and 100 PSI for PVC. Test duration shall be two (2) hours. Test pressure, however, shall not exceed pipe, valve and/or thrust restraint design pressure. Test pressure shall vary no more than +/- 5 PSI for the duration of the test. The rate of leakage shall not exceed 15 gallons per 24 hours per inch diameter per mile of force main. See following table.

| Nominal Pipe | Gallons /hour / 100 feet) | Gallons/Day/Ft | |
|--------------|---------------------------|----------------|--|
| Size, Inches | DIP / PVC | DIP / PVC | |
| 3 | 0.035 | 0.846 | |
| \ 4 | 0.047 | 1.136 | |
| 6 | 0.071 | 1.705 | |
| 8 | 0.095 | 2.273 | |

3.9 PROTECTION AND RESTORATION OF WORK AREA

- A. General: Return all items and all areas disturbed, directly or indirectly by work under these Specifications, to their original condition or better, as quickly as possible after work is started.
 - 1. The Contractor shall plan, coordinate, and prosecute the work such that disruption to personal property and business is held to a practical minimum.
 - 2. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly. Backfilling of underground facilities, ditches, and disturbed

- areas shall be accomplished on a daily basis as work is completed. Finishing, dressing, and grassing shall be accomplished immediately thereafter, as a continuous operation within each area being constructed and with emphasis placed on completing each individual yard or business frontage. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.
- 3. Handwork, including raking and smoothing, shall be required to ensure that the removal of roots, sticks, rocks, and other debris is removed in order to provide a neat and pleasing appearance.
- 4. The Georgia Department of Transportation or the Owner shall be authorized to stop all work by the Contractor when restoration and cleanup are unsatisfactory and to require appropriate remedial measures.
- B. Man Made Improvements: Protect, or remove and replace with the Owner's approval, all fences, walkways, mail boxes, pipe lines, drain culverts, power and telephone lines and cables, property pins and other improvements that may be encountered in the work.
- C. Cultivated Growth: Do not disturb cultivated trees or shrubbery unless approved by the Owner. Any such trees or shrubbery which must be removed shall be heeled in and replanted under the direction of an experienced nurseryman.
- D. Cutting of Trees: Do not cut trees for the performance of the work except as absolutely necessary. Protect trees that remain in the vicinity of the work from damage by equipment. Do not store spoil from excavation against the trunks. Remove excavated material stored over the root system of trees within 30 days to allow proper natural watering of the root system. Repair any damaged tree over 3 inches in diameter, not to be removed, under the direction of an experienced nurseryman. All trees and brush that require removal shall be promptly and completely removed from the work area and disposed of by the Contractor. No stumps, wood piles, or trash piles will be permitted on the work site.
- E. Disposal of Rubbish: Dispose of all materials cleared and grubbed during the construction of the project in accordance with the applicable codes and rules of the appropriate county, state and federal regulatory agencies.
- F. Swamps and Other Wetlands
 - 1. The Contractor shall not construct permanent roadbeds, berms, drainage structures or any other structures which alter the original topographic features within the easement.
 - 2. All temporary construction or alterations to the original topography will incorporate measures to prevent erosion into the surrounding swamp or wetland. All areas within the easement shall be returned to their original topographic condition as soon as possible after work is completed in the area. All materials of construction and other non-native materials shall be disposed by the Contractor.
 - 3. The Contractor shall provide temporary culverts or other drainage structures, as necessary, to permit the free migration of water between portions of a swamp, wetland or stream which may be temporarily divided by construction.
 - 4. The Contractor shall not spread, discharge or dump any fuel oil, gasoline, pesticide, or any other pollutant to adjacent swamps or wetlands.

SECTION 2 SEWER SERVICE CONNECTIONS

PART 1 GENERAL

1.1 SCOPE

A. The work covered by this Section shall consist of furnishing and installing service connections in the sewers, of the size and type shown on the Drawings and specified herein.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Service connections shall be made at the top or from the side at 45 degrees of the sewer line using PVC fittings for PVC sewer pipe or tapping saddles for ductile iron sewer pipe as shown on the Drawings. Service pipe shall be of the same material type and quality as that of the main sewer.
- B. Riser connections shall be required when the main sewer line is 10 feet or more below finished grade, unless otherwise directed by the Owner.
- C. The service connection shall extend from the sewer line to the edge of the permanent easement or right of way and be plugged or be connected to the existing service with a clean-out, depending on whether the service is new or a changeover.
- D. If the service connection ends in rock, the Contractor shall excavate the rock an additional 10 feet beyond the plugged end.
- E. Connection of service lines or risers to sewer line shall be by means of standard tees or wyes, or as indicated on the Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Laying of service connection lines shall be in accordance with Section 1 of these Specifications.

END OF SECTION

BELT FILTER PRESS

SECTION 46 76 21

BELT FILTER PRESS

PART 1 GENERAL

1.1 SUMMARY

- A. Furnish and install the belt filter press and appurtenances in accordance with Charter Machine Company's documentation included herein as Attachment A and in accordance with these specifications and the contract drawings.
- B. The Owner has pre-negotiated the Base Bid equipment price shown in Section II of the Bid Form (Section 00 41 13). The equipment and services to be provided by Charter Machine Company for this price is detailed in their proposal and related documentation included herein in the specifications as Attachment A. The contractor shall provide all additional equipment, appurtenances, labor, etc. required to install the belt filter press and appurtenances as a complete working system. The Contractor shall include their costs for the work in their lump sum bid for constructing the proposed improvements (see Section I in Bid Form). Adjustments, if required and approved by the Owner during construction, to the Base Bid price listed in Section II of the Bid Form for equipment and services to be furnished by Charter Machine Company will be made via change order.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 - 1. Layout drawings shall be submitted and include the dimensions of all equipment, accessories, supports, connections, outlets, and all related piping.
 - 2. Equipment weights and anchor bolt designs.
- C. Product Data: Submit information concerning materials of construction and fabrication.
- D. Manufacturer's Installation Instructions: Submit detailed instructions on installation requirements including storage and handling procedures, anchoring, and layout.
- E. Submit operating instructions with descriptive literature, including a cross-sectional view, which indicates materials of construction, weights, principle dimensions and other important details.
- F. Manufacturer's Field Reports: Certify equipment has been installed in accordance with manufacturer's instructions.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

BELT FILTER PRESS

- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.
- C. Operation and Maintenance Data:
 - 1. Submit maintenance instructions for equipment and accessories.
 - 2. Furnish list of equipment and tools needed to maintain equipment.

1.4 QUALITY ASSURANCE

A. Install equipment according to manufacturer's printed instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.
- C. Inspect for damage.

D. Shipping

- 1. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components or for installation requirements.
- 2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which they are intended.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.7 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

1.8 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

1.9 MEASUREMENT AND PAYMENT

A. Basis of Payment: See Bid Form and paragraph 1.1, B herein.

BELT FILTER PRESS

PART 2 PRODUCTS

2.1 BELT FILTER PRESS EQUIPMENT PACKAGE

A. See Charter Machine Company's Budget Proposal No. 190717-C1Rev1 dated October 28, 2019 and related documentation included in Attachment A herein for material lists and appurtenances to be provided by the Manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install equipment where indicated on drawings and in accordance with manufacturer's instructions. All supports, piping, valves, and related appurtenances shall be provided and installed by the Contractor at no additional cost to the Owner.
- B. Provide and connect power and control conduit and wiring to make system operational, ready for startup.
- C. Equipment shall be installed in strict conformance with manufacturer's recommendations.

3.2 FIELD QUALILTY CONTROL

A. Section 01 40 00 - Quality Requirements 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish services of manufacturer's representative experienced in installation of products furnished under this specification for on-site installation inspection, equipment startup, field testing, certification that all equipment has been installed and started up properly according to the manufacturer's instructions and guidelines, and instructing Owner's personnel in maintenance of equipment.
- C. Schedule training class(es) with Owner.
- D. Certify that equipment has been properly installed and is functioning as designed and is ready for start-up and testing.
- E. Section 01 40 00 Quality Requirements 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION

ATTACHMENT A

Charter Machine Company – Base Bid Equipment Documentation

Dewatering Equipment Machines Division

A GEC Subsidiary

DATE: October 28, 2019

TO: Peter Johns, P.E.

Wiedeman And Singleton, Inc.

PROPOSAL: Charter Machine Company (CMC)

Budget Proposal No – 190717-C1Rev1

PROJECT: Dawson Forest WRF

Etowah Water & Sewer Authority

SUBJECT: Belt Filter Press and Polymer System Equipment

We are pleased to offer the following equipment of our manufacture and supply for your consideration relative to the above subject project. The model offered is a THREE belt Towerpress style (low gravity section and high cake discharge).

The Charter Belt Press Offering includes features that no other belt press manufacturer offers like:

- 8 pressure rolls for the largest dewatering area available
- Center Pivot steering of the belts for guaranteed 2,000+ hours of belt life
- Automated lifting of plows in gravity section and automated removal of discharge doctor blades
- Gravity section plow replacement in under 1 second
- Quadruple bearing seals

All belt filter presses in the industry use 20 gpm per meter per belt of wash water. So, a 2m 3 belt will use 120 gpm @min of 85psi.

Connected motor is two 3 HP VFD and one 1.5 HP Air Compressor Motor for the 3 belt and one 3 HP VFD and one 1.5 HP Air Compressor.

Operators should be at press for first ½ hour of startup and ½ hour at shutdown.

Polymer Usage shall be the same as the existing Roediger (Charter) Belt press.



Charter Machine Company is located in Metuchen NJ (1/2 hour outside of New York City) with a factory of over 100,000 square feet of manufacturing space. Charter builds all of its own presses, polymer systems, belt conveyors, screw conveyors, thickeners, control panels and much more. Charter houses over \$3,000,000 worth of spare parts with 24 hour delivery service available.

NOTE: Also, please be aware that Charter Machine Company also makes its own Polymer Systems, Shaftless Screw Conveyors, Odor Control covers, Lime Blending systems, Belt Conveyors, etc. Any or all of these can be supplied and/or quoted for this project if needed.

Item 1

One (1) Charter Machine Company Model 3BTP22.593S Belt Filter Press, with a 2.2 meter total belt width and 15 pressure rolls. The belt filter press will be supplied with a hot dip galvanized frame that is then Epoxy Coated per the specification and a hot dip galvanized perforated roll with industry leading 89% open area. All belt press electrical functions will be factory wired to numbered terminals in a frame mounted 304 Stainless Steel, NEMA 4X junction box. The machine will be shipped totally assembled. Also included will be one (1) upstream conditioning device consisting of a 304 Stainless Steel in-line adjustable orifice venturi type mixer, complete with a polyethylene injection ring. The Belt Filter Press will be totally pre-plumbed, requiring one (1) sludge feed connection, one (1) polymer feed connection, one (1) plant water connection and one (1) electrical connection. This press will be pneumatically steered and tensioned.

An air compressor system will also be supplied with this press.

Stainless Steel GA Engineering Stamp approved Anchor Bolts shall be supplied with the press per the specification.

Item 2

<u>The services of a factory trained representative</u> for the purposes of installation supervision, inspection, startup and operator training will be provided for a period not to exceed <u>six (6) days on-site</u>, and to be completed in one (3) trips.

Item 3

<u>One (1) Netzch Progressive Cavity Feed Pump</u>, capable of pumping up to 250 gpm to the press. The controls for the pump shall be mounted in the Belt Press Control Panel. Mounting and interconnecting wiring of the pump shall be by the installing contractor.

Item 4

One (1) Roedos Model L – 2 Polymer Preparation/Feed Unit, capable of metering, diluting, and activating an emulsion polymer with water. This system shall be capable of controlling separately the water flow and the polymer injection dosage, and shall be furnished as a complete assembled unit to the Contractor.

The polymer system shall include one (1) polymer feed pump to provide mixed polymer solution to the polymer injection points. The pump will be a full range, end suction centrifugal type as manufactured by Goulds, and will be driven by an AC motor.

All polymer system controls will be located in a local control panel. The polymer system power shall be 15 amps, single phase, powered by others.

Item 5

One (1) Charter Standard Wash Water Booster Pump, capable of boosting 10 psi feed pressure up to a minimum of 85 psi. This pump is estimated to require 10 HP for the 2 belt press and 12 HP for the 3 belt press. The controls and power feed shall be supplied by the main Belt Press Control Panel. The installing contractor is responsible for all mounting and interconnecting wiring.

Item 6

<u>Three (3) Charter 10" Diameter 304SS Shaftless Conveyors</u>, capable of conveying the dewatered sludge from the new press over to the outside dumpster per the drawings. One conveyor shall be 40' long and inclined and the others shall be 16.5' long with one slide gate per converyor. Both conveyors shall have 304 SS troughs with high strength carbon Steel shaftless screws and UHMW replaceable wear liners. The conveyor over the dumpster shall have two pneumatically controlled slide gates. The installing contractor is responsible for all support bracing and installing the conveyors per the drawings.

Item 7

One (1) Belt Filter Press Electrical Control Panel and One (1) Local Control Panel, totally factory wired to numbered terminal strips and including all necessary components for the automatic operation of the belt filter press system. Components will include VFD's, pushbuttons, lights, relays, switches, transformers, fuses, alarms and starters to perform the necessary control functions. The control panel will be 304 Stainless Steel, hinged front access with PLC and Touchscreen capable of connecting to plants SCADA system along with a panel mounted air conditioner/heater, completely factory assembled and tested. The local control panel will interface with the main control panel and will only have a touch screen for controls. Mounting and interconnecting wiring for both panels to be completed by installing contractor.

LUMP SUM PRICING FOR:

We propose to furnish the above described equipment for the Total Lot Net Selling Price of \$452,594.00 U.S.D.__, F.O.B. shipping point, with full truck freight allowed to the jobsite.

Item 8

One (1) Lot of Shop Drawings and Submittals, to be supplied to the owner and engineer prior to official installation bid.

Final Information and Pricing for Item 8 ONLY:

We propose to furnish the above described items and service for the Total Lot Net Selling Price of \$ 18,000.00 U.S.D.

NOTE: A separate PO has already been issued for the Shop Drawings and Submittals.

Additional service may be requested at a rate of \$120 per hour, plus all travel and living expenses.

Please note that Charter Machine Company offers a factory sludge test to optimize polymer selection prior to startup. A 5-gallon sludge sample is required. Testing is to be coordinated through Charter Machine Company's service department.

Please Note:

Except as otherwise noted herein, the following are not included in our offering:

Installation or off-loading, local, state or federal taxes, permits, or other fees, anchor bolts, local motor disconnects or lockouts, polymer for startup or operation, platforms, walkways, or handrails.

Warranty:

Our equipment shall be warranted against defects in workmanship and materials for a period of <u>eighteen (18)</u> months after delivery or <u>twelve (12)</u> months after start-up, whichever comes first. This warranty is based upon compliance with Charter Machine Company's handling, storage, installation, startup, operating and maintenance procedures.

Unless otherwise specified our standard payment terms are as follows:

10% - upon receipt of purchase order

80% - 30 days upon delivery

10% - upon start-up and acceptance of equipment

Other terms and conditions apply per the attached sheet. Late payments shall be subject to a 1.5% per month finance charge.

Early shipments of embedded metal work can possibly be made however there will be an additional charge of the lowest ground freight rate available to the purchaser.

Early shipments and partial shipments will be invoiced as shipped on a prorated basis to be determined by CMC.

Unless otherwise specified this proposal is offered for acceptance for (60) sixty days and is subject to review thereafter. Pricing is firm based upon receipt of a Purchase Order within this (60) sixty-day period. Delays in shipments caused by slow return of submittals or other delays caused by the contractor, owner, owner's agents or engineer may result in additional charges of 1% per month.

Submittal Schedule:

Approval submittals can be forwarded approximately <u>6-8 weeks</u> after our receipt and acceptance of your purchase order.

Delivery Schedule:

Shipment of the equipment can be made approximately **20-26 weeks** after our receipt of approval and your release to manufacture.

These lead times are based upon typical Engineering and Shop loading, which may vary to some degree.

Offering Basis and Escalation:

Please note that our offering, as described herein, is based upon Charter Machine's standard model. Should the contents of any addenda (or other applicable documents) have an effect on our offering, we must reserve the right to modify that offering (and pricing) accordingly. We request your assistance in keeping us abreast of all changes to the contract documents.

This quote is valid for 60 days. If the project extends longer that that time period without an issuance of a valid Purchase Order, Charter has the right to recost the bid based on any extra imposed taxes, duties, fees and cost of living increase from date of bid.

We wish you success on this project and look forward to the opportunity of working with you.

Page 6

Very truly yours,
Charter Machine Company

Christopher Boyd Director of Sales

CHARTER MACHINE COMPANY TERMS AND CONDITIONS OF SALE

- These Terms and Conditions shall exclusively govern the sale of equipment, 1. Governing Terms: components and related services by Charter Machine to Purchaser. Acceptance of Charter Machine's offer or counteroffer by acknowledgment is expressly limited to the terms and conditions set forth herein and those stated in any specific Charter Machine proposal or acknowledgment. Charter Machine hereby gives notice of objection to any different or additional terms which may be proposed or contained in any document forwarded by Purchaser. No other terms or conditions or modification of these terms shall be binding upon Charter Machine unless specifically accepted in writing by an authorized representative of Charter Machine. Merely signing a purchase order or other document as a condition of payment shall not be deemed a specific acceptance of different terms therein by Charter Machine. In the event of any inconsistency between these terms and conditions and the express terms and conditions of any specific Charter Machine proposal or acknowledgment, the express terms and conditions contained in that specific proposal or acknowledgment shall be controlling. In the event that Charter is forwarding these terms and conditions as part of Charter's acceptance of an offer made by the Purchaser, whether through a Purchase Order or other document, Charter's acceptance of such offer is hereby expressly conditioned upon Purchaser's acceptance of and assent to the terms and conditions set forth herein.
- 2. Pricing: Unless otherwise expressly stated therein, prices set forth in quotations are valid for acceptance within 60 days of a Charter Machine proposal and shipment is to be made within six months from any such acceptance. If Purchaser causes or requests delays in manufacture or shipment such that shipment is not made within six months from acceptance of a Charter Machine proposal, Charter Machine shall be entitled to receive a price increase in the amount of the actual escalation in labor, material, overhead, and component costs incurred by Charter Machine, as well as reasonable costs of shutdown, delay, start-up and storage costs. The price increase shall be affected by an appropriate Change Order, as more specifically set forth in Paragraph 4 of these Terms and Conditions.
- 3. Payment Terms: Subject to a satisfactory credit check and approval by the Charter Machine Credit Department, Charter Machine will extend credit to Purchaser and payment of the full net invoice price shall be due within 30 days of receipt by Purchaser. Should any investigation or other facts made known to or discovered by Charter Machine at any time cause Charter Machine to reasonably deem its ability to recover payment insecurity of payment at any time, Charter Machine reserves the right to demand payment terms which adequately assure Charter Machine of Purchaser's ability to make payment and to withhold shipment until such terms are reached or payment is received. Invoice amounts that are not paid within thirty days shall be subject to a 1.5% per month finance charge.
- 4. Change Orders: When Purchaser delivers a signed and approved Change Order, Charter Machine shall make such changes which are within the general scope of these Terms and Conditions and which are set forth in the Change Order. Adjustments in the pricing and time of delivery, if any, resulting from these changes shall be set forth in the agreed upon Change Order. Any adjustment in price shall be an agreed upon lump sum based upon Charter Machine's proposal for the Change Order work.
- Payment For Additional Work: Charter Machine will perform additional work if and when provided a
 final approved and agreed upon signed Change Order. Purchaser shall pay Charter Machine the amount set
 forth in the Change Order within thirty days from the date of the completion of the Change Order work.
- 6. Taxes: Purchaser shall be responsible for payment of any and all applicable sales, use, excise or other taxes resulting from any sale made to Purchaser. Charter Machine shall add any applicable sales, use, excise or other tax to the price of equipment, components or related services and remit such tax to the appropriate taxing authority. Purchaser is responsible for and bears the risk of establishment of a valid exemption from any tax, and shall indemnify, defend and hold Charter Machine harmless from any loss, cost or expense relating to exemptions.

- 7. Shipping: All equipment and components will ordinarily be shipped in one lot by the lowest cost method in the discretion of Charter Machine. Additional shipments requested by Purchaser shall be subject to additional shipping and handling charges. All shipments shall be F.O.B. Charter Machine's plant. Delivery to the carrier shall constitute delivery to Purchaser for purposes of transfer of risk of loss or damage in transit and meeting Purchaser's schedule. Purchaser is responsible for obtaining cargo insurance and shall pursue any loss or damage claims solely with the carrier.
- 8. Delivery Dates: All delivery dates are approximate and subject to revision due to engineering approval delays, availability of materials and components, and other causes beyond Charter Machine's control, including but not limited to unusual weather conditions, fire, unusual delays in transportation, acts of God or government, accidents, any labor dispute (including lockouts or strikes), damage or breakdown at Charter Machine's plant or any other work stoppage of 30 days or more Charter Machine will use its best efforts to meet promised delivery dates, but under no circumstances shall Charter Machine be liable for any direct, or indirect, consequential, incidental, liquidated or other damages for delay in delivery. Purchaser will notify Charter Machine within 30 days after order acceptance of the scheduled delivery date. If Purchaser does not notify Charter Machine a delivery date of 6 months after order acceptance is agreed. For any delays which are beyond Charter Machine's responsibility, a finance charge of 1.5% per month will be due.
- Field Service: "Field Service" refers to the services of a Charter Machine factory-trained representative at the site of end-use for initial installation, inspection, start-up observation and operator training and for subsequent investigation of warranty issues, operation difficulties and Purchaser complaints or requests for post-warranty service. Purchaser acknowledges that Charter Machine Field Service representatives shall make all arrangements necessary with labor unions for their presence on the site. No contractual warranty or indemnity relating to Field Service is extended by Charter Machine, nor are its Field Service representatives authorized to bind Charter Machine with any oral or written representations or statements that conflict with or alter the governmental contract terms or any manuals or written instructions provided by Charter Machine. This paragraph shall apply to any and all initial and subsequent Field Service provided by Charter Machine relating to the equipment sold to the Customer. Each project includes a specific number of days of start-up service on site, consisting of not more than 2 separate site visits. Charter Machine is unable and is not required to perform its start-up service unless and until the entire project is ready for start-up. All days for which Purchaser schedules Charter Machine for start-up services, but Charter Machine cannot perform start-up services because of improper installation, the failure of other equipment or the status or operability of any other portion of the project, will be charged against the allotment of start-up services for the project. If the allotted amount of start-up services are exhausted and any additional start-up services are required, all start-up services in excess of the allotted start-up services will require approval of a written Change Order and Purchaser will be required to pay for such additional start-up services at the rates established in that change order.
- 10. Cancellation: Purchaser may not cancel or terminate its order without the written consent of Charter Machine and payment of Charter Machine's incurred costs, overhead, losses and anticipated profit. If Purchaser is subject to a termination for convenience provision in the prime contract, Charter Machine may consider a request to defer payment pending resolution of the Purchaser's claim.
- 11. Government Standards: Charter Machine's equipment will be designed and manufactured to comply with federal government occupational safety, noise, sanitation and health standards. The Purchaser is solely responsible for compliance of the equipment and its operation with any state or local laws, codes, ordinances, or regulations, unless specifically identified by Charter Machine in its proposal.
- 12. Limited Warranty: Charter Machine warrants that the equipment and components furnished will be and remain free from defects in workmanship and materials and perform the general process function intended, solely under the conditions defined by Charter Machine, for a period of (a) 12 months from completion of installation, start-up or acceptance of the equipment, or (b) 18 months from the date of delivery to Purchaser, whichever expires first. Charter Machine will replace, modify or repair, at its sole option, any

such defective component or equipment at no charge provided that Charter Machine is notified promptly in writing of any claimed defect and, if requested by Charter Machine, the claimed defective part or component is returned to Charter Machine, freight pre-paid. If Purchaser fails to promptly notify Charter Machine in writing of any claimed defect, Purchaser waives its right to claim a breach of the warranty with respect to such claimed defects. This warranty does not apply to any defect or malfunction arising out of failure to store, install, operate or maintain the equipment in accordance with instructions by Charter Machine or its operation under conditions other than those defined by Charter Machine. Any unauthorized modification or alteration of the equipment or repair or replacement of components shall void this warranty.

THIS WARRANTY IS EXCLUSIVE AND INTENDED TO BE IN LIEU OF ANY OTHER WARRANTIES, INLCUDING THE IMPLED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

- 13. Exclusive Remedies: Purchaser acknowledges that its sole and exclusive remedies for breach of the Limited Warranty shall be replacement or repair by Charter Machine of any defective equipment or component, and payment of the reasonable out-of-pocket costs incurred in connection with replacement or repair if such costs are approved in advance by Charter Machine, or refund of 80% of the purchase price if the equipment cannot be repaired or replaced. This remedy is exclusive and does not include any consequential, incidental, special or other form of damage or extraordinary costs for removal or reinstallation, such as crane rental or structural alteration or demolition.
- 14. Limitation of Liabilities: Charter Machine shall not be liable in contract, tort or otherwise for any form of consequential, incidental, punitive, or liquidated damages, loss of use, cost of cover, extraordinary removal or re-installation costs, or governmental fines or penalties arising out of failure of its equipment to perform or be free from defects, late shipment, errors or omissions in Field Service or any other breach or failure to perform whatsoever. Under no circumstances shall Charter Machine's total liability of any type exceed 80% of the purchase price.
- 15. Indemnification: Charter Machine shall indemnify Purchaser from and against any claims, suits, or demands by others for property damage, personal injury or death arising out of the sole fault or neglect of Charter Machine in the manufacture of its equipment, or for damages for patent infringement arising solely out of equipment or components designed and supplied by Charter Machine. This indemnity obligation shall be void unless Purchaser provides prompt written notice to Charter Machine of any occurrence which may require indemnification. Charter Machine shall assume the defense and settlement of any claim, suit or demand, and Purchaser shall cooperate in all respects with Charter Machine in any such defense and settlement.
- 16. Title: Notwithstanding delivery or installation, title to all equipment furnished shall remain solely with Charter Machine until the full purchase price is paid by Purchaser. Until such time, Charter Machine may enter the premises where such equipment is then located and repossess and remove such equipment by any lawful means and as Charter Machine's personal property. Purchaser agrees to perform all acts deemed necessary or desirable or requested by Charter Machine to maintain Charter Machine's rights, in, and title to, such equipment.
- 17. Governing Law: The transaction between Purchaser and Charter Machine shall be deemed to be made under and its terms shall be governed by, construed and enforced in accordance with the laws of the State of New Jersey without regard to its conflict of laws provisions.
- 18. Arbitration: Any controversy or claim arising out of or relating to this contract or its breach shall be settled by binding arbitration conducted in New Jersey in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association and New Jersey law and judgment on the award rendered by the arbitrator(s) may be entered in any court of competent jurisdiction. The party prevailing in the arbitration shall be entitled to recover its attorneys' fees and costs of the arbitration.

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- 19. Assignment: Purchaser shall not assign any of its rights or obligations without the express prior written consent of Charter Machine, which consent may be withheld, delayed or conditioned in Charter Machine's sole discretion. The transaction between Purchaser and Charter Machine shall not be construed to confer or create a third-party beneficiary relationship with any other entity.
- Severability: The partial or complete invalidity of any one or more provisions of these Terms and Conditions shall not affect the validity or continuing force and effect of any other provision.
- 21. Joint Drafting: The parties expressly agree that these Terms and Conditions were jointly drafted, and that they both had an opportunity to negotiate its terms and to obtain the assistance of counsel in reviewing its terms prior to execution. These Terms and Conditions therefore shall be construed neither against nor in favor of either party, but shall be construed in a neutral manner.

WIEDEMAN AND SINGLETON, INC.

CIVIL AND ENVIRONMENTAL ENGINEERS 3091 GOVERNORS LAKE DRIVE, SUITE 430

NORCROSS, GEORGIA 30071

(404) 876-5862

HAROLD WIEDEMAN PETER SNYDER

FAX (404) 876-4054

To: Mr. Stanley Mize

TROY BEGAN PETER JOHNS

Templeton & Associates

4324 Brogdon Exchange, Suite 100

Suwanee, GA 30024

770-614-8550

Re: Dawson Forest WRF

2/17/2020

Date:

Sludge Dewatering Upgrades

Etowah Water & Sewer Authority

Dawson County, Georgia

W&S #: 273-18-210

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| COPIES | W&S SUBM. # | DESCRIPTION |
|--------|----------------------------------|---|
| 1 | 467621-01 Charter # 806-R1 | Mechanical and Electrical Submittal R1 One (1) THREE BELT TOWER PRESS - Model 3BTP22.593S One (1) Polymer System - Model L2.10 One (1) Sludge Feed Pump Three (3) Shaftless Screw Conveyors |
| | | YOUR PROPOSAL NUMBER – 190717-C1 CHARTER MACHINE PROJECT NUMBER – 806.22.593 |

REMARKS:

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Ahmed Annaim, P.E.



Memorandum

To: Stanley Mize – Templeton & Associates

Christopher Boyd – Charter Machine Company

Cc: Brooke Anderson, Tim Collins, David Zimmer, Peter Johns, File

From: Shawn McCaffrey, Ahmed An-naim

Date: February 17, 2020

Re: Charter Machine Company Submittal – Belt Press and Appurtenances

Charter Proposal No. 190717-C1 (Project No. 806.22.593) (W&S# SD 467621-01)

Job No.: 273-18-210 Dawson Forest WRF Sludge Dewatering Upgrades

SUBMITTAL REVIEW

THIS REVIEW DOES NOT RELIEVE CONTRACTOR FROM COMPLIANCE WITH REQUIREMENTS OF DRAWINGS & SPECIFICATIONS. THIS CHECK IS ONLY FOR REVIEW OF GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT & GENERAL COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMING AND CORRELATING ALL QUANTITIES & DIMENSIONS: SELECTING FABRICATION PROCESSES & TECHNIQUES OF CONSTRUCTION COORDINATING HIS WORK WITH THAT OF OTHER TRADES & PERFORMING HIS WORK IN A SAFE AND SATISFACTORY MANNER.

| ┙ | REVIEW COMPLETED: |
|---|-------------------------|
| | NO CORRECTIONS NOTED |
| 1 | REVIEW COMPLETED: |
| | MARIE CODDECTIONS NOTED |

- MAKE CORRECTIONS NOTED
 RESUBMIT FOR REVIEW:
 REVISE AND/OR CORRECT
- **REJECTED**
- RECEIVED: ENGINEER REVIEW NOT REQUIRED

DATE: February 17, 2020 BY: Ahmed An-naim

The following section shows the Original *W&S Comments from January 14*, 2020, <u>Charter Machine Company (MC) Responses from February 12</u>, 2020, and <u>W&S Responses</u>;

1. <u>W&S Comment:</u> Please confirm the Charter Machine project number. On the cover page it is listed as 806.22.593 and on page 33 of the PDF submittal it is listed as 758.22.593.

<u>Charter MC Response:</u> The project number is 806.22.593; The number on page 33 has been updated. Page 37this submittal

W&S Response: This is acceptable.

2. <u>W&S Comment:</u> Please provide Drawing No. 806-K-TAGS. It is listed in the Table of Contents but has not been included in the Submittal.

Charter MC Response: Drawing 806-K-TAGS has been supplied

<u>W&S Response:</u> This is acceptable.

3. <u>W&S Comment:</u> Please confirm the Netzsch Sludge feed pump dimensions. The dimensions for the sludge pump on layout drawing 785-X-0101 do not match those of the shop drawing from Tab 18 – Drawing B-076BY20.

<u>Charter MC Response:</u> The sludge pump drawings have been updated

<u>W&S Response:</u> This is acceptable.

- 4. <u>W&S Comment:</u> For both Conveyors 'B' change Layout Drawings 785-X-0104 and 806-H-0202 as follows:
 - a. W&S Comment: Change the 77 ½" dimension between the inlet hopper centerline and sliding gate discharge point centerline to 120".

Charter MC Response: The 77 1/2" dimension has been updated to 120".

W&S Response: This is acceptable.

b. W&S Comment: Change the 90" dimension between the sliding gate discharge point centerline and the open discharge point centerline to 126".

Charter MC Response: The 90" dimension has been updated to 126".

<u>W&S Response:</u> This is acceptable.

c. W&S Comment: Adjust the conveyor lengths accordingly. If this increases the equipment costs, please advise.

<u>Charter MC Response:</u> The conveyor lengths have been updated; please see attached

<u>W&S Response:</u> This is acceptable.

5. <u>W&S Comment:</u> Please provide anchoring requirements for the belt press, sludge feed pumps, air compressor, and booster pump. Anchoring requirements shall include anchor size, type, embedment depth, and epoxy type to be used. Please note that wedge type anchors are not permitted.

<u>Charter MC Response:</u> Charter Machine recommends a highly corrosion resistant (i. e. 316 stainless steel) anchor bolt; and an epoxy that is rated for a wet, possibly corrosive environment. The anchor bolt and epoxy must have sufficient strength for the application. Below is a table showing typical epoxy anchor bolt diameters, hole diameters and embedment depths.

| Anchor Dia. (") | 3/4 | 5/8 | 1/2 | 3/8 |
|-----------------|-------|-------|-------|------|
| Hole Dia. (") | 5/8 | 3/4 | 9/16 | 7/16 |
| Depth (") | 6 3/4 | 5 5/8 | 4 1/2 | 3 ½ |

Detailed site calculations made by a qualified professional engineer using as a minimum: equipment weights, anchor bolt tension/shear strengths, concrete breakout strength, epoxy bond failure strength and seismic load conditions should be obtained before anchoring any equipment

<u>W&S Response</u>: Charter Machine Company shall provide the detailed site calculations and required epoxy type and embedment depth. Or provide the design loads (tension and shear) for each anchor.

6. W&S Comment: Please be aware that Charter Machine recommends the air compressor to be located so it has a source of clean air (see page 93 of the pdf submittal file). We can't locate the air compressor in another room; do we have to plumb the intake to a clean dry air source? The outside air may be as humid as the belt press room. There is a filter coalescer regulator on the air output line. Is the filter coalescer used to remove oil or water from the air stream? Will this take care of the moisture in the air if we plumb the air intake to the interior of the belt press room or even outside? Or do we need a dessicant type dryer? Is an automatic condensate drain on the air compressor available? Please advise how dry the air should be.

<u>Charter MC Response:</u> As with all compressed air applications the dryer the better. Most of our installations (90%+) have the air compressor and intake in the dewatering room. The coalescing regulator is used to remove moisture in the air stream. There is an auto drain on the tank.

<u>W&S Response</u>: Noted. The air compressor in this project will be installed in the same room as the belt press without any additional dryers or outdoor air supply.

7. <u>W&S Comment:</u> Please confirm the suction and discharge connection sizes for the booster pump. This was not clear in the submittal.

<u>Charter MC Response:</u> The connection sizes for the booster pump are: suction 2", discharge 1"

<u>W&S Response:</u> This is acceptable.

8. <u>W&S Comment:</u> Please note there is only one polymer feed point. There is approximately 55-feet of 6-inch ductile iron pipe with 5 - 90° bends between the polymer feed point and the belt press inlet connection. Please confirm that this is acceptable.

Charter MC Response: Final location of the polymer injection point and mixer assembly can only be determined based upon actual testing of the dewatering system. Due to the variability of process parameters in any installation, Charter Machine recommends provisions be made in the sludge feed piping to allow a minimum of 2 locations for polymer injection points (mixer assembly locations). The first approximately 15 to 20' prior to the inlet of the dewatering equipment and the second approximately 30 to 40' prior to the inlet of the dewatering equipment.

The mixer assembly is 19" long. We recommend that a 19" spool piece be installed at the second location; and the mixer installed at the first. Charter Machine requests that the polymer feed line be plumbed to each of the potential polymer injection points and that a ball valve be installed at each injection point. Upon start-up, the polymer injection ring and mixer assembly shall be moved to determine the best location for polymer application and the amount of mixing required for the particular sludge. Any unused polymer injection locations can be isolated from the sludge line and used as polymer sampling ports; if so desired.

<u>W&S Response:</u> This is acceptable. Polymer feed point(s) will be provided per these requirements.

9. Panel Drawings

a. <u>W&S Comment:</u> Confirm if the booster pump spare is being installed. If not, please delete all reference to it on the panel drawings (e.g., 806-K-0101-INT).

<u>Charter MC Response:</u> No spare booster pump is being supplied

<u>W&S Response:</u> This is acceptable.

b. <u>W&S Comment:</u> Label the conveyors to match the designations given in the Layout Drawings and Tabs 16 and 17 (i.e., 1x Conveyor A and 2x Conveyor B).

Charter MC Response: The conveyor designations have been updated

<u>W&S Response:</u> This is acceptable.

c. <u>W&S Comment:</u> The control panel needs a through the door, lockable, disconnect switch.

<u>Charter MC Response:</u> KXT2N4XFLHDL4 ABB DISC MECHANISM Part listed in the bill of materials and on the Enclosure layout. Reference bubble mismarked should reference line 3 on BOM on the page

W&S Response: This is acceptable.

d. <u>W&S Comment:</u> The Owner's SCADA system will communicate to the Belt Press Panel Micrologix 1400 via an ethernet cable (Ethernet/IP) which will connect to the ethernet switch in the Belt Press Panel.

<u>Charter MC Response:</u> Panel contains an Ethernet switch for the possible use of SCADA interconnection with the customer

W&S Response: This is acceptable.

e. <u>W&S Comment:</u> Provide shop drawings for the 480V,3Ph actuators

<u>Charter MC Response:</u> All data sheets pertaining to the Motor Starters in the control panel are in the submittal pages 335 to 386. This includes dimensions and internally layouts of the devices.

<u>W&S Response:</u> This is acceptable.

END OF COMMENTS

Water Treatment Machines Division
A GEC Subsidiary

MECHANICAL and ELECTRICAL SUBMITTAL R1

One (1) THREE BELT TOWER PRESS - Model 3BTP22.593S
One (1) Polymer System - Model L2.10
One (1) Sludge Feed Pump
Three (3) Shaftless Screw Conveyors

YOUR PROPOSAL NUMBER – 190717-C1 CHARTER MACHINE PROJECT NUMBER – 806.22.593

PREPARED FOR

DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

CONSULTING ENGINEERS

WIEDEMAN AND SINGLETON, INC.

3091 Governors Lake Drive Suite 430 Norcross, GA 30071

AUTHORIZED SALES REPRESENTATIVES

TEMPLETON & ASSOCIATES

4324 Brogdon Exchange Suite 100 Suwanee, Georgia 30024 PH: 770-614-8550

February 12, 2020





Memorandum

To: Stanley Mize – Templeton & Associates

Christopher Boyd – Charter Machine Company

Cc: Brooke Anderson, Tim Collins, David Zimmer, Peter Johns

From: Shawn McCaffrey, Ahmed An-naim

Date: February 12, 2020

Re: Charter Machine Company Submittal – Belt Press and Appurtenances

Charter Proposal No. 190717-C1 (Project No. 806.22.593)

Job No.: 273-18-210 Dawson Forest WRF Sludge Dewatering Upgrades

We have reviewed the referenced submittal, for the Belt Press and Appurtenances for the Dawson Forest WRF Sludge Dewatering Upgrades project, received on January 14, 2020 from Templeton & Associates, and have the following comments:

1. Please confirm the Charter Machine project number. On the cover page it is listed as 806.22.593 and on page 33 of the PDF submittal it is listed as 758.22.593.

The project number is 806.22.593; The number on page 33 has been updated. Page 37 this submittal.

2. Please provide Drawing No. 806-K-TAGS. It is listed in the Table of Contents but has not been included in the Submittal.

Drawing 806-K-TAGS has been supplied.

3. Please confirm the Netzsch Sludge feed pump dimensions. The dimensions for the sludge pump on layout drawing 785-X-0101 do not match those of the shop drawing from Tab 18 – Drawing B-076BY20.

The sludge pump drawings have been updated.

- 4. For both Conveyors 'B' change Layout Drawings 785-X-0104 and 806-H-0202 as follows:
 - a. Change the 77 ½" dimension between the inlet hopper centerline and sliding gate discharge point centerline to 120".

The 77 1/2" dimension has been updated to 120".

b. Change the 90" dimension between the sliding gate discharge point centerline and the open discharge point centerline to 126".

The 90" dimension has been updated to 126".

c. Adjust the conveyor lengths accordingly. If this increases the equipment costs, please advise.

The conveyor lengths have been updated; please see attached.

5. Please provide anchoring requirements for the belt press, sludge feed pumps, air compressor, and booster pump. Anchoring requirements shall include anchor size, type, embedment depth, and epoxy type to be used. Please note that wedge type anchors are not permitted.

Charter Machine recommends a highly corrosion resistant (i. e. 316 stainless steel) anchor bolt; and an epoxy that is rated for a wet, possibly corrosive environment. The anchor bolt and epoxy must have sufficient strength for the application.

Below is a table showing <u>typical</u> epoxy anchor bolt diameters, hole diameters and embedment depths.

| Anchor Dia. (") | <mark>3/4</mark> | <u>5/8</u> | 1/2 | 3/8 |
|-----------------|------------------|------------------|-------|-------------------|
| Hole Dia. (") | <u>5/8</u> | <mark>3/4</mark> | 9/16 | <mark>7/16</mark> |
| Depth (") | 6 3/4 | 5 5/8 | 4 1/2 | 3 1/2 |

Detailed site calculations made by a qualified professional engineer using as a minimum: equipment weights, anchor bolt tension /shear strengths, concrete breakout strength, epoxy bond failure strength and seismic load conditions should be obtained before anchoring any equipment.

6. Please be aware that Charter Machine recommends the air compressor to be located so it has a source of clean air (see page 93 of the pdf submittal file). We can't locate the air compressor in another room; do we have to plumb the intake to a clean dry air source? The outside air may be as humid as the belt press room. There is a filter coalescer regulator on the air output line. Is the filter coalescer used to remove oil or water from the air stream? Will this take care of the moisture in the air if we plumb the air intake to the interior of the belt press room or even outside? Or do we need a dessicant type dryer? Is an automatic condensate drain on the air compressor available? Please advise how dry the air should be.

As with all compressed air applications the dryer the better. Most of our installations (90%+) have the air compressor and intake in the dewatering room. The coalescing regulator is used to remove moisture in the air stream. There is an auto drain on the tank.

7. Please confirm the suction and discharge connection sizes for the booster pump. This was not clear in the submittal.

The connection sizes for the booster pump are: suction 2", discharge 1"

8. Please note there is only one polymer feed point. There is approximately 55-feet of 6-inch ductile iron pipe with 5 - 90° bends between the polymer feed point and the belt press inlet connection. Please confirm that this is acceptable.

Final location of the polymer injection point and mixer assembly can only be determined based upon actual testing of the dewatering system. Due to the variability of process parameters in any installation, Charter Machine recommends provisions be made in the sludge feed piping to allow a minimum of 2 locations for polymer injection points (mixer assembly locations). The first approximately 15 to 20' prior to the inlet of the dewatering equipment and the second approximately 30 to 40' prior to the inlet of the dewatering equipment.

The mixer assembly is 19" long. We recommend that a 19" spool piece be installed at the second location; and the mixer installed at the first. Charter Machine requests that the polymer feed line be plumbed to each of the potential polymer injection points and that a ball valve be installed at each injection point. Upon start-up, the polymer injection ring and mixer assembly shall be moved to determine the best location for polymer application and the amount of mixing required for the particular sludge. Any unused polymer injection locations can be isolated from the sludge line and used as polymer sampling ports; if so desired.

9. Panel Drawings

a. Confirm if the booster pump spare is being installed. If not, please delete all reference to it on the panel drawings (e.g., 806-K-0101-INT).

No spare booster pump is being supplied

b. Label the conveyors to match the designations given in the Layout Drawings and Tabs 16 and 17 (i.e., 1x Conveyor A and 2x Conveyor B).

The conveyor designations have been updated.

c. The control panel needs a through the door, lockable, disconnect switch.

KXT2N4XFLHDL4 ABB DISC MECHANISM Part listed in the bill of materials and on the Enclosure layout. Reference bubble mismarked should reference line 3 on BOM on the page.

d. The Owner's SCADA system will communicate to the Belt Press Panel Micrologix 1400 via an ethernet cable (Ethernet/IP) which will connect to the ethernet switch in the Belt Press Panel.

Panel contains an Ethernet switch for the possible use of SCADA interconnection with the customer.

e. Provide shop drawings for the 480V,3Ph actuators.

All data sheets pertaining to the Motor Starters in the control panel are in the submittal pages 335 to 386. This includes dimensions and internally layouts of the devices.

END OF COMMENTS

DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

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INSTALLATION AND HANDLING INSTRUCTIONS

<u>FOR</u>

CHARTER MACHINE COMPANY

THREE BELT TOWER FILTER PRESS

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1. INTRODUCTION

We at the Charter Machine Company would like to thank you for choosing Charter Machine dewatering equipment. Below is information to familiarize yourself with your equipment prior to delivery and installation. We took great care in fabricating this equipment, and would like to see that its installation is as easy as possible for you, the contractor.

2. DELIVERY

Charter Machine's dewatering equipment is fully assembled and tested in our Metuchen, New Jersey factory prior to shipment.

Shipment of equipment is typically made via standard flat bed trailers. If special shipping requirements are necessary, please notify us so arrangements can be made.

3. <u>UNLOADING</u>

Prior to equipment arriving on-site, arrangements should be made so that a crane and crew are ready to receive the dewatering equipment when it arrives. Before the equipment is off loaded, a quick inspection should be conducted to look for obvious signs of damage that may have occurred during transit.

All Charter Machine Three Belt Tower Presses have four lift points on each section, which should be used when removing the equipment from the trailer. Each lift point is designed to accommodate a standard lifting (chain) shackle with 1" diameter pin. Ideally, two spreader bars should be used when lifting and moving the machine. The spreader bars should be connected across the width of the machine and then each spreader bar should be connected to a central lift point.

4. STORAGE

If the dewatering equipment is not going to be installed immediately upon receipt, place each section on a wooden platform or other hard, clean, dry surface in an area where the equipment will not be damaged. The dewatering equipment should be left in its protective plastic covering, or re-covered with a plastic or canvas tarp. Any miscellaneous equipment shipped with the belt press (pumps, compressors, spare parts, control panels) should be stored under dry, weatherproof covering.

5. INSTALLATION

First the belt press section should be placed on its foundation and leveled with stainless steel shims. Next the gravity belt thickener section should be placed on its foundation and leveled with stainless steel shims. We recommend that for thickener section and the press section four (4) $\frac{3}{4}$ x 8 $\frac{1}{2}$ " anchor bolts (supplied by the contractor) are grouted in-place after the entire machine has been positioned.

All thickener mounted electrical controls are prewired to a common electrical terminal box (or control panel) mounted on the thickener section. All press mounted electrical controls are prewired to fullest extent possible. The contractor will terminate the existing wires in the thickener mounted terminal box, and then wire between the thickener terminal box and main electrical control panel. Additional wiring between the main control panel and auxiliary equipment (air compressor, sludge pump (s), water pump (s), polymer system (s), etc.) will be required where necessary. All connections will be clearly labeled.

The contractor shall be responsible for all necessary gaskets, fasteners, and hardware for piping connections to the dewatering equipment.

The sludge inlet on the thickener section is typically either a 4" or 6" diameter flanged connection (see equipment submittal).

The water inlet to the unit is typically a 2" diameter PVC socket connection. A 2" diameter NPT connection is supplied if a water solenoid valve is specified. If the unit is supplied with a booster pump the contractor will be responsible for plumbing from the plants water supply to the inlet of the water booster pump and from the pump to the inlet on the press. If the unit is supplied with a water "recycle" option, the contractor will also be responsible for plumbing from the thickener's filtrate collection pan to the inlet of the water booster pump; 2" schedule 80 PVC piping is typical and all connections will be clearly labeled.

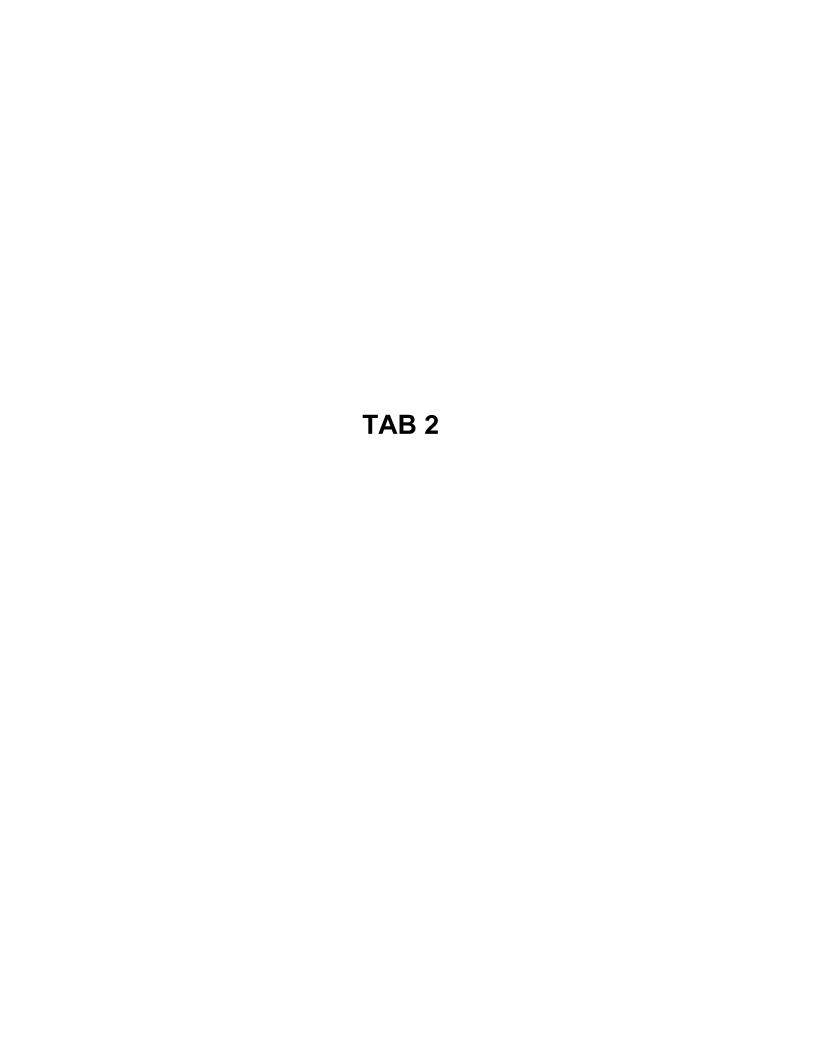
All thickener section mounted pneumatic components are preplumbed to a common pneumatic terminal box. All press section mounted pneumatic components are preplumbed to the fullest extent possible, and the contractor shall plumb the bundled pneumatic lines to the pneumatic terminal box mounted on the thickener. The contractor shall be responsible for all plumbing requirements between the air compressor, or plant air system, and the unit's ¼" diameter NPT air inlet. All connections will be clearly labeled.

After installation of the dewatering equipment, the unit should be covered with a plastic or canvas tarp to protect the unit from construction debris until ready for start-up.

6. START-UP

After the belt press and all ancillary dewatering equipment have been installed, the unit is ready for start-up. In order to honor the equipment warranty, a Charter Machine service technician must be present to verify installation of the equipment and conduct start-up services. Please contact Charter Machine as far as possible in advance of when start-up is to take place.









Your Complete Source for Dewatering Equipment

LABORATORY BENCH TEST

CUSTOMER: Etowah WSA

Date: September 11th 2019

pH:

| | | | | | | <u> </u> | Filtrate | |
|----------|-----------------|--------------|----------|-------------|--------|----------------|----------|---------|
| Sample # | Sludge quantity | Polymer code | Solution | Polymer. ml | Mixing | Floccformation | PSI | Capture |
| 1 | 200 | 9446x40 | 0.2 | 26 | 5 | med stranded | 60 | 98% |
| 2 | 200 | 9446x40 | 0.2 | 26 | 5 | med stranded | 100 | 98% |
| 3 | 200 | 9419x40 | 0.2 | 20 | 5 | med stranded | 60 | 98% |
| 4 | 200 | 9419x40 | 0.2 | 20 | 5 | med stranded | 100 | 98% |
| 5 | 200 | 9428x40 | 0.2 | 14 | 5 | med stranded | 60 | 98 |
| 6 | 200 | 9428x40 | 0.2 | 14 | 5 | med stranded | 100 | 98 |
| 7 | 200 | 9507fs40 | 0.2 | 18 | 5 | med stranded | 60 | 98 |
| 8 | 200 | 9507fs40 | 0.2 | 18 | 5 | med stranded | 100 | 98 |
| 9 | | | | | | | | |
| 10 | | · | | | | | | |

Mixing: The number indicate how often the sludge samples were transferred from one beaker to the other.

Polymer consumption in lbs/t/ds

| Sample # |] | |
|----------|---|-------|
| 1 | | 35.74 |
| 2 | | 35.74 |
| 3 | | 27.49 |
| 4 | | 27.49 |

| Sample # | |
|----------|-------|
| 5 | 19.24 |
| 6 | 19.24 |
| 7 | 24.74 |
| 8 | 24.74 |

SAMPLE EVALUATION

| Sample # | Average Feed | 1 | 2 | 3 | 4 | 5 | 6 | |
|-----------------|--------------|-------|-------|-------|-------|-------|-------|---------|
| Cake | | X | X | X | х | X | X | |
| Feed | Х | | | | | | | |
| Gravity drained | | | | | | | | |
| Dish # | | 1 | 2 | 3 | 4 | 5 | 6 | |
| Tare | | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | |
| Wet and tare | 41.6 | 13.13 | 8.2 | 13.3 | 10.7 | 18.6 | 19.3 | |
| Wet | | 10.93 | 6 | 11.1 | 8.5 | 16.4 | 17.1 | 0 |
| Dry and tare | | 4.4 | 3.4 | 4.9 | 4.2 | 4.7 | 5.3 | |
| Dry | 0 | 2.2 | 1.2 | 2.7 | 2 | 2.5 | 3.1 | 0 |
| % total solids | 1.46 | 20.13 | 20.00 | 24.32 | 23.53 | 15.24 | 18.13 | #DIV/0! |



Your Complete Source for Dewatering Equipment

LABORATORY BENCH TEST

| CUSTOMER: | Etowah WSA |
|-----------|------------|
| | |

Date: September 11th 2019

pH:

Filtrate

| | Filtrate | | | | | | | |
|----------|-----------------|--------------|----------|-------------|--------|----------------|-----|---------|
| Sample # | Sludge quantity | Polymer code | Solution | Polymer. ml | Mixing | Floccformation | PSI | Capture |
| 1 | 200 | 9446x40 | 0.2 | 26 | 5 | med stranded | 60 | 98% |
| 2 | 200 | 9446x40 | 0.2 | 26 | 5 | med stranded | 100 | 98% |
| 3 | 200 | 9419x40 | 0.2 | 20 | 5 | med stranded | 60 | 98% |
| 4 | 200 | 9419x40 | 0.2 | 20 | 5 | med stranded | 100 | 98% |
| 5 | 200 | 9428x40 | 0.2 | 14 | 5 | large stranded | 60 | 98 |
| 6 | 200 | 9428x40 | 0.2 | 14 | 5 | med stranded | 100 | 98 |
| 7 | 200 | 9507fs40 | 0.2 | 18 | 5 | med stranded | 60 | 98 |
| 8 | 200 | 9507fs40 | 0.2 | 18 | 5 | med stranded | 100 | 98 |
| 9 | | | | | | | | |
| 10 | | | | | | | | |

Mixing: The number indicate how often the sludge samples were transferred from one beaker to the other.

Polymer consumption in lbs/t/ds

| Sample # | |
|----------|-------|
| 1 | 35.74 |
| 2 | 35.74 |
| 3 | 27.49 |
| 4 | 27.49 |

| Sample # | |
|----------|-------|
| 5 | 19.24 |
| 6 | 19.24 |
| 7 | 24.74 |
| 8 | 24.74 |

SAMPLE EVALUATION

| Sample # | Average feed | 7 | 8 | composit | | | feed | feed |
|-----------------|--------------|-------|-------|----------|---------|---------|------|------|
| Cake | | X | Х | | | | | |
| Feed | | | | | | | X | Х |
| Gravity drained | | | | X | | | | |
| Dish # | | 7 | 8 | 9 | | | F3 | F4 |
| Tare | | 2.2 | 2.2 | 2.2 | | | 2.2 | 2.2 |
| Wet and tare | | 10.6 | 28.8 | 49.7 | | | 41.6 | 38.3 |
| Wet | 0 | 8.4 | 26.6 | 47.5 | 0 | 0 | 39.4 | 36.1 |
| Dry and tare | | 3.7 | 6.8 | 4.8 | | | 2.8 | 2.7 |
| Dry | 0 | 1.5 | 4.6 | 2.6 | 0 | 0 | 0.6 | 0.5 |
| % total solids | 1.46 | 17.86 | 17.29 | 5.47 | #DIV/0! | #DIV/0! | 1.52 | 1.39 |

Dewatering Equipment Machines Division

A GEC Subsidiary

DATE: September 18, 2019

TO: Stanley Mize

Templeton Associates

PROPOSAL: Charter Machine Company (CMC)

Lab Bench Test Report

PROJECT: Dawson/Etowah WSA GA Dewatering

INTRODUCTION: Charter Machine Co. received sample of sludge from the Etowah plant for lab testing. Charter performed lab testing with multiple different Charter stock polymers.

PROTOCOL: The lab technician mixed up different polymer solutions to neat concentrations of 0.2% and the used those polymers to dose 200ml of sludge in increasing dosages to see how well the sludge would floc. Then once a polymer dosage is determined, that amount is added to 200 ml of sludge to perform a one time dosage and mixing. Then that material is drained through a piece of belting material. The sample is then subjected to pressing through a proprietary machine to simulate belt press conditions. Normal 8 roll and High Solids 15 roll pressures were used to determine if more time under pressure would equate to drier cake solids Please note that these conditions are only static and can not exactly simulate the dynamic conditions found in a continuous fed belt press. After pressing, cake is then weighed and dried to determine cake solids concentration.

SLUDGE AND POLYMER CONDITION:

All the polymers that were tested formed a range of medium to large floc. With this large floc, all of the samples produced very good results with cake solids over 18% easily while using 10-17 Active pounds per ton of polymer and delivering an excellent clear filtrate (98%+ recovery). The sludge that was jar tested had a feed solids of 1.46%. The decant was crystal clear.

CONCLUSIONS/RECOMMENDATIONS:

The simulated 8 roll version produced the as bid 18% T.S. cake solids. The simulated 15 roll version produced 20-22%T.S. cake solids so by adding the extra pressure rolls, the average cake produced may increase by at least 2 percentage points and can be as high as 4 percentage points higher.

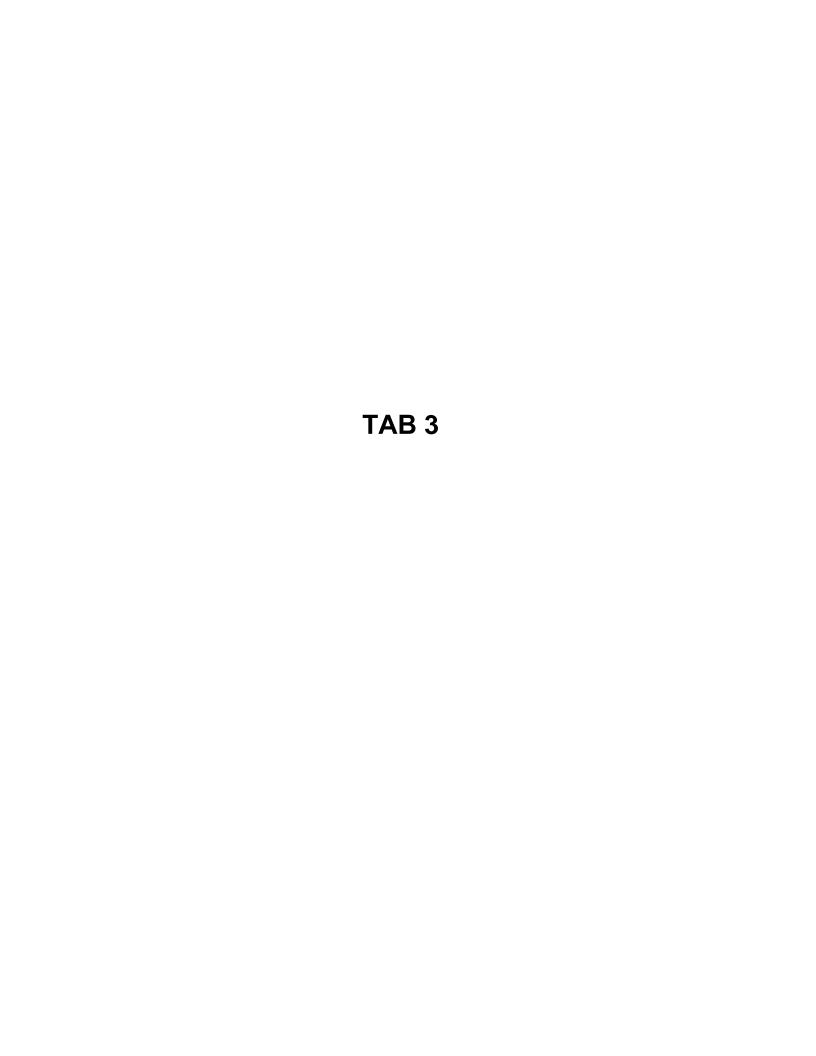
Please remember that this is static lab testing and does not simulate solids loading on the press but only the achievable cake solids. Lower solids loading rates on a belt press always result in better dewatering and the opposite is always true. Just some things to keep in mind when designing hours of operation and flow rate to the belt press.

Thank you for your time and review of our information presented. If you have any questions, please call or email.

Very truly yours, Charter Machine Company

Christopher Boyd Director of Sales

732-425-7489





Dewatering Equipment Machines Division A GEC Subsidiary

DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

EQUIPMENT WARRANTY

CHARTER MACHINE COMPANY shall warranty its equipment to be free from defects in material and workmanship for a period of one (1) year after final acceptance by Owner, provided any such defect as may appear is not the result of inadequate preventive maintenance. Upon receipt of notice from the Owner of failure of any part of the equipment during the warranty period, the affected part(s) shall promptly be replaced by, and at the expense of, CHARTER MACHINE COMPANY.

Dewatering Equipment Machines Division
A GEC Subsidiary

DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

EQUIPMENT FRAME AND COATING

CHARTER MACHINE COMPANY shall warranty the equipment frame and frame coating for a period of one (1) year from the date of acceptance by the owner. This warranty shall include manufacturing defects, structural integrity and coatings. Defects or corrosion shall be repaired or replaced at no additional cost to the owner. The frame and coating shall not require preventative maintenance during this warranty period. Physical damage to the equipment could cause structural failure or corrosion and will void the warranty. We recommend maintaining an operational program that includes good housekeeping.

Dewatering Equipment Machines Division A GEC Subsidiary

DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

GRAVITY BELT SECTION ROLL SUPPORT BEARINGS

CHARTER MACHINE COMPANY shall warranty the roll support bearings for the life of the unit. This warranty shall include all parts for repairing or replacing any roll bearing that fails during that warranty period, providing that they have been properly lubricated as set forth in the lubrication schedule included with the Operation and Maintenance Manuals.

Dewatering Equipment Machines Division A GEC Subsidiary

DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

PRESSURE SECTION

ROLL SUPPORT BEARINGS

CHARTER MACHINE COMPANY shall warranty the roll support bearings for a period of five (5) years from the date of acceptance by the owner. This warranty shall include all parts and labor for repairing or replacing any roll bearing that fails during that warranty period, providing that they have been properly lubricated as set forth in the lubrication schedule included with the Operation and Maintenance Manuals.

Dewatering Equipment Machines Division
A GEC Subsidiary

DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

GRAVITY ZONE DE-WATERING BELTS

CHARTER MACHINE COMPANY shall warranty the de-watering belts for a belt life of two thousand (2000) hours operation at the rated design conditions from the date of acceptance by the owner. This warranty shall include all parts including the belts and connecting clipper splices. This warranty covers belt damage caused by malfunction of the equipment but does not cover belt damage caused by inadequate belt washing, application of chemicals detrimental to polyester fabrics, application of heat detrimental to polyester fabrics, continued operation of the equipment after the alarm system has signaled a malfunction without clearing the cause of the malfunction, and intrusion of foreign objects including, but not limited to, tools, fasteners and stones.

Dewatering Equipment Machines Division
A GEC Subsidiary

DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

TOWER PRESS DE-WATERING BELTS

CHARTER MACHINE COMPANY shall warranty the de-watering belts for a belt life of two thousand (2000) hours operation at the rated design conditions from the date of acceptance by Charter Machine Company and the owner. The validation of any claims made against such warranty shall be determined by Charter Machine Company. This warranty shall include all parts including the belts and connecting clipper splices. This warranty covers belt failure caused by faulty manufacture of the belt only and does not cover belt damage caused by component failures of the equipment, inadequate belt washing, application of chemicals detrimental to polyester fabrics, application of heat detrimental to polyester fabrics, continued operation of the equipment after the alarm system has signaled a malfunction without clearing the cause of the malfunction, and intrusion of foreign objects including, but not limited to, tools, fasteners and stones.

Dewatering Equipment Machines Division A GEC Subsidiary

DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

ROLLS

CHARTER MACHINE COMPANY shall warranty the operation, structure and coating of the rolls for a period of one (1) year from the date of acceptance by the owner. Any roll found to be defective or inoperable shall be replaced or repaired. Physical damage to the equipment could cause structural failure or corrosion and will void the warranty. We recommend maintaining an operational program that includes good housekeeping.

Dewatering Equipment Machines Division
A GEC Subsidiary

CHARTER MACHINE COMPANY

WARRANTY

TERMS and CONDITIONS

Charter Machine Company warrants that the equipment and components furnished will be and remain free from defects in workmanship and materials as stated in the warranties Charter Machine Company will replace, modify or repair, any defective component or equipment, provided that Charter Machine is notified promptly in writing of any claimed defect and, if requested by Charter Machine, any part or component is returned to Charter Machine. All warranties offered by Charter Machine Company are based upon proper storage and installation. All warranties are based upon the proper operation and maintenance of the equipment as per the operation and maintenance manuals provided. Any damage due to misuse or utilizing the equipment in a manner for which it was not intended will void the warranty. Any unauthorized modification or alteration of the equipment or replacement of components may void the warranty. All equipment and components will be shipped in one lot by the lowest cost method and will be the responsibility of the owner. All repairs or shipments of parts will be provided during normal working hours, weekend, holiday or special arrangements must be coordinated through Charter Machine. The cost for replacement or repair by Charter Machine Company does not include: other consequential, incidental, special or other form of damages; costs or labor for removal or re-installation; and items over which Charter Machine has no control such as but not limited to structural alteration, demolition or building design or configuration.





DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

CHARTER MACHINE PROJECT NUMBER - 806.22.593

SPECIFICATIONS

GRAVITY BELT THICKENER/BELT FILTER PRESS

3-BELT COMBINATION UNIT

CHARTER MACHINE COMPANY

Model - 3BTP22.593S - 2.2 Meter Belt Width

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1. GENERAL

- 1.1 The Gravity Belt Thickener/Belt Filter Press furnished under this contract shall comply with the following specifications, which are based upon proven design. That design combines high strength structural integrity, extensive material longevity, minimal maintenance and utility requirements and state of the art process resulting in superior overall performance.
- 1.2 The Combination gravity belt thickener/belt filter press shall be of a three-belt design with three distinct dewatering zones, including an independent gravity-dewatering zone, wedge zone and a shear/pressure zone. The gravity zone shall be independent of the wedge zone and shear/pressure zone making it possible to select different dewatering belts and vary the speed of each area independently of the other for dual use purposes. The separation of the gravity and pressure areas shall optimize throughputs enhancing the hydraulic capacity of the press when processing diluted sludges. Each machine shall be designed to serve both as a belt press and also as an independent gravity belt thickener.
- 1.3 The combination 3-Belt Unit shall be designed, fabricated, assembled and tested by the belt filter press manufacturer in their own facility. In order to provide maximum quality assurance, personnel employed by the manufacturer shall perform all aspects of the design, fabrication and assembly. The belt filter press manufacturer shall at the same facility maintain a suitable spare parts inventory.
- 1.4 The belt filter press manufacturer is to have a minimum 20 years of experience in the development and manufacturing of Gravity Belt Thickeners and Belt Filter Presses.
- 1.5 The equipment shall be guaranteed against defects in material and workmanship under normal use and service for a period of period of thirty (30) months after delivery or twenty-four (24) months after final acceptance by Owner during which time repairs or replacements shall be made without charge.
- 1.6 All equipment, which deviates from the following specifications, will be acceptable only on the basis that all costs associated with any revisions in the engineering or construction will be the responsibility of the contractor.

2. DESIGN CRITERIA

2.1 Number of 3-belt combination unit(s) required: (1)

| 2.2 | Model | Belt Width Minimum | Width Overall | Length Overall | Height Overall |
|-----|--------|-----------------------|---------------|----------------|----------------|
| | 3-Belt | 2.2m | 10'-9" | 26'-8" | 8'-11" |

- 2.3 The Combination 3-Belt Unit(s) shall be Charter Machine Company Model: 3BTP22.593S
- 2.4 Each Gravity Belt Thickener/Belt Filter Press shall be capable of operating satisfactorily under the following performance conditions:

| Description | Charac | teristics | |
|--|--|-----------|--|
| | GBT BFP | | |
| Sludge Type | Mixture primary and aerobically digested WAS | | |
| Number of units | 1 | 1 | |
| Effective width of filter belt, meters | 2.0 | 2.0 | |
| Average infeed solids, % | 1.0-2.0 | 1.0-2.0 | |
| Minimum solids loading rate lbs. ds / hour | 1,000 | 1,000 | |
| Minimum cake solids, % | | 17 | |
| Minimum dry solids capture, % | 95 | 95 | |
| Overall range of belt speed, ft / min. | 10-75 | 3-20 | |

3. MAIN FRAME

- 3.1 The main frame coating is crucial to the protection of the thickener/press. All frame members shall be prepared and coated according to ASTM A123, hot dip galvanized to a minimum 5-mils thickness. All frame members shall be drilled and machined prior to galvanizing and all bolted connections shall be disassembled prior to galvanizing.
- 3.2 All hardware used in assembly shall be ½" diameter minimum, type 304 stainless steel.
- 3.3 THICKENER SECTION The thickener section frame shall be constructed of welded and bolted 6" x 18 MC channels conforming to ASTM Specification A36 and sized such that, during installation and under conditions of operational loading, the deflection of no frame member shall exceed 0.0036". The minimum frame safety factor shall be greater than 18.0.

3.4 PRESSURE SECTION - The press section frame shall be a box frame of welded and bolted tubing conforming to ASTM Specification A36. Pressure roller bearings shall be installed on 8" x 22.8" MC channels and the remaining principle frame members shall be 6" x 18.0" to accommodate all operating and static loads without significant deflection, deformation or vibration. Maximum operational loading shall be defined as the sum of the belt tension load based on a belt tension of 50 pli; friction loads; roller, equipment and sludge loads; any loads induced by the belts; and any loads induced by the torque of the drive. The pressure zone main beams shall have a moment of inertia of at least 60 inches to the fourth power. The frame safety factor shall be greater than 7.7 with a maximum frame deflection of 0.017".

4. FLOCCULATOR

- 4.1 The gravity belt thickener shall be furnished with an upstream sludge-conditioning device consisting of an inline adjustable orifice venturi type mixer complete with polymer injection device. The mixer shall be designed to condition the sludge with polymer to result in a degree of flocculation that will produce the greatest amount of dewatering while maintaining the highest quality filtrate.
- 4.2 The inline mixer will have 6-inch flanged connections and be constructed of type 304 stainless steel. Also included will be a UHMW polyethylene injection ring, providing one complete unit.
- 4.3 Location of the inline mixer will vary with the application. Contractor shall provide spool pieces if indicated.

5. GRAVITY DEWATERING ZONE

- 5.1 The gravity-dewatering zone shall consist of a 12-foot section of the horizontal filter belt. The minimum dewatering area shall be, 89 square feet. The gravity dewatering zone shall be independent of the belt filter press section and be capable of operating in a thickening mode only, utilizing its own drive, tensioning and tracking systems.
- 5.2 A type 304 stainless steel head-box shall distribute sludge onto the horizontal dewatering belt.
- 5.3 The sludge shall be contained on the belt by type 304 stainless steel side channels with neoprene seals.
- 5.4 A grid of UHMW polyethylene wear bars shall support the dewatering belt. Each wear bar can be replaced on the hot-dipped galvanized support structure without disassembly or removing any additional components.

- 5.5 Thickened sludge shall gently be turned by 75 individually adjustable sludge plows evenly spaced along ten (10) rows. The sludge plows shall be constructed of 20% glass filled polypropylene and shall be free floating to ride on the filter belt.
- 5.6 Each row of plows shall be on a one-piece grid assembly. The plow assembly shall be operated by using a four-way pneumatic hand valve to enable the entire plow assembly to be raised from the filter belt for cleaning purposes.

6. THICKENED SLUDGE DISCHARGE ZONE

6.1 A counterweighted doctor blade shall be mounted at the discharge roller for removing sludge cake from the belt. The doctor blade shall be constructed of UHMW polyethylene. The blade shall be rigidly reinforced to provide even, gentle pressure on the belt with a minimal amount of abrasiveness and shall be capable of providing passage clearance for the belt seam without injuring that seam.

7. WEDGE ZONE

- 7.1 The wedge zone shall be provided to transition the thickened sludge to the shear/pressure zone from the gravity zone. The wedge zone initiates the pressure on the sludge by converging the two belts to form the cloth/cake sandwich.
- 7.2 The wedge zone will be provided with a leveling bar and type 304 stainless steel containment sides for even distribution along the entire width of the belt.
- 7.3 The total wedge zone dewatering area shall be a minimum of; 32.0 square feet as measured along the lower belt.

8. HIGH PRESSURE/SHEAR ZONE

8.1 The high pressure/shear zone shall consist of a minimum of fifteen (15) rollers. The first shall be a 1/4" thick perforated drum of 26" diameter with perforations of minimum 7/8" diameter and minimum 34% open area. The succeeding rollers shall be solid faced decreasing in diameter from 20" to 14" to 11" and arranged in a vertical configuration with belt to roller contact exceeding 205 degrees. The total high-pressure dewatering area shall be a minimum of 218 square feet as measured along the length of a single belt in contact with the pressure rolls.

9. CAKE DISCHARGE ZONE

9.1 Adjustable pneumatically loaded doctor blades shall be mounted at the discharge rollers for removing sludge cake from both belts. The doctor blades shall be power retractable and can be held away from the filter belts for cleaning and maintenance. The amount of pressure the doctor blades exert equally against both belts can be

- varied while the machine is operating. The adjustment of the doctor blades can be regulated from a pneumatic control panel located on the thickener section.
- 9.2 The doctor blades shall be made from UHMW polyethylene. The blades shall be rigidly reinforced to provide even gentle pressure on the belts with a minimal amount of abrasiveness and shall be capable of providing passage clearance for the belt seam without injuring the seam.
- 9.3 A 14-gauge type 304 stainless steel chute shall be provided to accommodate the method of removal.

10. ROLLERS

- 10.1 The perforated drum shall be of through shaft design with internal bulkhead and matched deflection of shaft and end plates. All other rollers shall be of stub shaft design with each stub secured by an end plate and an internal bulkhead. Assembly of rollers, shafts, end plates, and bulkheads shall be of machined concentricity and by means of continuous weld. The shaft inserted into the bearing shall be machined and polished to a diameter of 2.953 inches (75mm).
- 10.2 Drive rollers and tracking rollers shall be coated with a minimum 3/8" thick synthetic rubber of 60 durometer to provide the friction required for efficient belt drive and tracking. All other solid rollers shall be coated to the point of insertion into the bearing with Rilsan Nylon II to a thickness of 25 mils by the Electro Static, Fusion Bonded Rilsan Powder Dispersion Process.
- 10.3 THICKENER SECTION All rollers shall be designed for a deflection of less than 0.05" at mid span under conditions of maximum operational loading. Maximum operational loading shall be defined as the sum of the belt tension load; friction loads; equipment and sludge loads; any loads induced by the elasticity of the belt; and any loads induced by the torque of the drive. Minimum roll safety factor shall be 6.0. Maximum roll deflection shall be (in) 0.045", which is calculated using the belt tension of 50 PLI, and the drive torque of 6670 inch pounds.
- 10.4 PRESSURE SECTION All rollers shall be designed for a maximum deflection of 0.073" at mid span under maximum loading conditions. Maximum loading shall be defined as the sum of the belt tension load at 50 pli; friction loads; equipment and sludge loads; any loads induced by the elasticity of the belts; and any loads induced by the torque of the drive. Minimum roll safety factor shall be 2.94 at mid span.
- 10.5 PRESSURE SECTION The perforated drum shall be hot dip galvanized and shall be totally free of projections that may shorten belt life. The perforated drum shall be fabricated from ¼" thick, A-36 carbon steel. The carbon steel shaft shall be 3 ¾" dia. through the perforated roll and 2.952" dia. at the bearing

10.6 PRESSURE SECTION - The pressure rollers shall be arranged vertically on alternating sides of the main pressure frame. The diameters of the rollers starting with the perforated roll shall decrease in size up through the vertical stack to the first of five 10 ¾" diameter rolls, with each roller separately pan drained to prevent rewetting of the sludge on the preceding rollers.

11. ROLLER BEARINGS AND SEALS

- 11.1 All bearing housings shall be class 30 cast iron one-piece pillow block type with gasketed access plate as manufactured by Charter Machine Company. Bearing housings shall be cleaned and coated with Rilsan Nylon II to a minimum thickness of 12 mils by the Electro Static, Fusion Bonded Rilsan Powder Dispersion Process.
- 11.2 All bearing pads and bearing housings shall be machined at the factory to guarantee proper alignment. In addition each stub shaft shall be held in place with a lock ring to guarantee alignment and eliminate any slippage or misalignment that can occur with tapered sleeves and tightening ring arrangements
- 11.3 THICKENER SECTION Roller bearings shall have an L-10 rating greater than 3,495,000 hours per AFBMA test procedure under maximum loading conditions and calculated at a belt speed of 60 feet per minute. All bearings shall be double row spherical roller type with all grease fittings located for servicing from the machine exterior. Bearings shall have quadruple lip contact seals.
- 11.4 THICKENER SECTION All roller bearings located on the thickening portion of the combination 3-belt unit shall be guaranteed for the life of the unit.
- 11.5 PRESSURE SECTION Roller bearings shall have an L-10 rating greater than, 521,900 hours per AFBMA test procedure under maximum loading conditions as the sum of the belt tension load at 50 pli and calculated at a belt speed of 15 feet per minute. All bearings and grease fittings shall be located on the machine exterior for servicing and maintenance. All roller bearings shall be double row spherical. All bearings shall have quadruple lip contact seals.
- 11.6 PRESSURE SECTION All Tower Press roller bearings shall be guaranteed for five (5) years.

12. BELT TENSIONING

- 12.1 All belt tensioning shall be maintained pneumatically and controlled from the thickener mounted pneumatic control center.
- 12.2 Each filter belt shall be tensioned by a pair of corrosion resistant pneumatic cylinders attached to a rigid tensioning assembly. The tensioning assembly shall be attached to each tensioning cylinder in such a way as to assure parallel movement of the tensioning roller.

12.3 Each belt shall be tensioned individually and capable of changes while the machine is in operation. Tensioning pressure shall be gauged at the pneumatic control center. Tensioning cylinders shall be power retractable for belt replacement and emergency detensioning.

13. BELT TRACKING

- 13.1 Belt tracking shall be totally pneumatic and shall function as a continuous automatic belt guidance system. The belt shall be tracked by a type 304 stainless steel paddle arm and analog system sensor that monitors one edge of the belt and pneumatically signals a corrosion resistant pneumatic cylinder for corrective positioning when required. That corrective motion shall be smooth, minimal, and adjustable.
- 13.2 The belt tracking assembly shall be center pivoting complete with bearings to minimize dewatering belt stretch and wear.

14. PNEUMATIC CONTROL SYSTEM

- All belt pneumatic system controls, belt tensioning, tracking, sludge plow grid and doctor blades control shall be frame mounted on the thickener in a 304 S/S NEMA 4X enclosure. Low air alarm switch, tensioning and plow grid lift valves shall be mounted inside the enclosure. Tensioning on/off and plow grid lift levers, tension gauges, and adjustment controls shall extend through the enclosure wall for easy access. The enclosed controls shall be preceded by a three (3) micron air filter/regulator with gage a 0.1-micron oil coalescing filter and a full system lubricator. One (1) 1/4" female NPT supply air connection shall be required to the total pneumatic system
- 14.2 All pneumatic cylinders shall be rated for 200 PSI and constructed of anodized aluminum tube with stainless steel tie rods, Teflon seals and graphite bearings.
- 14.3 Each combination belt press and thickener shall be furnished with a receiver mounted single stage air compressor. The unit shall be complete with 17 gallon ASME Code receiver rated for 200 psi, pressure gauge, automatic overload protector, intake air filter-muffler, pressure switch, safety valve, tank drain, outlet valve, and constant speed regulator. The motor shall be 1.5 HP, TEFC with 1.15 service factor.

15. BELT WASH STATION

15.1 Each filter belt shall be equipped with a belt wash station for constant belt washing. The belt wash station shall include a manifold with removable stainless steel nozzles, internal hand wheel operated brush, hand wheel operated flush valve, and

stainless steel neoprene skirted enclosure for containing spray mist. Belt spray water shall be collected in the stainless steel enclosure and plumbed to the base sump. Spray nozzles shall be suitable for use with non-potable water with a maximum solids concentration of 200 mg/l without clogging.

15.2 One wash water booster pump will be provided to be utilized for both the gravity belt thickener and the high pressure section. The pump shall be centrifugal type with replaceable wear rings and shall be plumbed into the belt wash system by the Contractor.

16. FILTER BELT

- 16.1 The filter belt shall be of polyester monofilament wovenware with minimum tensile strength of 890 pounds per lineal inch. Belt edges shall be reinforced and sealed. The belt seams shall be type 316 stainless steel clipper type. Mesh shall be selected for optimal dewatering of the pertinent sludge. Belts shall be self-threading under power for replacement.
- 16.2 Replacement of filter belt shall be accomplished without any disassembly of any part of the gravity belt thickener except the belt seam.
- 16.3 Belt life will be warranted for 2,000 hours of operation.

17. DRIVES AND MOTORS

- 17.1 The belt drives shall be variable speed, shaft mounted on the drive roller shaft. The drive motor shall be severe duty TEFC of ample power for starting and operating under normal conditions without exceeding the nameplate horsepower.
- 17.2 The drive motor shall be a severe duty, TEFC, type motor of ample power for starting and operating under normal conditions without exceeding the nameplate horsepower. The drive motor shall have a service factor of 1.15.
- 17.3 All electrical controls for the drives shall be in the master control panel.

18. FACTORY WIRING

18.1 All equipment and components shall be factory wired using 600V minimum UL approved PVC/Nylon jacketed multi-conductor cable with stranded copper conductors and fittings wired to numbered terminal blocks in a frame mounted NEMA 4X junction box. The cable is suitable for Class 1, Division 2 hazardous locations. All cable shall be run and secured inside the MC channel frame wherever possible.

19. SAFETY FEATURES

- 19.1 Each section of the combination unit shall be equipped with a lanyard type safety switch with cable encircling that section at an easily accessible height.
- 19.2 The belt tracking system shall have a limit switch on each side of each belt that shall shut down the system in the event of belt tracking failure.
- 19.3 The belt tensioning system shall have a limit switch on each belt that shall shut down the system in the event of total belt failure.
- 19.4 Each pneumatic control center shall have a pressure switch that shall shut down the system in the event of low air pressure.
- 19.5 The wash water system shall have a pressure switch that shall shut down the system in the event of low water pressure.

20. UTILITY REQUIREMENTS

| 20.1 | Electrical | - | 460 volt, 3 phase, 60 Hz |
|------|------------|---|--------------------------|
| | | | |

20.2 Power (HP)

| GBT Drive | 2.0 |
|-------------------------|------|
| BFP Belt Drive | 5.0 |
| Air Compressor | 1.5 |
| Wash Water Booster Pump | 15.0 |

20.3 Belt Wash Water

Water @ 85 psi (min)

Thickening mode: 35 gpm (thickener only)

Dewatering mode: 105 gpm (thickener and press)

20.4 Pneumatics 3 cfm at 80-psi min., 250 psi max.

21. ELECTRICAL CONTROL PANEL

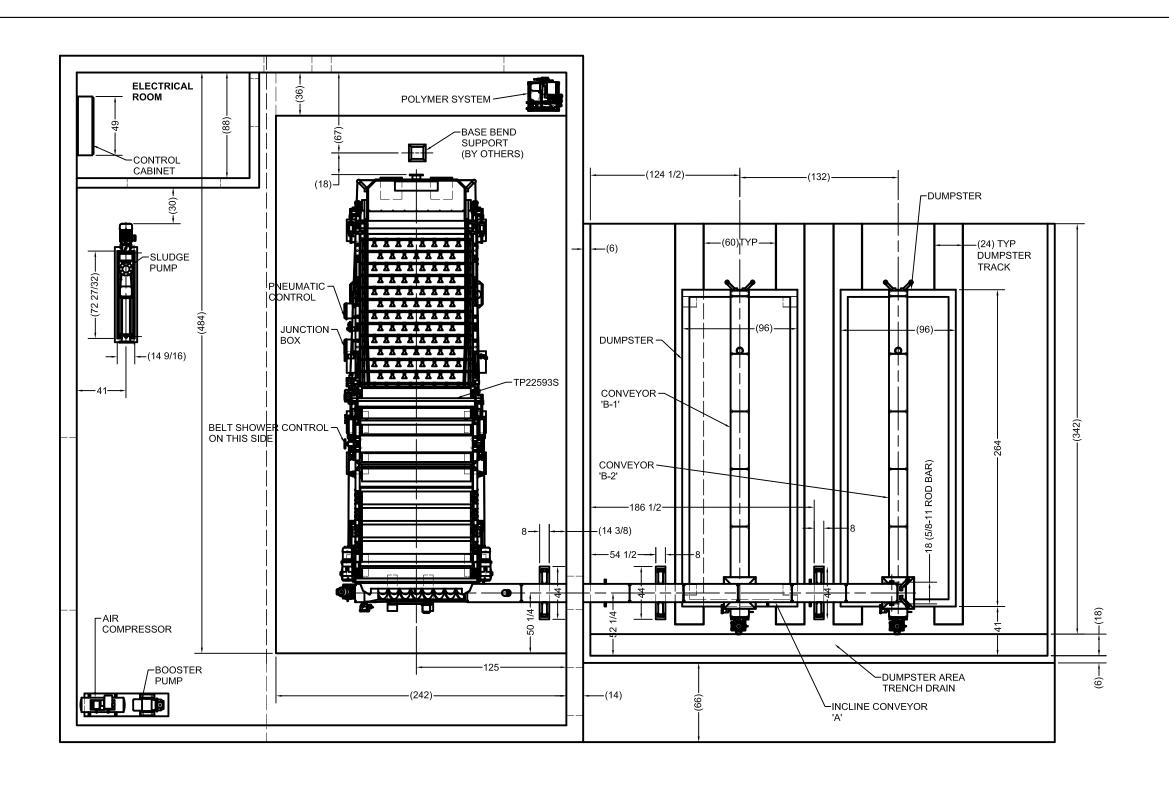
Each belt filter press shall be provided with a control panel that shall contain the necessary control devices and equipment for controlling the dewatering process as described in the contract specifications. The control panel shall accept 480 volts, 60 hertz, 3-phase, AC power input. This panel shall be specifically designed according to the specifications / documentation and as determined through the submittal process.

22. FIELD SERVICE

The manufacturer shall include the services of a factory-trained representative for the purposes of installation inspection, equipment start-up and training of plant personnel regarding proper operation and maintenance of the equipment.



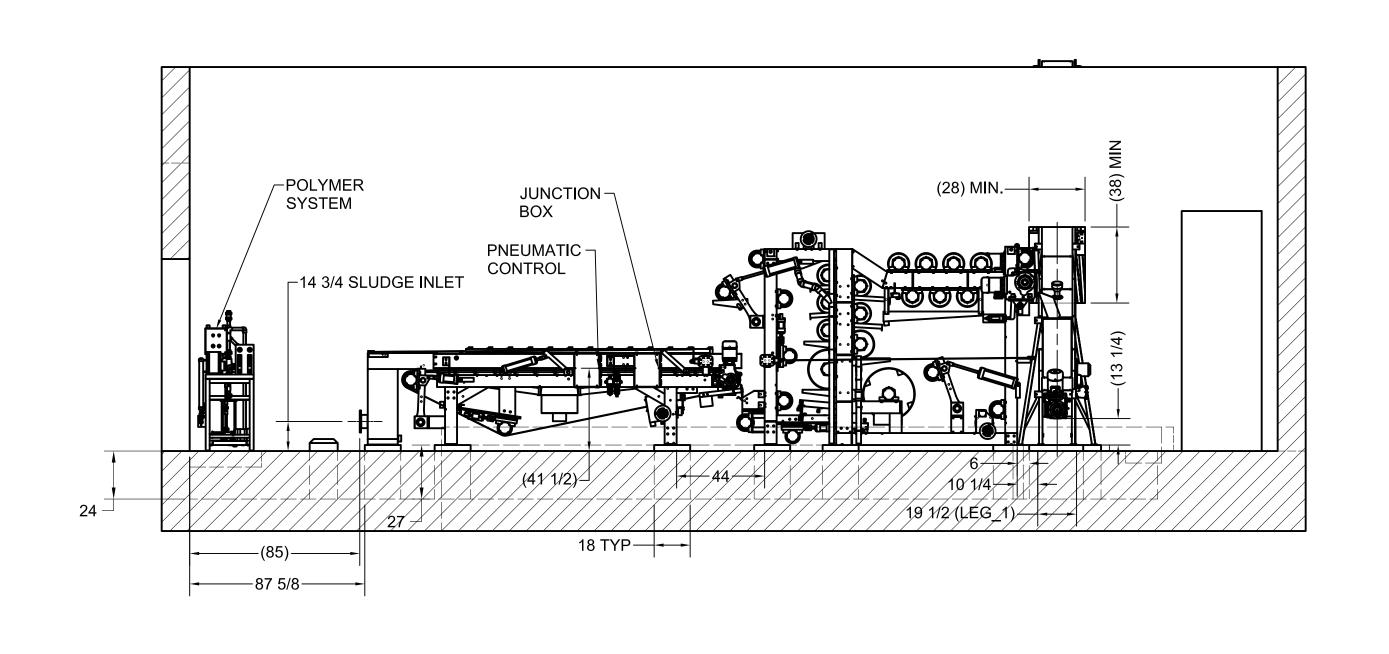




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| OTHERWISE SPECIFIED FRACTIONAL DIM ±1/64 | | | AN VIEW 593S | | | | | | |
| DECIMAL DIM ±.005 ANGLE ± 1/2 SURFACE FINISH 12: | = | SIZE B | | DWG No 806-X- | | | | | REV 1 |
| SURFACE FINISH 12 | 3 | SCALE | 1:48 | | | SHEET | 1 | OF | 1 |

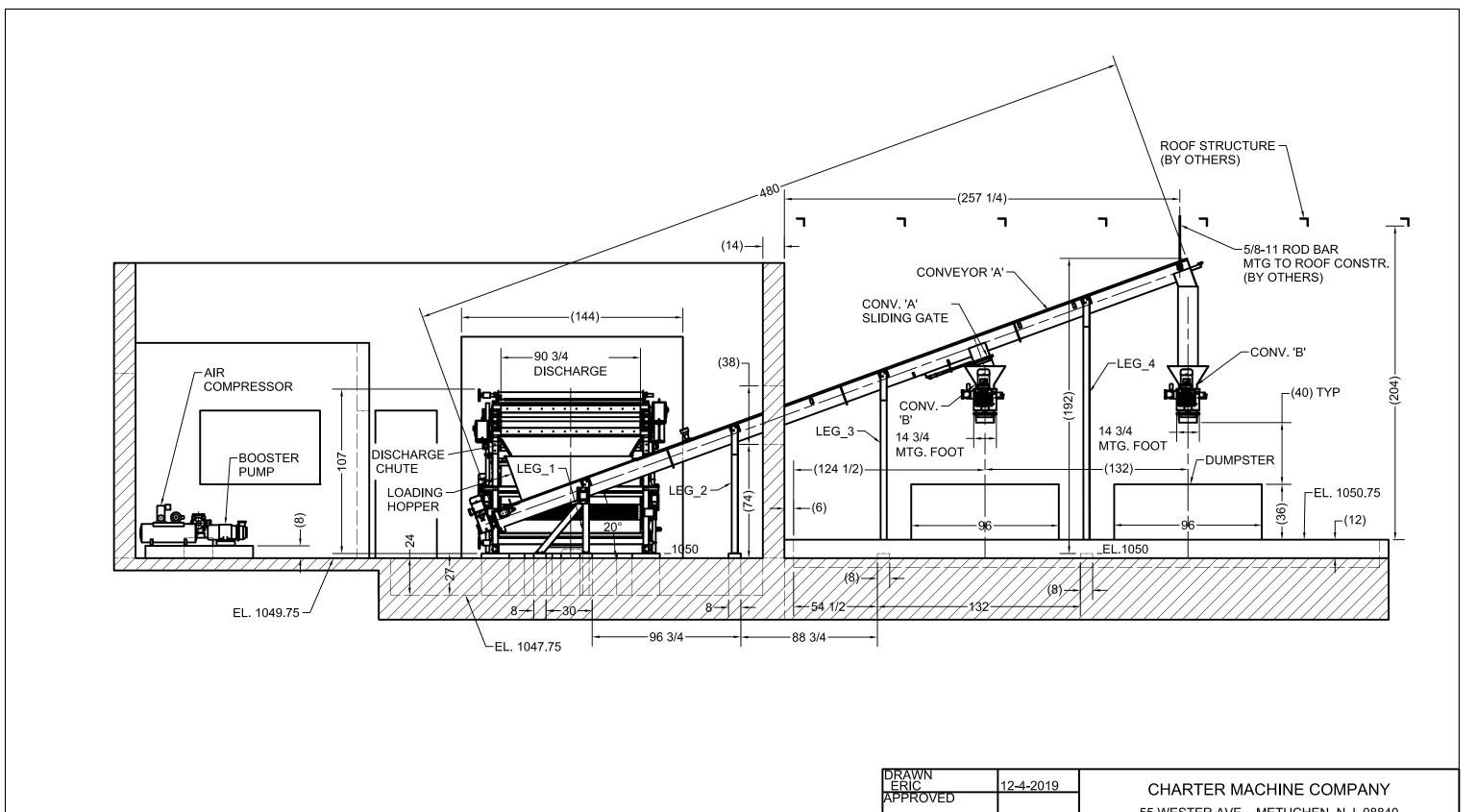
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| REV | DESCRIPTION | DATE | APPROVED | | | |
| | CONVS. 'B' CHANGED | | | | | |
| 1 | SLUDGE PUMP CORRECTED | 1/30/2020 | ERIC | | | |

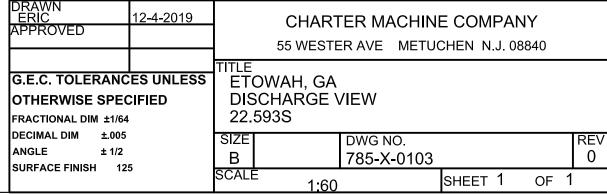




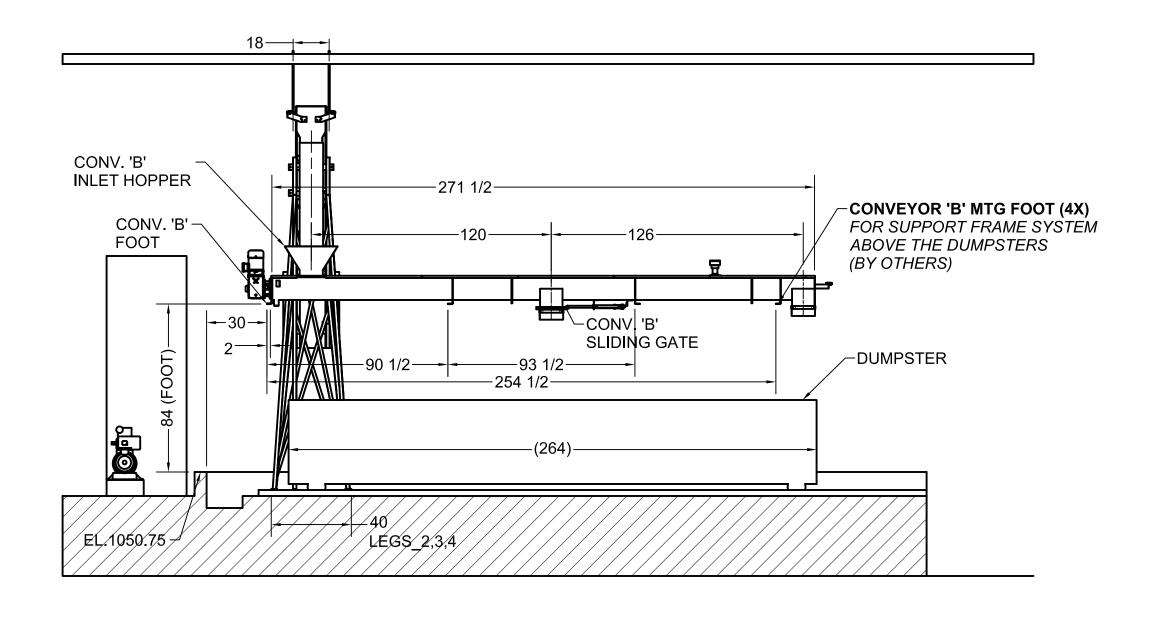
| DRAWN ERIC 12 APPROVED | 2-4-2019 | | 55 WESTE | | E COMPA | | |
|---|----------|--------------------|-----------------------------|----------------|-------------|----|---------------|
| G.E.C. TOLERANCES OTHERWISE SPECIF FRACTIONAL DIM ±1/64 | | SIE | OWAH, GA DE VIEW 593S | | | | |
| DECIMAL DIM ±.005 ANGLE ± 1/2 SURFACE FINISH 125 | | SIZE B SCALI | Ē 1:48 | DWG N 785-X | SHEET 1 | OF | RE\ 0 1 |







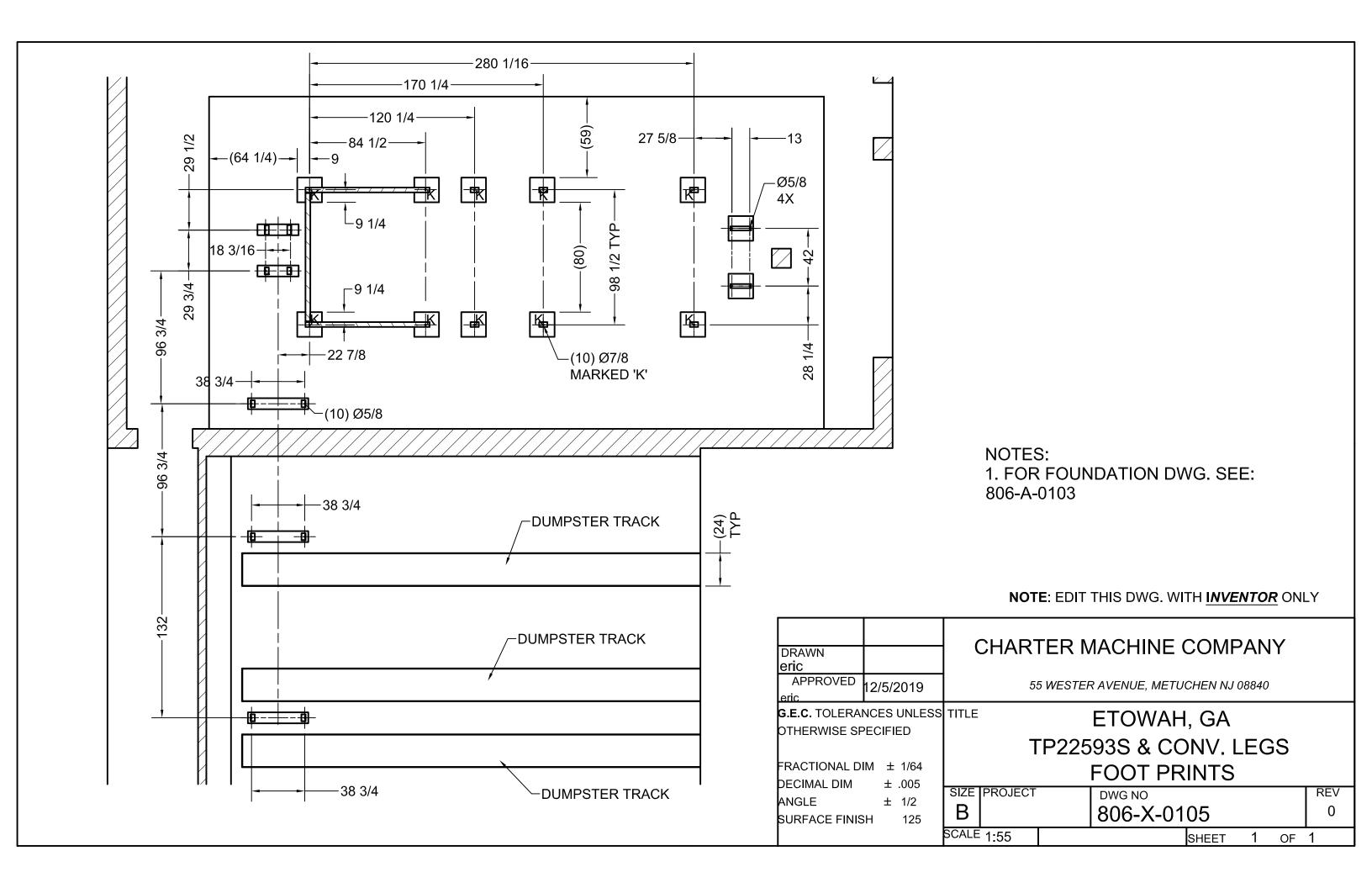




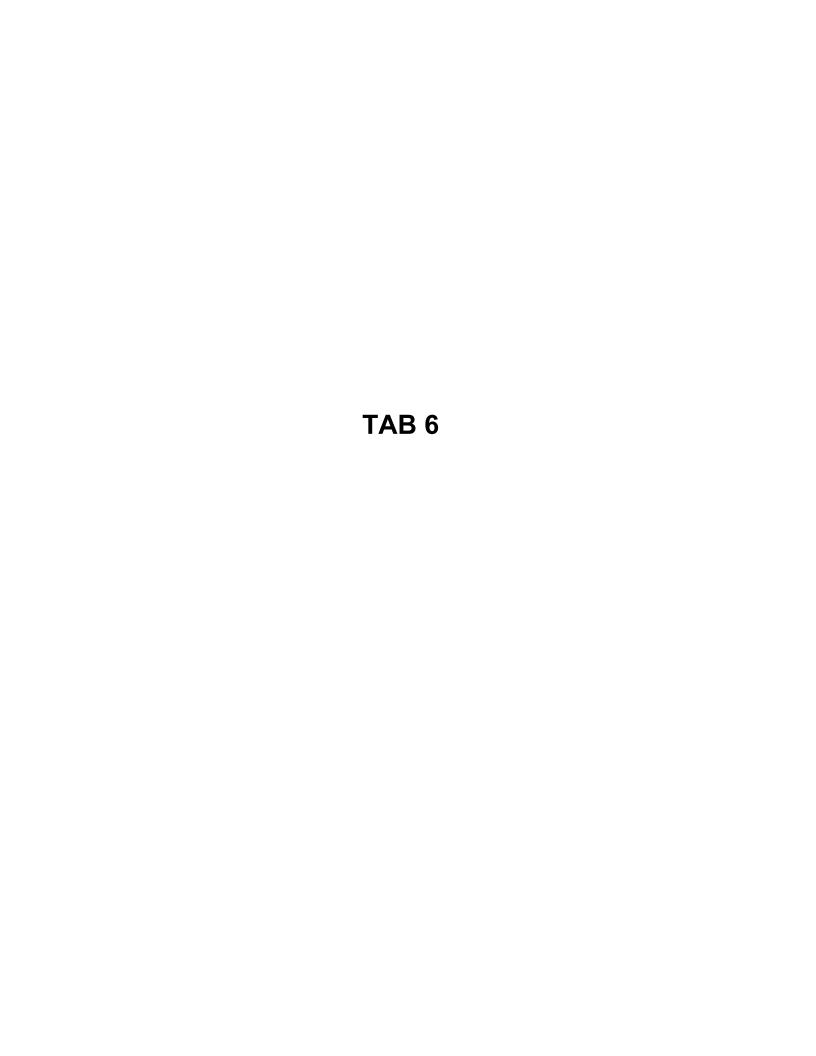
| REVISION HISTORY | | | | | | | |
|------------------|--------------------|-----------|----------|--|--|--|--|
| REV | DESCRIPTION | DATE | APPROVED | | | | |
| 1 | CONVS. 'B' CHANGED | 1/30/2020 | ERIC | | | | |

| DRAWN ERIC APPROVED | 12-4-2019 | CHARTER MACHINE COMPANY 55 WESTER AVE METUCHEN N.J. 08840 | | | | | |
|---|-----------|---|-------|-----------------------|---------|------|----------|
| G.E.C. TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONAL DIM ±1/64 | | ETOWA CONVE 22.593 | EYÓRS | DISCHARGE | VIEW | | |
| DECIMAL DIM ±.005 ANGLE ± 1/2 SURFACE FINISH 12: | 5 | SIZE B SCALE | 1:48 | DWG NO. 806-X-0104 | SHEET 1 | OF 1 | REV 1 |

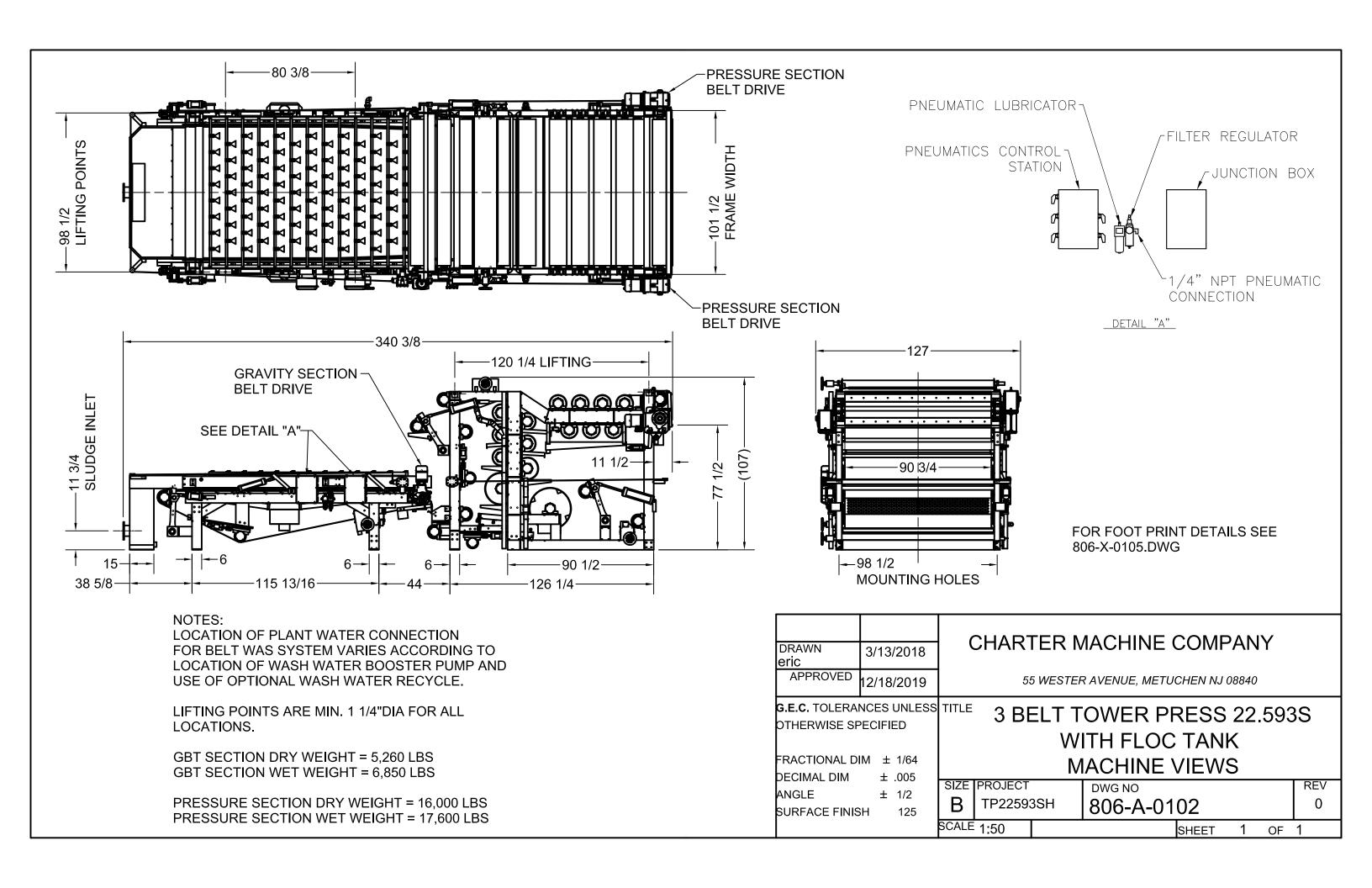




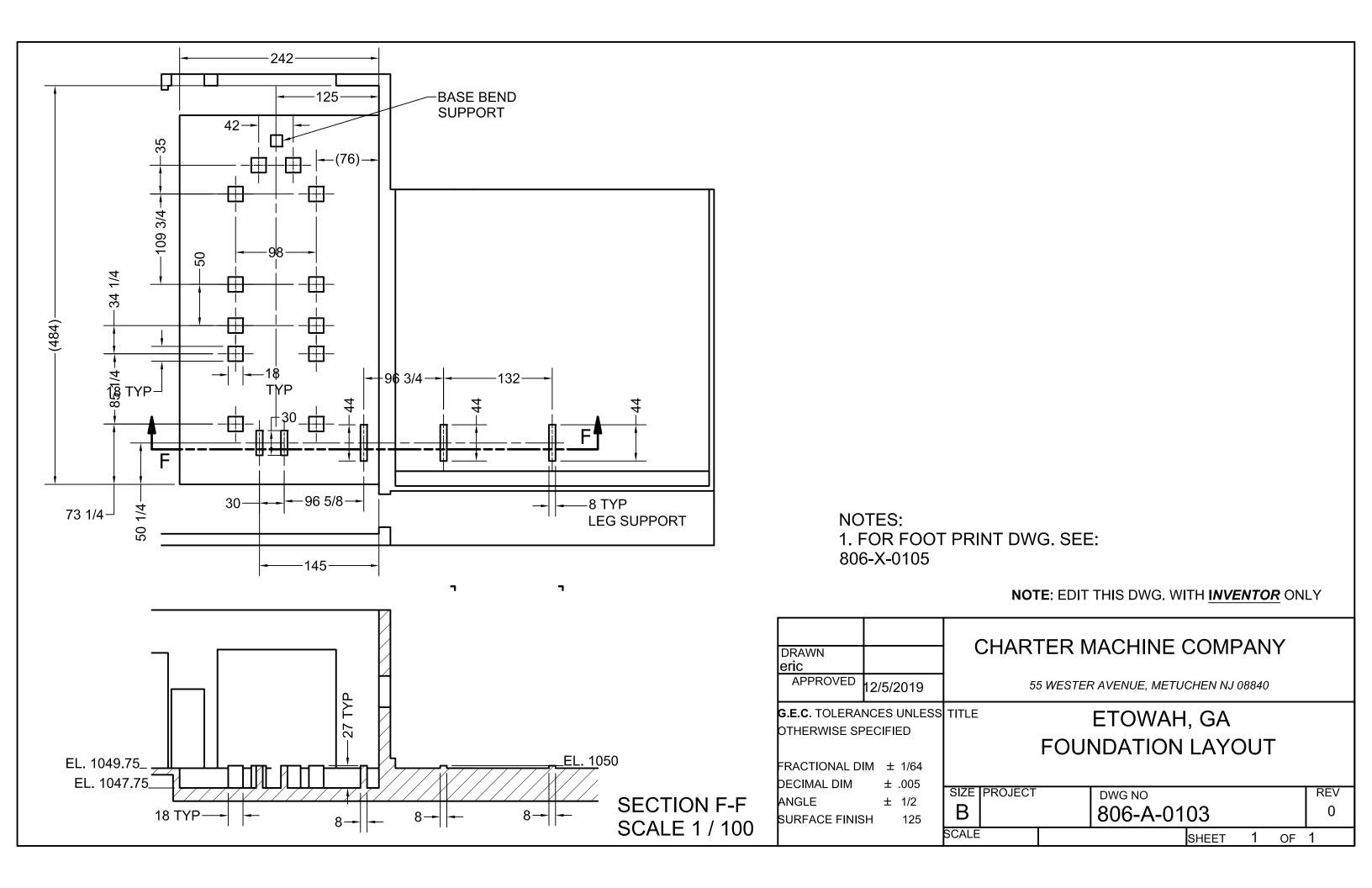




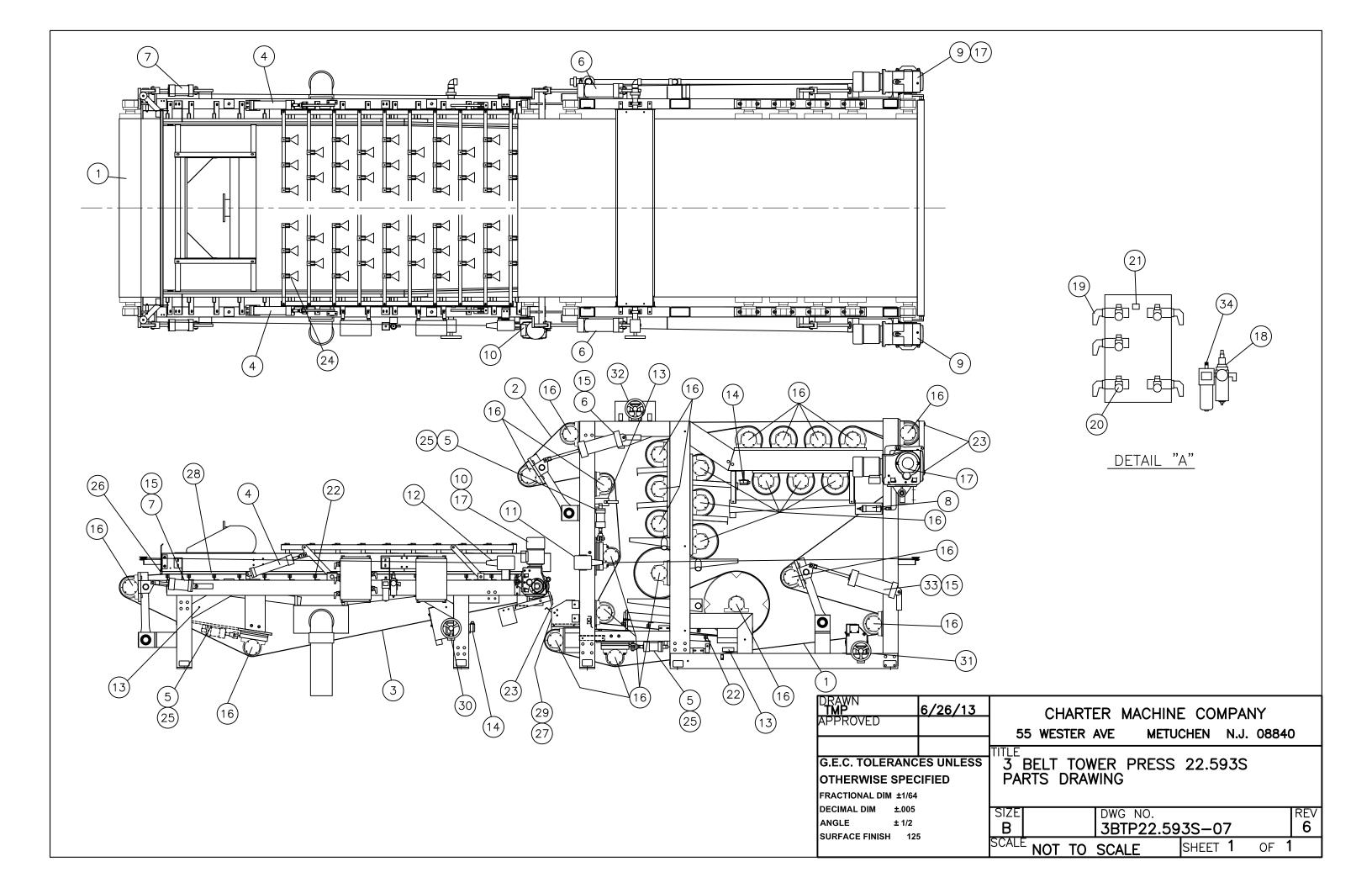














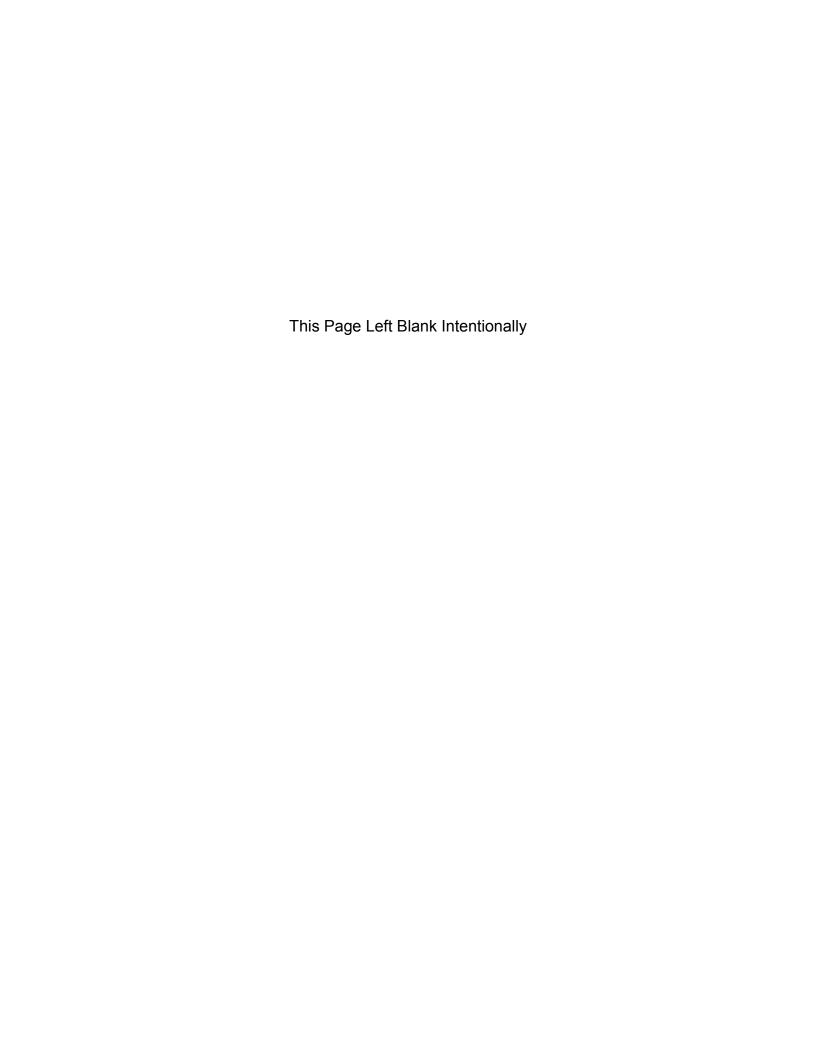
3BTP 22.593S - Parts List

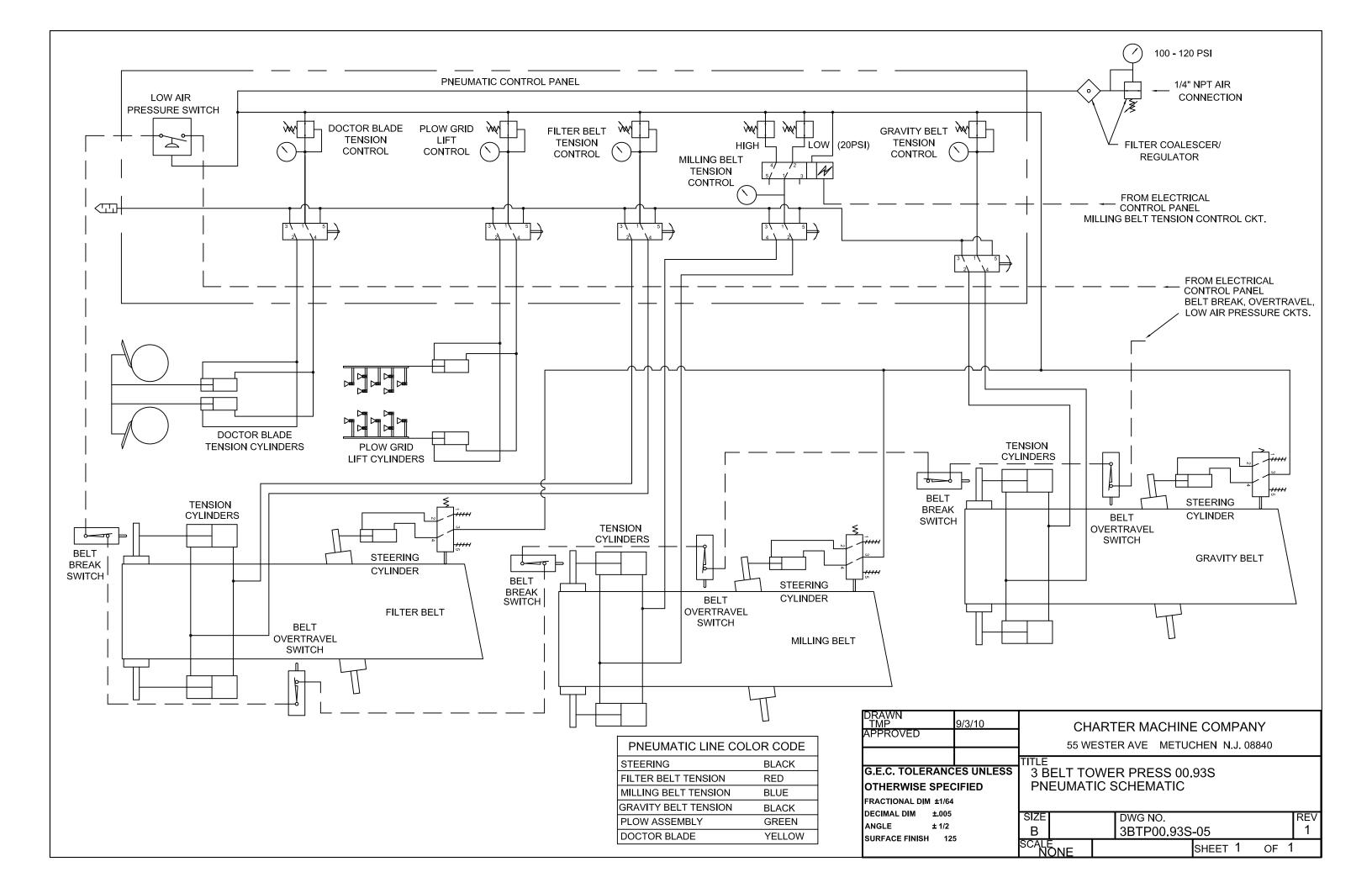
| ITEM | QTY | PART NUMBER | DESCRIPTION |
|---|---|--|--|
| 1 2 3 4 5 6 7 8 9 10 11 12 13 | 1 1 1 2 3 2 2 2 2 1 1 1 3 3 | 050-016-3148 050-026-3146 050-036-3146 TRDCYL3.25X12 TRDCYL3.25X2 TRDCYL5X12 TRDCYL4X4 030-011-3545 035-225-0047 035-225-0147 030-165-0006 TP00.43S-A-044 | Filter Belt Milling Belt Gravity Belt 3 1/4" x 12" Plow Lift Cylinder 3 1/4" x 2" Steering Cylinder 5" x 12" Tension Cylinder 4" x 4" Tension Cylinder 2" x 3" Doctor Blade Cylinder Belt Drive (Press Section) – See Belt Drive Section Belt Drive (Gravity Area) – See Belt Drive Section Safety Stop – Lanyard Switch (Right Hand) Safety Stop – Lanyard Switch (Left Hand) Steering Valve Paddle Arm |
| 14 | 4 4 | 035-225-0175 TP00.43S-A-043 | Belt Over-Travel Switch Paddle Arm |
| 15 | 3 | 710-000-009 | Belt Break Switch |
| 16 | 55 1 each 1 each 2 each 1 each 1 each 4 each 4 each 1 each 1 each | TP00.43S-B-2952/1 FAG 22215E1A.M.C3 BH-F-2952-1 BC-2952 National #417492 WHM-500 WSM-293 CG2437-1 | 75mm Pillow Block Roller Bearing - Complete (Closed) 75mm Roller Bearing Insert 75mm Pillow Block Housing 75mm Bearing End Cap (Closed) Double Lip Oil Seal (Closed) Bearing Retaining Ring (Housing) Bearing Retaining Ring (Shaft) Bearing Housing Cap Gasket Socket Cap Screw #10 Neoprene Bonded Washer Grease Fitting Pressure Relief Vent |
| 17 | 3 1 each | TP00.43S-B-2952/2 FAG 22215E1A.M.C3 BH-F-2952-1 BC-2952-M National #417492 WHM-500 CG2437-1 BP22.61-A-003 McMaster #9452K158 | 75mm Pillow Block Roller Bearing - Complete (Drive) 75mm Roller Bearing Insert 75mm Pillow Block Housing 75mm Bearing End Cap (Thru) Double Lip Oil Seal Bearing Retaining Ring (Housing) Bearing Housing Cap Gasket Drive Shaft Sleeve O-Ring Socket Cap Screw #10 Neoprene Bonded Washer Grease Fitting Pressure Relief Vent |
| 18 | 1 | 030-185-0112 | Coalescing Filter Regulator |

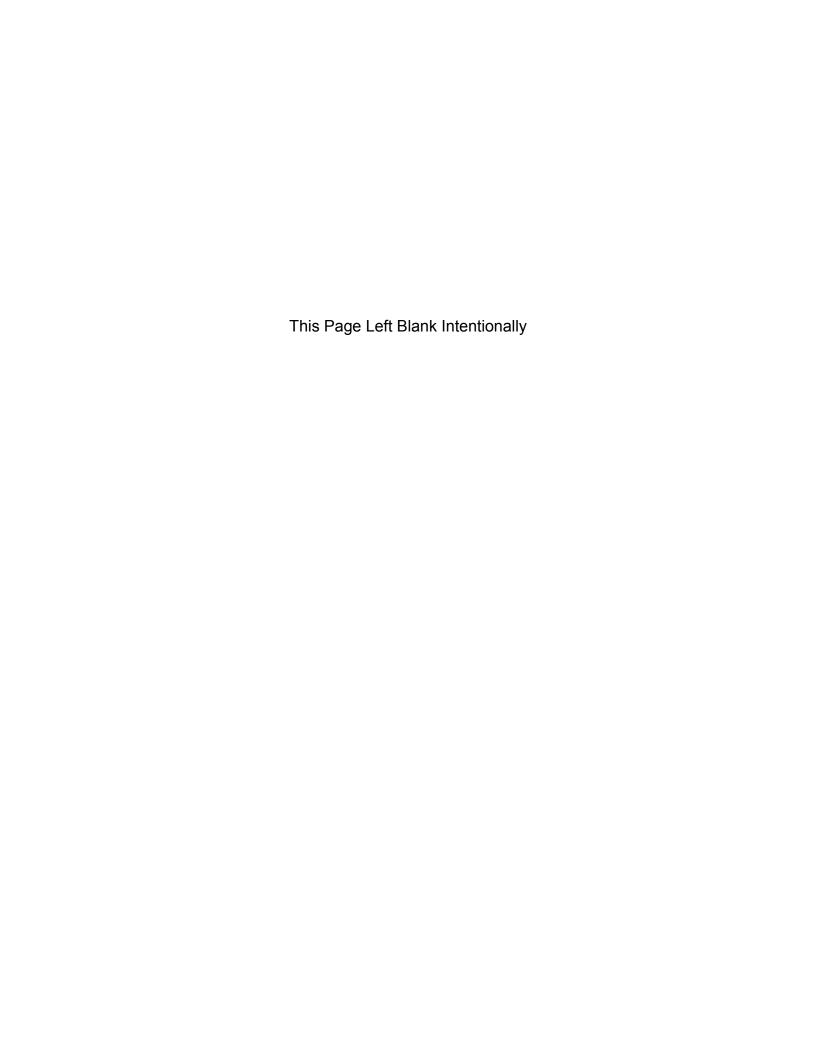
3BTP 22.593S - Parts List

| ITEM | QTY | PART NUMBER | DESCRIPTION |
|------|-----------------------------|---|---|
| 19 | 5 | M212LS-11 | 4-Way Hand Valve |
| 20 | 5 | 030-175-0009 | Pressure Regulator with Gauge |
| 21 | 1 | 030-245-0012 | Pressure Switch |
| 22 | 25 | TP22.43S-B-007/1 | UHMW Belt Support Wear Strips |
| 23 | 3 | TP22.43S-B-003 | UHMW Doctor Blade |
| 24 | 75 | TP00.43S-C-106 | Sludge Plow |
| 25 | 6 | TP00.43S-A-001 | Steering Slider Block |
| 26 | 1 | TP22.43S-B-007/2 | Sludge Guide Cross Wall Seal |
| 27 | 2 | 3BTP00.93S-A-103 | Wedge Zone Seal |
| 28 | 2 | 3BTP00.93S-A-001 | Sludge Guide Seal |
| 29 | 1 | 3BTP22.93S-A-001 | Sludge Chute Seal |
| 30 | 1 4 1 11 | 025-191-1387 RB822.3-A-101 27449-10-CP 27149-6012-316L | Belt Wash Spray Pipe - Gravity Belt Gravity Section Seal – Gravity Belt Internal Brush .099" Wash Nozzles with Gasket |
| 31 | 1 1 1 2 1 | 025-191-1387 TP22.93S-B-004/1 TP22.93S-B-004/2 BP00.61-B-025 27449-10-CP 27149-6012-316L | Belt Wash Spray Pipe – Filter Belt Wash Station Seal #1 – Filter Belt Wash Station Seal #2 – Filter Belt Upper Spray Shower Seal – Filter Belt Internal Brush .099" Wash Nozzles with Gasket |
| 32 | 1 6 2 2 1 11 | 025-191-1487 BP22.61-A-001/3 BP00.61-B-025 TP22.43S-B-007/2 27449-10-CP 27149-6012-316L | Belt Wash Spray Pipe – Milling Belt Lower Wash Station Seal – Milling Belt Upper Spray Shower Seal – Milling Belt Cross Wall Seal – Milling Belt Internal Brush .099" Wash Nozzles with Gasket |
| 33 | 2 | TRDCYL5X14 | 5" x 14" Tension Cylinder |
| 34 | 1 | L32L-04M | Pneumatic Lubricator |







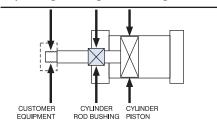


SERIES 'TA' (NFPA) CYLINDER

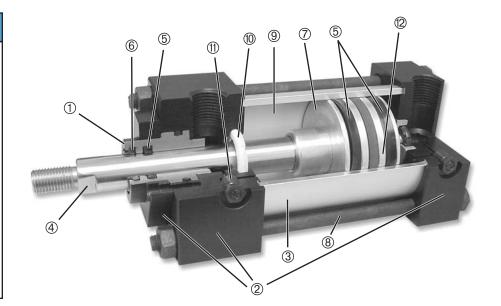
Floating Rod Bushing

SELF ALIGNMENT FEATURE

Rod Bushing is designed to float .002", improving bearing surface alignment.



- · Reduces cylinder drag and erractic operation
- Reduces cylinder wear
- Provides a minimum of 25% longer life than "fixed" Rod Bushing designs



HEAVY-DUTY DESIGN FOR RELIABLE, CONSISTENT OPERATION

- ① <u>FLOATING</u> ROD BUSHING Precision machined from 150,000 PSI rated graphite filled cast iron and PTFE coated to reduce friction and extend cycle life. Bushing design "traps" lubrication in effective bearing area.
- ② HEAD, CAP & RETAINER Precision machined from high strength 6061-T6 aluminum alloy. Black anodized for corrosion resistance.
- ③ CYLINDER TUBE Precision machined from 6063-T6832 high tensile aluminum alloy and hard coat to 60 Rc for wear resistance and extended cycle life.
- PISTON ROD Precision machined from high yield, polished and hard chrome plated steel.

 PISTON ROD Precision machined from high yield, polished and hard chrome plated steel.

 Output

 Description

 Descripti
- ⑤ PISTON & ROD SEALS Heavy lip design Carboxilated Nitrile construction. Seals are pressure activated and wear compensating for long life. (Self lubricating material).
- ® ROD WIPER Abrasion resistant urethane provides aggressive wiping action in all environments. External lip design prevents debris from entering cylinder.

- ⑦ PISTON Precision machined from 6061-T651 alloy aluminum, provides an excellent bearing surface for extended cylinder life.
- ® TIE RODS Prestressed high carbon steel tie rod construction eliminates axial loading of cylinder tube and maintains compression on tube and end seals.
- PERMANENT LUBRICATION Permanently lubricated with Magna-Lube G PTFE based grease on all internal components. This is a non-migratory type high performance grease providing outstanding service life. No additional lubrication is required.
- © CUSHIONS (Options H & C) Floating cushion seal designed for maximum cushion performance, quick return stroke break-away and extended life.
- ① CUSHION ADJUSTMENT NEEDLE Adjustable steel needle design has fine thread metering and is positively captured to prevent needle ejection during adjustment.
- PISTON MAGNET (Option MPR) for TRD magnetically operated reed and solid state switches (refer to pages 107-113).

OPERATING Pressure

250 PSI AIR (17 BAR)

OPERATING TEMPERATURE

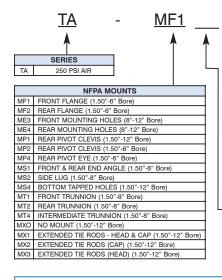
Carboxilated Nitrile: -20°F to 200°F (-25°C to 90°C) Fluorocarbon: 0°F to 400°F (-20°C to 200°C)

<u>Performance options:</u>

- <u>WB</u> PTFE piston wear band, recommended for pivot mounted, long strokes or cylinders that may see side loads.
- <u>ST</u> Stop tubes are used to reduce rod bearing and piston stress (refer to page 89 for cylinder design guidance).
- <u>MA</u> Micro-Adjust provides a precision adjustment on the cylinder extend stroke, providing quick and accurate cylinder positioning, reducing set-up time.
- <u>SSA</u> Stainless Steel Piston Rod, Tie Rods, Nuts, and Fasteners provide corrosion resistance in outdoor applications and wet environments.
- <u>LF</u> Low Friction seals reduce breakaway and running friction. Effective at all operating pressures.
- <u>NR</u> Non-Rotating option incorporates (2) internal guide rods preventing rod rotation (NFPA dimensions).

HOW TO ORDER: SERIES 'TA' (STANDARD CYLINDER)

2.50 x 10 - HC - MPR



| A | A | | ↑ ↑ |
|--|---------------------------|-----|---|
| BORE ST | ROKE | | CUSHIONS |
| 2.50 3.25 Ma | o 120" ade to Order | Н | HEAD CUSHION POSITION 2 IS <i>STANDARD</i> <i>SPECIFY</i> FOR POSITIONS: 1, 3 & 4 |
| 6 8 10 12 | | LH | LONG HEAD CUSHION POSITION 2 IS <i>Standard</i> Specify for Positions: 1, 3 & 4 |
| | | ELH | EXTRA LONG HEAD CUSHION POSITION 2 IS STANDARD SPECIFY FOR POSITIONS: 1, 3 & 4 |
| | | O | CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8 |
| | | LC | LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8 |
| STYLE SINGLE ROD (LEAVE B D = DOUBLE ROD B | | ELC | EXTRA LONG CAP CUSHION POSITION 6 IS STANDARD SPECIFY FOR POSITIONS: 5, 7 & 8 |
| | | | FIXED CUSHIONS |
| | | FCH | FIXED HEAD CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE) |
| | | FCC | FIXED CAP CUSHION (NON-ADJUSTABLE, NO ADJUSTMENT NEEDLE) |
| | | FC | FIXED HEAD AND CAP CUSHION (NON-ADJUSTABLE, NO |

| | | OPTIONS |
|----------|------------|--|
| | ADDS LEN | IGTH TO CYLINDER - SEE "OPTION LENGTH ADDER" CHART BELOW. |
| | A = | EXTENDED PISTON ROD THREAD (Example: A = 2") |
| | AS | ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, Example: AS = 4") |
| Г | A/O | AIR / OIL PISTON |
| Х | В | .25" URETHANE BUMPER BOTH ENDS |
| Х | BC | .25" URETHANE BUMPER CAP ONLY |
| Х | BH | .25" URETHANE BUMPER HEAD ONLY |
| | BP | BUMPER PISTON SEALS (1.50" - 8" Bore) |
| | BSP | BSP PORTS (SPECIFY SIZE, Example: BSP = .25") |
| Г | C = | EXTENDED PISTON ROD |
| ш | 0 - | (Example: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50") |
| \perp | EN | ELECTROLESS NICKEL PLATED (Refer to page 84 for specifications) |
| \vdash | KK2 | LARGE MALE ROD THREAD |
| \perp | KK3 | FEMALE ROD THREAD |
| \perp | KK3S | STUDDED PISTON ROD (KK3 with Stud, Loctite in place) |
| \perp | KK4 | FULL DIAMETER MALE ROD THREAD |
| ш | KK5 | BLANK ROD END (NO THREADS, "A" = 0") |
| \perp | LF | LOW FRICTION SEALS (Refer to page 84 for specifications) |
| ш | MA | MICRO-ADJUST (6" MAX. STROKE) Available on Double Rod End Models |
| ш | MAB | MICRO-ADJUST WITH SOUND DAMPENING BUMPER (6" MAX. STROKE) |
| | MPR | MAGNETIC PISTON FOR REED OR SOLID STATE SWITCHES - TRD MODELS: R10, R10P, RAC, RHT & MSS (Refer to pages 107-113 for selection) |
| \Box | MS | METALLIC ROD SCRAPER (BRASS CONSTRUCTION) |
| | NR | NON-ROTATING (Refer to page 86 for specifications) |
| | OP | OPTIONAL PORT LOCATION (Example: Ports @ 3 & 7) |
| \Box | os | OVERSIZE ROD DIAMETER (SPECIFY SIZE, Example: 0S = 1.38") |
| \Box | SAE | SAE PORTS (SPECIFY SIZE, Example: SAE #10) |
| Х | SE | SPRING EXTEND (1.50, 2, 2.50 bore) |
| Х | SR | SPRING RETURN (1.50, 2, 2.50 bore) |
| Г | SSA | STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS |
| \Box | SSF | STAINLESS STEEL FASTENERS |
| | SSR | STAINLESS STEEL PISTON ROD |
| | SST | STAINLESS STEEL TIE RODS & NUTS |
| Х | ST | STOP TUBE (SPECIFY STOP TUBE LENGTH AND EFFECTIVE STROKE) (Example: TA MS4 2 X 24" EFFECTIVE STROKE-ST=3) |
| Г | STEEL TUBE | STEEL CYLINDER TUBE, BLACK EPOXY PAINT FINISH |
| | TH | 400 PSI HYDRAULIC NON-SHOCK (Refer to page 90 for specifications) |
| | VS | FLUOROCARBON SEALS |
| | WB | PISTON WEAR BAND |
| | XX | SPECIAL VARIATION (SPECIFY) |

About our Part Number System

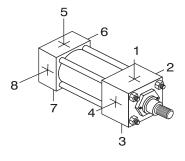
- · Simple, easy to understand
- No excessive codes!
- · Eliminates mistakes when ordering

Example: A 2.50" Bore by 10" Stroke NFPA cylinder, Front Flange Mount, Head & Cap Cushions, Magnetic Piston for Switches.

Part Number: TA-MF1-2.50 x 10-HC-MPR

STANDARD PORT AND CUSHION ADJUSTMENT POSITIONS

- Ports Positions 1 and 5
- · Cushion Adjustment Positions 2 and 6
- Specify Non-Standard Positions When Ordering

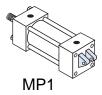


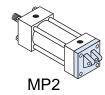
ADJUSTMENT NEEDLE)

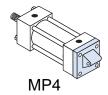
| OPTION LENGTH ADDER (ADD TO CATALOG BASIC OVERALL LENGTH DIMENSIONS) | | | | | | | | | | | | | | | | |
|--|-----|--------|-----|------|------|-----------|-------|----------------------------------|--|--|--|--|--|--|--|--|
| | | OPTION | | | | | | | | | | | | | | |
| BORE | В | вс | вн | ELC | ELH | SE SR | | ST* (STOP TUBE) Example: ST=2 | | | | | | | | |
| 1.50 | .50 | .25 | .25 | 1 | 1 | Refe | er to | 2 | | | | | | | | |
| 2 | .50 | .25 | .25 | 1 | 1 | pag | 2 | | | | | | | | | |
| 2.50 | .50 | .25 | .25 | 1 | 1 | fo | or | 2 | | | | | | | | |
| 3.25 | .50 | .25 | .25 | 1.25 | 1.25 | len | - | 2 | | | | | | | | |
| 4 | .50 | .25 | .25 | 1.25 | 1.25 | add ar | | 2 | | | | | | | | |
| 5 | .50 | .25 | .25 | 1.25 | 1.25 | avail | | 2 | | | | | | | | |
| 6 | .50 | .25 | .25 | 1.50 | 1.50 | | re | 2 | | | | | | | | |
| 8 | .50 | .25 | .25 | 1.50 | 1.50 | siz | es | 2 | | | | | | | | |
| 10 | .50 | .25 | .25 | 2 | 2 | ar | | 2 | | | | | | | | |
| 12 | .50 | .25 | .25 | 2 | 2 | stro | kes | 2 | | | | | | | | |

NFPA MOUNTS

*Note: The desired Stop Tube length adds directly to the overall cylinder length.







| PNEUMATIC CYLINDER LIST | | | | | | | | |
|-------------------------|-------------------|---|--|--|--|--|--|--|
| LOCATION | DESCRIPTION | | | | | | | |
| THICKENER SECTION | | | | | | | | |
| TENSION | (2) TRDCYL4X4 | TA-MP1-4X4-KK4-SSA | | | | | | |
| STEERING | (1) TRDCYL3.25X2 | TA-MP4-3.25X2-KK4-SSA, #60882, ALUM MP4 | | | | | | |
| PLOW GRID | (2) TRDCYL3.25X12 | TA-MP1-3.25X12-KK4SSA | | | | | | |
| | PRES | SS SECTION | | | | | | |
| TENSION | (4) TRDCYL5X12 | TA-MP1-5X12-KK4-SSA, C=1.125, EXT ALUM | | | | | | |
| STEERING | (2) TRDCYL3.25X2 | TA-MP4-3.25X2-KK4-SSA, ALUM MP4 | | | | | | |
| DOCTOR BLADE | (2) TRDCYL2X3 | TA-MP4-2X3-KK2-SSA, #60881, ALUM MP4 | | | | | | |

SERIES 'TA' DIMENSIONS: BASIC CYLINDER (NO MOUNT)

About Rod End Styles

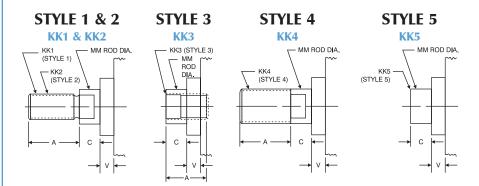
Style 1 Male Rod End is STANDARD

Other NFPA Styles can be specified (See Chart).

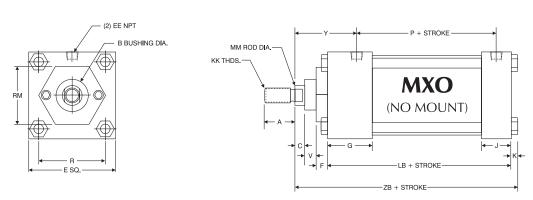
Need a rod end not listed? NO PROBLEM! Each Piston Rod is made to order and does not delay shipment. Coarse (UNC) threads, Metric threads or just plain rod ends are common. Thread lengths are also made to order (Specify: "A"=Length).

NEED SOMETHING NOT LISTED? Just send us a sketch. In most cases, quotes are turned around in one day!

PISTON ROD END STYLES

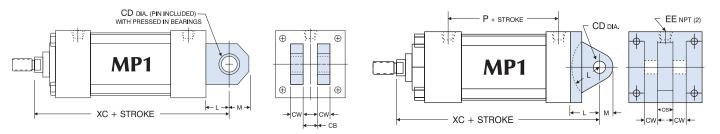


| | | STAN | DARD | | OPTIONAL | | | | | | | | | |
|------------|---------------|---------|----------------|---------|----------------|---------|------------------|---------|--------|-----------------|-----|-----|--|--|
| | MM ROD | Style 1 | Style 1 - Male | | Style 2 - Male | | Style 3 - Female | | - Male | Style 5 - Blank | | | | |
| BORE | DIAMETER | KK1 | A | KK2 | A | KK3 | A | KK4 | A | KK5 | C | V | | |
| 1.50, 2, | .63 Standard | .44-20 | .75 | .50-20 | .75 | .44-20 | .75 | .63-18 | .75 | No Threads | .38 | .25 | | |
| 2.50 | 1 Oversize | .75-16 | 1.13 | .88-14 | 1.13 | .75-16 | 1.13 | 1-14 | 1.13 | No Threads | .50 | .50 | | |
| 3.25, 4, 5 | 1 Standard | .75-16 | 1.13 | .88-14 | 1.13 | .75-16 | 1.13 | 1-14 | 1.13 | No Threads | .50 | .25 | | |
| 3.23, 4, 3 | 1.38 Oversize | 1-14 | 1.63 | 1.25-12 | 1.63 | 1-14 | 1.63 | 1.38-12 | 1.63 | No Threads | .63 | .38 | | |
| 6 & 8 | 1.38 Standard | 1-14 | 1.63 | 1.25-12 | 1.63 | 1-14 | 1.63 | 1.38-12 | 1.63 | No Threads | .63 | .38 | | |
| 0 & 0 | 1.75 Oversize | 1.25-12 | 2 | 1.50-12 | 2 | 1.25-12 | 2 | 1.75-12 | 2 | No Threads | .75 | .50 | | |
| 10 | 1.75 Standard | 1.25-12 | 2 | 1.50-12 | 2 | 1.25-12 | 2 | 1.75-12 | 2 | No Threads | .75 | .50 | | |
| 10 | 2 Oversize | 1.50-12 | 2.25 | 1.75-12 | 2.25 | 1.50-12 | 2.25 | 2-12 | 2.25 | No Threads | .88 | .38 | | |
| 12 | 2 Standard | 1.50-12 | 2.25 | 1.75-12 | 2.25 | 1.50-12 | 2.25 | 2-12 | 2.25 | No Threads | .88 | .38 | | |
| 12 | 2.50 Oversize | 1.88-12 | 3 | 2.25-12 | 3 | 1.88-12 | 3 | 2.50-12 | 3 | No Threads | 1 | .50 | | |



| | BASIC DIMENSIONS 'MXO' STANDARD & OVERSIZE RODS | | | | | | | | | | | | | | | | | | |
|-------------|---|------|------|-----|-------|---------|---------|----------|------|-----|---------|------|------|------|------|-----------|-----|------|--------------|
| | ROD | | | | | | | | | | | | | | | | | | |
| BORE | DIAMETER | Α | В | С | E | EE | F | G | J | K | KK | LB | MM | P | R | RM | V | Y | ZB |
| 1.50 | .63 Standard | .75 | 1.13 | .38 | 2 | .38 | .38 .38 | 1.50 | 1 | .25 | .44-20 | 3.63 | .63 | 2.38 | 1.43 | 2 SQ. | .25 | 1.88 | 4.88 |
| 1.50 | 1 Oversize | 1.13 | 1.50 | .50 | | .50 | .50 | 1.50 | L. | 3 | .75-16 | 3.03 | 1 | 2.50 | 1.15 | ` ` | .50 | 2.25 | 5.25 |
| 2 | .63 Standard | .75 | 1.13 | .38 | 2.50 | .38 | .38 | 1.50 | 1 | .31 | .44-20 | 3.63 | .63 | 2.38 | 1.84 | 1.75 HEX | .25 | 1.88 | 4.94 |
| _ | 1 Oversize | 1.13 | 1.50 | .50 | | | .50 1. | | 1.50 | | .75-16 | 5105 | 1 | | | 2.50 SQ. | .50 | 2.25 | 5.31 |
| 2.50 | .63 Standard | .75 | 1.13 | .38 | 3 | .38 | .38 | 1.50 | 1 | .31 | .44-20 | 3.75 | .63 | 2.50 | 2.19 | 1.75 HEX | .25 | 1.88 | 5.06 |
| | 1 Oversize | 1.13 | 1.50 | .50 | _ | .50 | .50 | | · | | .75-16 | | 1 | | | 3 SQ. | .50 | 2.25 | 5.44 |
| 3.25 | 1 Standard | 1.13 | 1.50 | .50 | 3.75 | .50 | .63 | 1.75 | 1.25 | .38 | .75-16 | 4.25 | 1 | 2.75 | 2.76 | 2.75 DIA. | .25 | 2.38 | 6 |
| | 1.38 Oversize | 1.63 | 2 | .63 | | | | | | | 1-14 | | 1.38 | | | 3.75 SQ. | .38 | 2.63 | |
| 4 | 1 Standard | 1.13 | 1.50 | .50 | 4.50 | .50 .63 | .63 | 3 1.75 | 1.25 | .38 | .75-16 | 4.25 | 1 20 | 2.75 | 3.32 | 2.75 DIA. | .25 | 2.38 | 6 |
| | 1.38 Oversize | 1.63 | 2 | .63 | | | | | | | 1-14 | | 1.38 | | | 3.50 DIA. | .38 | 2.63 | 6.25 |
| 5 | 1 Standard | 1.13 | 1.50 | .50 | 5.50 | .50 | .63 | 1.75 | 1.25 | .44 | .75-16 | 4.50 | 1 20 | 3 | 4.10 | 2.75 DIA. | .25 | 2.38 | |
| | 1.38 Oversize | 1.63 | 2 | .63 | | | | | | | 1-14 | | 1.38 | | | 3.50 DIA. | .38 | 2.63 | 6.56 |
| 6 | 1.38 Standard | 1.63 | 2 | .63 | 6.50 | .75 | .63 | 2 | 1.50 | .44 | 1-14 | 5 | 1.38 | 3.25 | 4.88 | 3.50 DIA. | .38 | 2.75 | |
| | 1.75 Oversize 1.38 Standard | 1.63 | 2.38 | .63 | | | | | | | 1.25-12 | | 1.75 | | | | .50 | 2.75 | 7.31 7.31 |
| 8 | 1.75 Oversize | 1.03 | 2.38 | .75 | 8.50 | .75 | .63 | 2 | 1.50 | .56 | 1.25-12 | 5.13 | 1.75 | 3.38 | 6.44 | 3.50 DIA. | .38 | 3 | 7.56 |
| | 1.75 Standard | 2 | 2.38 | .75 | | | .63 | | | | 1.25-12 | | 1.75 | | | 3.50 DIA. | .50 | 3.06 | 8.94 |
| 10 | 2 Oversize | 2.25 | 2.63 | ./3 | 10.63 | 1 | .75 | 2.25 | 2 | .69 | 1.50-12 | 6.38 | 2 | 4.31 | 7.92 | 5 DIA. | .38 | 3.19 | 9.06 |
| | 2 Standard | 2.25 | 2.63 | .88 | | | ./5 | | | | 1.50-12 | | 2 | | | J DIA. | .38 | 3.19 | 9.56 |
| 12 | 2.50 Oversize | 3 | 3.13 | .00 | 12.75 | 1 | .75 | 2.25 | 2 | .69 | 1.88-12 | 6.88 | 2.50 | 4.81 | 9.40 | 5 DIA. | .50 | 3.44 | |
| | 2.50 Oversize | 3 | 3.13 | 1 | | | | | | | 1.00-12 | | 2.50 | | | | .50 | 3.44 | 9.01 |

SERIES 'TA' DIMENSIONS: PIVOT MOUNTS

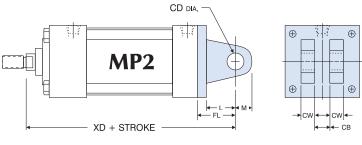


EXTRUDED MP1 MOUNT

IRON CASTING MP1 MOUNT

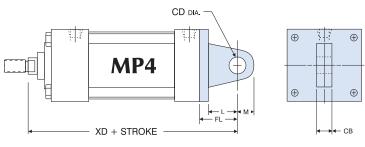
(EXTRUDED: 1.50" - 8" BORES, WELDMENT: 10" & 12" BORES)

(OPTIONAL)**



MP2 MOUNT

(IRON CASTING)



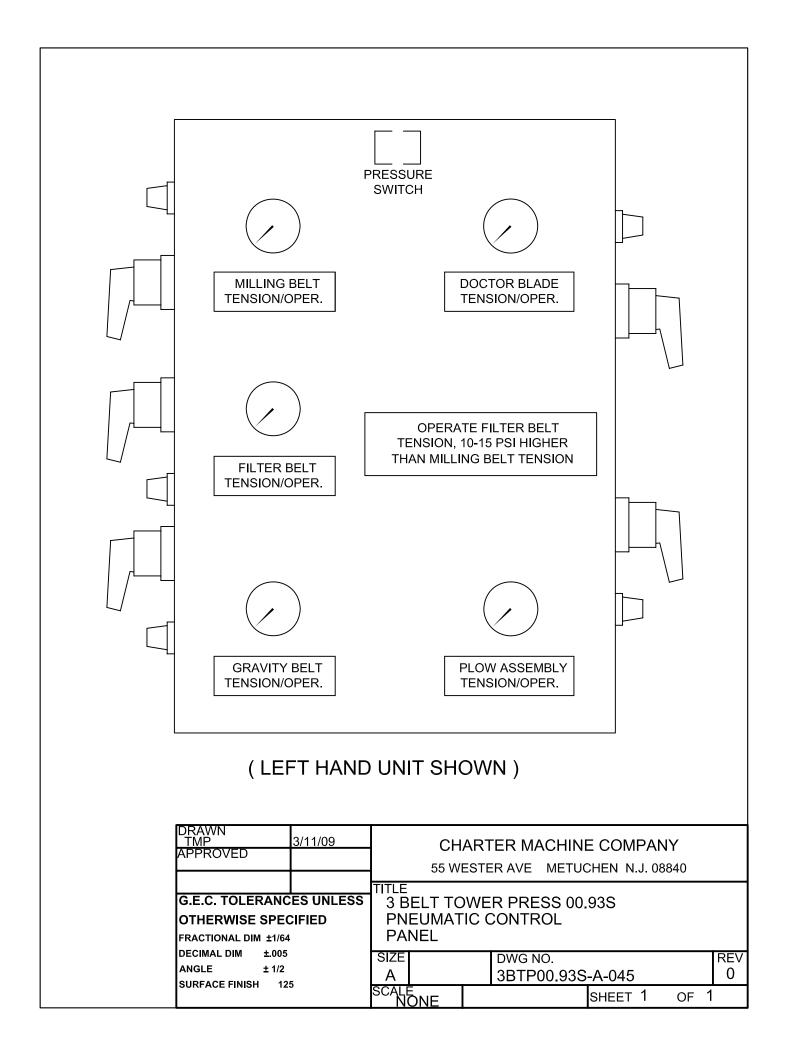
MP4 MOUNT

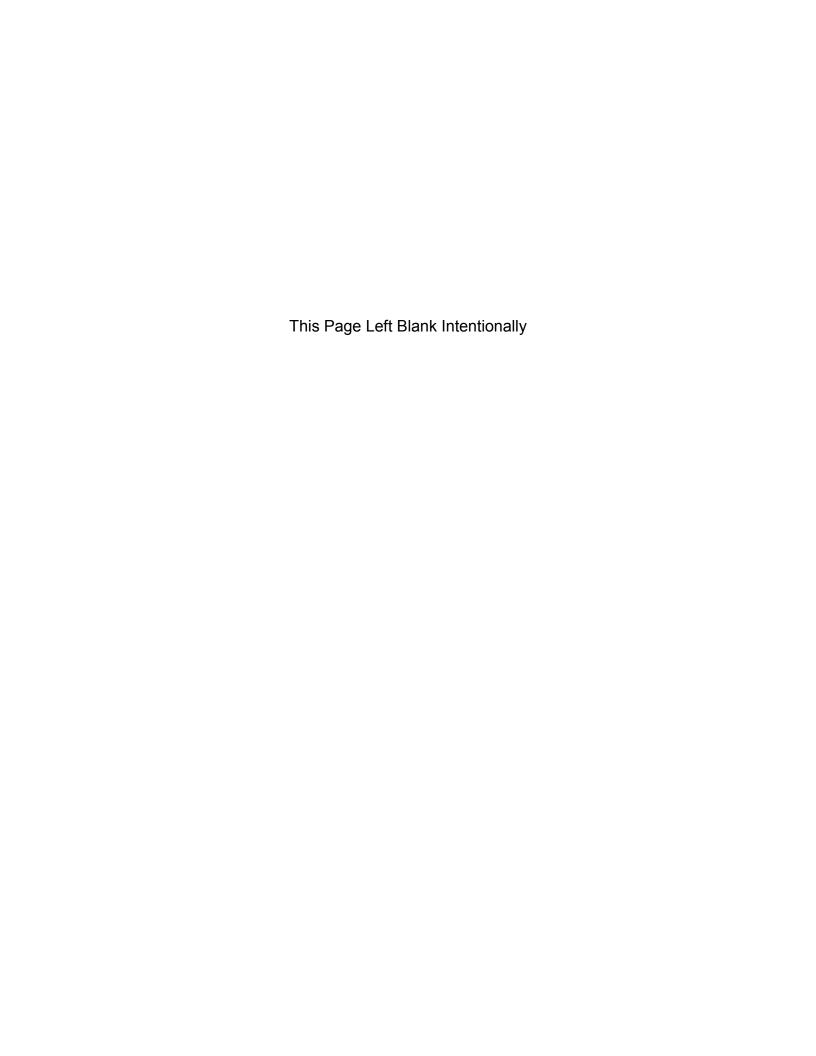
(IRON CASTING: 1.50" - 4" BORES, WELDMENT: 5" - 6" BORES*)

| | 'MP1', 'MP2' CLEVIS AND 'MP4' EYE MOUNT DIMENSIONS | | | | | | | | | ACCESSORIES (SEE PAGES 101-102 FOR DIMENSIONS) | | | | |
|------|--|------|------|------|-------------|------|------|-------|------|--|---------|------------|-----------------------|--------------------------|
| BORE | ROD Diameter | СВ | CD | CW | FL | L | М | хс | XD | ROD CLEVIS | ROD EYE | CLEVIS PIN | EYE BRACKET (FOR MP1) | CLEVIS BRKT (FOR MP4) |
| 1.50 | .63 Standard | .75 | .50 | .50 | 1.13 | .75 | .63 | 5.38 | 5.75 | RC437 | RE437 | CP500 | | |
| 1.50 | 1 Oversize | ./3 | .50 | .50 | 1.15 | ./ 5 | .03 | 5.75 | 6.13 | RC750 | RE750 | CP750 | | |
| 2 | .63 Standard | .75 | .50 | .50 | 1.13 | .75 | .63 | 5.38 | 5.75 | RC437 | RE437 | CP500 | EB500 | CB500 |
| | 1 Oversize | ./3 | .50 | .50 | 1.15 | ./ 3 | .03 | 5.75 | 6.13 | RC750 | RE750 | CP750 | _ LD300 | CB300 |
| 2.50 | .63 Standard | .75 | .50 | .50 | 1.13 | .75 | .63 | 5.50 | 5.88 | RC437 | RE437 | CP500 | | |
| 2.50 | 1 Oversize | ./3 | .50 | .50 | 1.15 | ./ 5 | .03 | 5.88 | 6.25 | RC750 | RE750 | CP750 | | |
| 3.25 | 1 Standard | 1.25 | .75 | .63 | 1.88 | 1.25 | .88 | 6.88 | 7.50 | RC750 | RE750 | CP750 | | |
| 3.23 | 1.38 Oversize | 1.23 | ./ 3 | .03 | 1.00 | 1.23 | .00 | 7.13 | 7.75 | RC1000 | RE1000 | CP1000 | | |
| 4 | 1 Standard | 1.25 | .75 | .63 | 1.88 | 1.25 | .88 | 6.88 | 7.50 | RC750 | RE750 | CP750 | EB750 | CB750 |
| 7 | 1.38 Oversize | 1.23 | ./ 5 | .03 | 1.00 | 1.23 | .00 | 7.13 | 7.75 | RC1000 | RE1000 | CP1000 | [[5/30 | CB/ 30 |
| 5* | 1 Standard | 1.25 | .75 | .63 | 1.88 | 1.25 | .88 | 7.13 | 7.75 | RC750 | RE750 | CP750 | 1 | |
|) | 1.38 Oversize | 1.23 | ./3 | .03 | 1.00 | 1.23 | .00 | 7.38 | 8 | RC1000 | RE1000 | CP1000 | 1 | |
| 6* | 1.38 Standard | 1.50 | 1 | .75 | 2.25 | 1.50 | 1 | 8.13 | 8.88 | RC1000 | RE1000 | CP1000 | | |
| | 1.75 Oversize | 1.50 | ' | ./ 5 | 2.23 | 1.50 | l ' | 8.38 | 9.13 | RC1250 | RE1250 | CP1375 | EB1000 | CB1000 |
| 8 | 1.38 Standard | 1.50 | 1 | .75 | N/A | 1.50 | 1 | 8.25 | N/A | RC1000 | RE1000 | CP1000 | LBTOOO | СВТООО |
| 0 | 1.75 Oversize | 1.50 | ' | ./3 | 19/7 | 1.50 | ' | 8.50 | 11// | RC1250 | RE1250 | CP1375 | 1 | |
| 10 | 1.75 Standard | 2 | 1.38 | 1 | N/A | 2.13 | 1.38 | 10.38 | N/A | RC1250 | RE1250 | CP1375 | EB1375 | CB1375 |
| 10 | 2 Oversize |] - | 1.30 | ' | 1 1 1 / / 1 | 2.13 | 1.30 | 10.50 | 19/7 | RC1500 | RE1500 | CP1750 | | |
| 12 | 2 Standard | 2.50 | 1.75 | 1.25 | N/A | 2.25 | 1.75 | 11.13 | N/A | RC1500 | RE1500 | CP1750 | EB1750 | CB1750 |
| 12 | 2.50 Oversize | 2.50 | 1./3 | 1.23 | IN/A | 2.23 | 1./3 | 11.38 | IN/A | RC1875 | N/A | CP2000 | | |

Clevis pins are provided with pivot mounts. *MP4 5"-6" bores are 5-7 day delivery. For dimensions not shown, see page 6.

^{**}Extruded MP1 mounts are standard (1.50"-8" bores). Cast Iron removable mounts are optional, and must be requested when ordering (1.50"-6" bores). Specify "CAST MP1" when ordering.





MINIATURE COMPRESSED AIR REGULATOR



MODEL NUMBER

R07-200-RGKA (Repair Kit 3407-02) Relieving Type Regulator with Gauge

FEATURES

- · Full flow gauge ports
- Low torque, non-rising pressure adjustment knob provides easy hand adjustment at any pressure.
- Outlet pressure can be reduced even though the system is dead-ended

SPECIFICATIONS

Fluid: Compressed air

Maximum Inlet Pressure: 300 psig (20.7 bar)

Outlet Pressure Adjustment Range: 5 to 100 psig

Temperature Range: 0° to 150°F (-18° to 66°C), When temperature is below 35°F (2°C) the air

supply must be dry enough to avoid ice formation in the regulator.

Main Ports: 1/4" NPT

Gauge Ports: two 1/8" NPT, full flow

Type: Diaphragm, relieving

MATERIALS OF CONSTRUCTION

Bonnet: Acetal Body: Zinc

Valve: Brass/Nitrile or Geolast

Valve Seat: Acetal Elastomers: Nitrile

SSG2001 & 2002 SERIES 2" CENTER BACK LIQUID FILLLED GAUGES

ALL SPECIFICATIONS AND DIMENSIONS SUBJECT TO CHANGE WITHOUT NOTICE



3302001 & 2002 SERIES

Case: 304 Stainless Steel

· Dial: Aluminum, White, Black, & Blue Type

Scale: Dual (lb/in² - bar - x 100 kpa)

Bourdon Tube: Brass

Connection:

Lens: Acrylic

 Surge Protection: Standard Accuracy: ANSI Grade B.

| PART# | RANGE |
|-------------|-----------|
| SSG200*-V | 30hg-0 |
| SSG200*-15 | 0-15PSI |
| SSG200*-30 | 0-30PSI |
| SSG200*-60 | 0-60PSI |
| SSC200* 100 | 0-100PSI |
| SSG200*-160 | 0-160PSI |
| 536200° 200 | 0-200PSI |
| SSG200*-300 | 0-300PSI |
| SSG200*-400 | 0-400PSI |
| SSG200*-600 | 0-600PSI |
| SSG200*-1K | 0-1000PSI |
| SSG200*-2K | 0-2000PSI |
| SSG200*-3K | 0-3000PSI |
| SSG200*-5K | 0-5000PSI |
| | |





LSS2002 SERIES 2" CENTER BACK LIQUID FILLLED GAUGES

LSS2002 SERIES ALL STAINLESS

- Case: 304 Stainless Steel
- . Dial: Aluminum, White, Black, & Blue Type
- Scale: Dual (lb/in² bar x 100 kpa)
- Bourdon Tube: 316 Stainless Steel
- Connection: 316 Stainless Steel 1/4" NPT
- Lens: Acrylic
- Surge Protection: Standard
- Accuracy: ANSI Grade

| PART# | RANGE |
|-------------|-----------|
| L3S2002-V | 30hg-0 |
| LSS2002 20 | 0-30PSI |
| LSS2002-60 | 0-60PSI |
| LSS2002-200 | 0-200PSI |
| LSS2002-300 | 0-300PSI |
| LSS2002-400 | 0-400PS1 |
| LSS2002-2K | 0-2000PSI |
| LSS2002-3K | 0-3000PSI |
| LSS2002-5K | 0-5000PSI |

ALL STAINLESS



SSG2011 & 2012 SERIES 2" LOWER CONNECTION LIQUID FILLLED GAUGES

SSG2011 & 2012 SERIES

- Case: 304 Stainless Steel
- · Dial: Aluminum, White, Black, & Blue Type
- Scale: Dual (lb/in² bar x 100 kpa)
- Bourdon Tube: Brass
- Connection:

SSG2011- Brass 1/4" NPT SSG2012- Brass 1/2" NPT

- Lens: Acrylic
- Surge Protection: Standard · Accuracy: ANSI Grade B

| PART# | RANGE |
|-------------|-----------|
| SSG201*-V | 30hg-0 |
| SSG201*-15 | 0-15PSI |
| SSG201*-30 | 0-30PS |
| SSG201*-60 | 0 OUPSI |
| 3SG201*-100 | 0-100PSI |
| SSG201 163 | 0-160PSI |
| SSG201*-200 | 0-200PSI |
| 35G201*-300 | 0-300PSI |
| SSG201*-400 | 0-403PSI |
| SSG201*-600 | 0-600PSI |
| SSG201*-1K | 0-1000PSI |
| SSG201*-2K | 0-2000PSI |
| SSG201*-3K | 0-3000PSI |
| SSG201*-5K | 0-5000PSI |
| | |

* Denotes Connection 1=1/8"NPT, 2=1/4"NPT





PRESSURE SWITCH

| RANGE | PRES | PRESSURE SETTING RANGE | | | APPROX | PROOF | LIMIT | CATALO |
|------------------------------|-------|------------------------|------------|-------|---------|----------|--------|----------|
| (PSI) | DECRE | EASING | INCREASING | | ACT. | PRESSURE | SWITCH | G |
| | MIN | MAX | MIN | MAX | VALUE | | CKASS | NUMBER |
| 100 | 10.0 | 92.1 | 17.9 | 100.0 | 2.0-7.9 | 150 | EE | MSPS- |
| | | | | | | | | EE100SS |
| APPROXIMATE SHIPPING WEIGHT: | | | | | | | | .25 LBS. |

^{*} Fixed at any pressure setting, varies from lowest to highest setting.

DETAIL DATA

Electrical Connection .250" wide x .032" thick quick-connect switch terminals

Pressure Connection 1/8" NPT external

Wetted Materials Diaphragm – Buna N

Fitting – 304 Stainless Steel

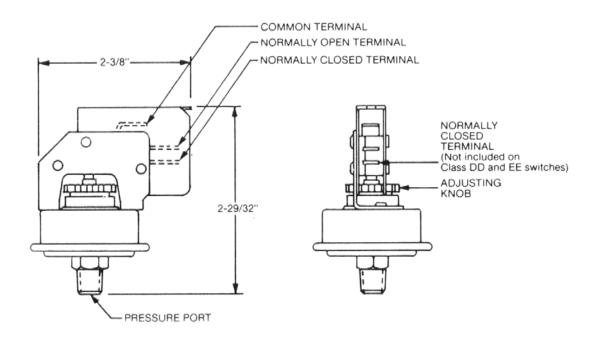
Approvals UL recognized and CSA listed

Adjustment Turn adjusting knob clockwise to increase and counterclockwise

to decrease pressure setting.

Temperature Range $+20^{\circ}$ F to 165° F (-7° C to +74° C)

| ELECTRICAL RATING | | | | | |
|-------------------|-------------|---------------------|-----------|--|--|
| LIMIT | VOLTAGE | MAXIMUM CO | ONTINUOUS | | |
| SWITCH | (VOLTS) | OLTS) CURRENT (AMP) | | | |
| CLASS | | RESISTIVE | INDUCTIVE | | |
| EE | 125/250 VAC | 3 | 3 | | |



^{**} Class EE switches; single pole, single throw, normally open.



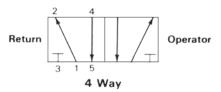
- Rugged aluminum body is lightweight and durable.
- Valves are available with roller cam, cam stem, push button, or selector, with spring return.
- Ideal for sensing the position and controlling moving devices such as cylinders, slides and gates.
- 1/4" 3-way valves can be plumbed to perform as normally passing, normally non-passing, or selector. 1/8" 3-way can only be used as normally non-passing.
- Stock the basic cam stem valve and a selection of actuators to meet most application needs.



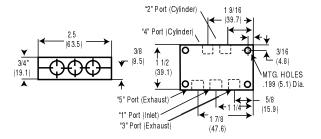
M212LS-11, 4-way long knob selector, manual

| _ | | | | |
|----|-----|-----|------|------|
| | chi | nic | วไ ไ |)ata |
| 16 | GH | | aı L | Jala |

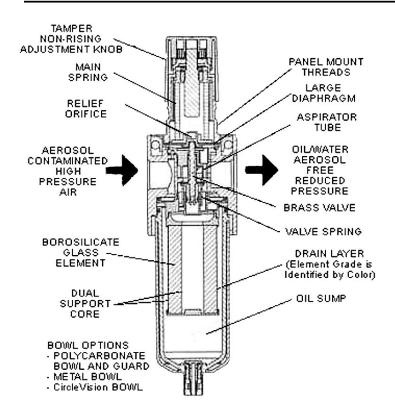
| Port size: | 1/4" NPT |
|-----------------------|-----------------------------|
| Pressure Range: | 0-150 PSI |
| Temperature: Range | 32-160 F (0-71 C) |
| Media: | Compressed Air |
| Flow: | C _V =.7, 26 scfm |



Basic 4-Way Valve



FRL FLEXIBLOX SERIES 32 - COALESCING/REGULATOR



APPLICATION

Numatics C Series Coalescing/Regulator is a two station point of use air preparation system designed to provide superior filtration and regulation in one compact housing. The C Series combines a multiple support cartridge style borosilicate glass element with a pilot balanced regulator to assure the maximum performance of downstream components.

Available with four different element choices, the C Series Coalescing/Regulator can be specified to attack and remove the exact type of contamination that is critical to the specific application.

FEATURES

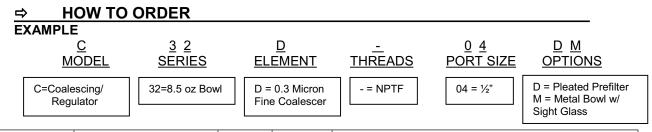
- Cartridge element design.
- Inner and outer support cores prevent element from crushing in either flow direction.
- · Connects to FlexiBlok modular system.
- Four element grade available.

RECOMMENDED USES

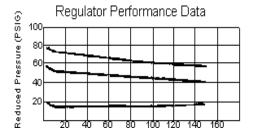
<u>ELEMENT D</u>, identified by its <u>GREEN</u> drain layer, is a fine filter for cylinder or valves especially when the circuit is being run without lubrication("Dry"). Excellent filter for desiccant or regenerative style dryers.

PREFILTER OPTION - SUFFIX "D"

When using models with elements C, D, or E, they can be equipped with an optional 3 micron prefilter. The prefilter protects the fine borosilicate glass fibers from particle overload in severe contamination environments. For most applications, the prefilter eliminates the requirement of a separate particle filter.



| MODEL NUMBER | ELEMENT ABSOLUTE MICRON | PIPE SIZE | BOWL SIZE | SCFM at 100 PSIG Inlet Pressure and a 1.5 PSID across the element | | |
|-----------------|----------------------------|--------------|--------------|---|----|-----|
| | RATING | | | | | |
| | | | | 25 | 60 | 100 |
| C32D -04 | 0.3 | 1/2" | 8.5 oz | 28 | 40 | 55 |



ELEMENT PERFORMANCE DATA

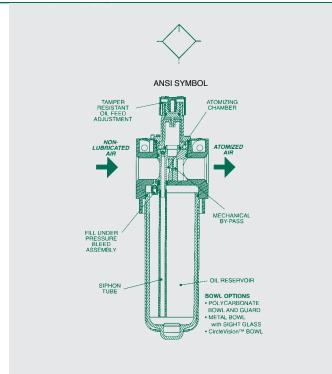
Performance of any coalescing filter is in relationship to the velocity of the air passing through (inside to outside) the element.

Since the velocity and ΔP are directly proportional (the higher the ΔP the higher the velocity). We must size filters according to flow at an optimum ΔP rather than flow at maximum velocity to atmosphere. Tests indicate the most effective ΔP for removing aerosols and contaminants from an air line is 1.5 PSI or less. This indicates that the filters are capable of flowing much more than is recommended for maximum contamination removal.





FLEXIBLOK® FRL Series



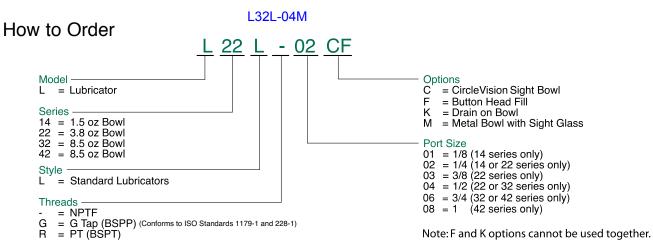
Lubricator

L14L, L22L, L32L, L42L Series

- · Four convenient sizes
- Lubrication to begin at 2 SCFM
- · Can be filled under pressure (32 and 42 series only)
- Tamper-resistant knob standard
- Optional CircleVision™ sight bowl
- · Optional metal bowl with sight glass
- · Can be mounted as individual or modular unit
- · Button head fill optional on all sizes
- Atomizing chamber develops longer life aerosols

Specifications

| | 14 SERIES | 22 SERIES | 32 SERIES | 42 SERIES |
|------------------------|-----------|-----------|-----------|-----------|
| Temperature Range (°F) | 40-120 | 40-120 | 40-120 | 40-120 |
| Temperature Range (°C) | 4-50 | 4-50 | 4-50 | 4-50 |
| Max. Pressure (PSIG) | 200 | 200 | 200 | 200 |
| Max. Pressure (BAR) | 14 | 14 | 14 | 14 |
| Weight (lbs.) | 0.60 | 0.69 | 1.37 | 4.15 |
| Weight (kg) | 0.27 | 0.31 | 0.62 | 2.18 |
| Body Material | Zinc | Aluminum | Aluminum | Aluminum |



NEED MORE PARTS AND INFORMATION?

• See page 35 for information on ordering replacement parts.

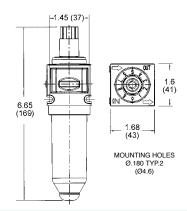
numatics

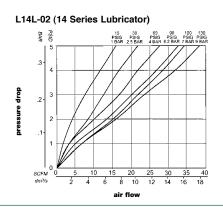




14 Series Lubricator

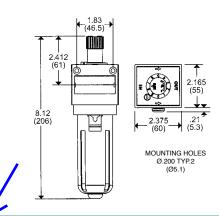


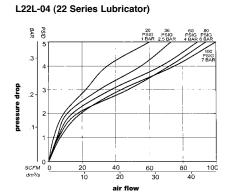




22 Series Lubricator

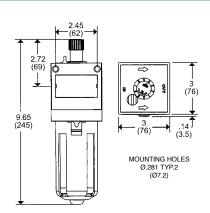


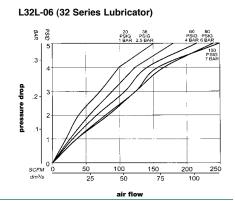




32 Series Lubricator

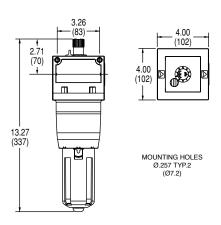




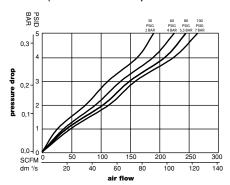


42 Series Lubricator





L42L-06 (42 Series Lubricator)



NUMATROL II

PRODUCT OF NUMATICS, INC.

GENERAL

The Sentinel Line is a family of rugged, heavy-duty limit valves, designed to provide the ultimate in reliability, versatility, and long trouble-free life under the most demanding conditions.

It was intended to out-perform the best limit switches in applications where the limit is exposed to coolants, die lubricants, water, degreasing fluids, foundry sand, and other similar environments where limits are a major source of machine downtime.

APPLICATION

Each "Sentinel" is a small, mechanically actuated, spring return air valve. All models have a blocked center spool, so there is no possibility of blow-by or cross-bleed from one flow path to another as the valve shifts. They are sub-plate mounted, the equivalent of a plug-in limit switch. Each sub-plate has three different sets of mounting holes, providing a variety of mounting possibilities.

Subplates have ports in the bottom and in the end opposite the operator. A conduit adapter option allows the connecting tubing to be run to the end ports through standard electrical conduit. The bottom ports have counter-bores for o-ring seals.

LR5 limits are dirtproof and splashproof, multi-purpose, 4 – way valves with 5 separate ports for maximum versatility. Any port may be pressurized.

OPERATING DATA

PRESSURE RANGE: Vacuum to 150 PSIG
TEMPERATURE RANGE: +40° F to + 200° F ambient.

OPERATING TORQUE OF ROTARY ACTUATORS:

2.5 in./lbs. Full shift.

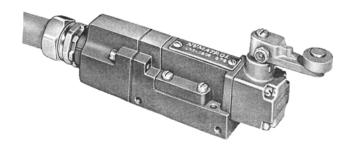
REPEAT ACCURACY: Rotary Actuator + 1/4°

SERVICE: Valves may be used on properly filtered and lubricated air, dry air, vacuum or noncorrosive, nontoxic, and nonflammable dry gases.

FLOW CAPACITY: Series LR valves have a C_v of .32. At 80 PSIG supply pressure, discharging to atmosphere, the flow is 14.7 SCFM. See Numatics' Engineering & Technical Data for complete flow chart.

ROTARY ACTUATOR: 3 different roller – lever actuators are available. Each operator can be rotated to any of four positions on the valve, providing considerable mounting versatility. They also may be converted in the field from universal actuation to one-way –trip in either direction. Cam design data is provided for operating levers of varying lengths. See pages N-4-5 for installation data and lever arm specifications.

| MODEL SELECTION CHART | | | | | | | | |
|--|-----------------------|-----------|--|--|--|--|--|--|
| VALVE ACTION | MOUNTING DETAILS | CATALOG # | | | | | | |
| 5-Port Multi- | Complete Valve On | LR5-0201 | | | | | | |
| purpose, Dirtproof, | Sub-plate, No Conduit | | | | | | | |
| and Splashproof | Adapter | | | | | | | |
| #LR5-0201 used with #216-124P Lever for Belt Steering (2 Req.) | | | | | | | | |
| | Part # 030-165-0006 | | | | | | | |



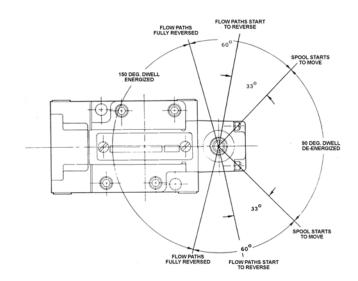


FIG 1

INSTALLATION AND CAM ARRANGEMENT

Figure 1 shows the positions of the lever actuator, relative to the operator assembly shaft, which determines valve operation. The "circle" may be rotated in any increment of the possible $360^\circ,$ however, the relative positions of the energized of de-energized "segments" are always the same. To take full advantage of the valve's flow capacity, the lever actuator must travel 60° for full valve spool shift from full open to full close. However, fewer degrees of travel will produce a signal.

For proper operation, first determine the actuating position desired. This may be done by placing a work piece in the path of the lever at the point of desired contact. Pressurize the valve, and rotate the shaft of the operator assembly until a signal is obtained. Attach the lever actuator to the operator shaft in the desired position and tighten the lever's clamp assembly. Test the limit's operation by running the system to see if the lever is actuated in the proper position. Repeat the assembly procedure, if necessary, until the exact orientation of the lever assembly, with respect to the operator shaft, is achieved.

Mannesmann Rexroth Corporation

Rexroth Mecman Division 1953 Mercer Road, Lexington, KY 40511-1021

Tel: 606-254-8031

Fax: 606-254-4188/800-489-4188



CD-7 4-WAY DIRECTIONAL VALVE Single Solenoid – External Pilot

4-way / 2 Position 1/4" NPT Solenoid & Air Pilot Operated

TECHNICAL DATA:

Port Sizes: 1/4" NPT

Working Pressure: Vacuum Service to 150 PSI

Pilot Pressure: 45 PSI Minimum

Flow: Cv + 1.1

Temperature Range: +5° F to +120° F
Media: Air (lubricated or not)
Materials: Body – Zinc die cast

Spools - Engineering Plastic

Seals: Buna-N Manual Override: Locking

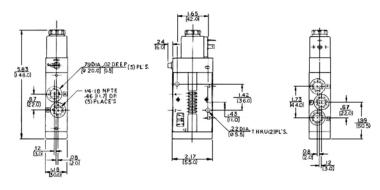
Coil: Continuous Duty

THE SERVICE STATE OF THE SERVI

ELECTRICAL DATA

| Voltage | Power Consumption | | |
|--------------|-------------------|---------|--|
| 120 VAC | Inrush | Holding | |
| (50 / 60 Hz) | 6.4 VA | 3.7 VA | |

VOLTAGE TOLERANCE: ±10%



CD-7 4-WAY DIRECTIONAL VALVE - PS34010-1355

| P/N | 0.30- | 165. | -()11 | 11 |
|-----|-------|------|-------|----|

| REPAIR KIT | NUMBER | DESCRIPTION | | | | |
|-------------------------|-------------|--|--|--|--|--|
| Body Repair Kit | P26235 | Includes all rubber parts, (2) cartridges and (2) pilot piston assemblies. | | | | |
| Solenoid Pilot Operator | P26628 | One per solenoid required. External Pilot | | | | |
| Solenoid Plunger | P69541 | Includes armature. Plunger/spring and seal. | | | | |
| External Pilot | P26240-0001 | 120 VAC 50/60 Hz | | | | |
| Solenoid Coil | P48835-1 | 120 VAC 50/60 Hz | | | | |

IN-LINE FOW CONTROL VALVE

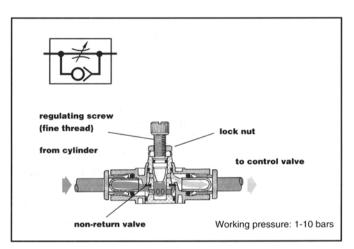
Designed to be versatile

In-Line flow controls are unidirectional. Intake flows freely through the flow control; exhaust air is metered out through a specially designed adjustment screw. An arrow on the body of the valve indicates the direction of controlled flow.

Since it is a tube to tube connection, it may be installed as a meter in or a meter out device.

Adjustment characteristics

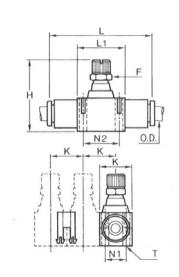
Control is achieved through a finely threaded special adjustment screw.

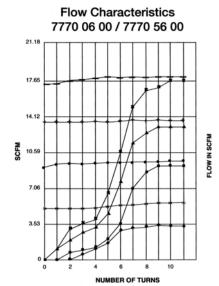


The special shaped adjustment screw produces a more linear flow control than ordinary tapered screws. With the use of a locking nut, the in-line control may be secured in its final setting. Settings are maintained even under adverse conditions such as vibration. A captive adjustment screw prevents loss or dangerous blow-out.

Full flow in both directions

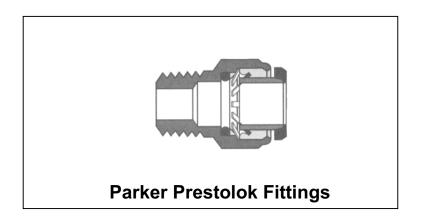
Intake capacity is always slightly greater than the full open exhaust capacity, enabling maximum variation of speeds between outward and return strokes.





7770 with LF3000 instant fitting connections (fractional inch) P/N 030-175-0034

| Tube O.D. | P/N | orifice | F (mm) | H (Min.) | H (Max.) | L | L1 | К | N1 | N2 | т | Oz. |
|--------------|-----------|---------|-----------|-------------|-------------|------|-----|-----|-----|-----|-----|-----|
| 1/4 | 777 56 00 | .16 | 5 | 1.15 | 1.15 | 1.52 | .59 | .47 | .31 | .43 | .09 | .42 |



Advantages

Ready-to-use compact one-piece fitting for use with most thermoplastic and soft metal tubing. This fitting is specially designed for low pressure circuits where fast assembly, disassembly and re-assembly is important. No special tools are needed for assembly; just insert the tubing until it bottoms. Prestolok is, designed, to be used with no tube support. Radial claws on the stainless steel grab ring grip the tubing securely to provide retention. Swivels are featured on all male pipe threaded shapes for installation in tight places and for precise positioning. Prestolok should not be used for live swivel applications. The outside diameter of the tubing to be used with the fitting is marked on the release button. removable release button can be color coded for ease of identification. Standard release button is green.

Materials

Prestolok Bodies: CA377, CA360, CA345

O-Ring: Nitrile

Release Button: Polyacetal Grab Ring: Stainless Steel

Applications

Use with Parker Parflex series "E" polyethylene tubing, series "N" nylon tubing, series "U" polyurethane tubing or soft metal tubing. Perfectly adapted for use in a large variety of industries,

Working Pressure/Temperature Ranges

Prestolok: Zero to 200°F at up to 300 PSI depending on tubing being used.

Assembly Instructions

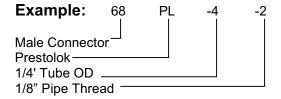
- Cut thermoplastic tubing squarely, using Parker Tube Cutter PTC-001. Metal tubing should be cut squarely and free of burrs. Be certain the port or mating part is clean and free of debris.
- Insert tubing into fitting until it bottoms. A slight twisting motion will ease the insertion. Pull on tubing to verify it is properly retained in the fitting.
- To disassemble, simply push the release button against the body and remove tubing.

Order

By part number and name

Nomenclature

Part numbers are constructed from symbols that identify the style and size of the fitting. The first series of numbers and letters identify the style and type fitting. The second series of numbers describe the size.

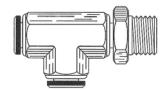


Male Elbow Swivel 90° 169 PL



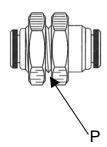
| Part No. | Tube Size | Pipe Thread (NPTF) |
|-----------|-----------|-----------------------|
| 169PL-4-2 | 1/4 | 1/8 |
| 169PL-4-4 | 1/4 | 1/4 |
| 169PL-4-6 | 1/4 | 3/8 |

Male Run Tee Swivel 171 PL



| Part No. | Tube Size | Pipe Thread (NPTF) |
|-----------|-----------|-----------------------|
| 171PL-4-4 | 1/4 | 1/4 |

Bulkhead Union 62PLBH



| Part No. | Tube Size | P (max.) |
|----------|-----------|----------|
| 62PLBH-4 | 1/4 | .24 |

Male Connector 68PL



| Part No. | Tube Size | Pipe Thread (NPTF) |
|----------|-----------|-----------------------|
| 68PL-4-2 | 1/4 | 1/8 |

Union Tee 164PL



| Part No. | Tube Size |
|----------|-----------|
| 164PL-4 | 1/4 |

Male Branch Tee Swivel 172PL



| Part No. | Tube Size | Pipe Thread (NPTF) |
|----------|-----------|-----------------------|
| 172PL4-4 | 1/4 | 1/4 |

POLYETHYLENE PNEUMATIC TUBING

The pneumatic lines have been color coded for ease of maintenance and service. The following is a list of the color and the intended use:

| COLOR | LOCATION | | | | |
|--------|----------------------|--|--|--|--|
| Black | Steering | | | | |
| Red | Filter Belt Tension | | | | |
| Blue | Milling Belt Tension | | | | |
| Green | Plow Assembly | | | | |
| Yellow | Doctor Blade | | | | |

The following page has specifications and part numbers.

Advantages

Chemical resistant, flexible, low cost, eight colors, five tube sizes and choice of reel lengths.

Construction

Flexible polyethylene thermoplastic tubing is extruded from high molecular weight resin for increased dimensional stability, uniformity and long-term strength. Its resistance to environmental stress cracking greatly exceeds that of ordinary polyethylene tubing as measured by ASTM D-1693, (10% IGEPAL).

Applications & Approvals

Polyethylene tubing is available in black as well as seven coding colors as recommended by the Instrument Society of America. Black (EB) tubing contains an ultra-violet inhibitor which is recommended for use in sunlit areas. Ingredients of natural and color tubing (except black) listed below meet FDA requirements for food contact applications. All tubing conforms to ASTM D-1248, Type I, Class A, Category 4, Grade E5.

Temperature Range

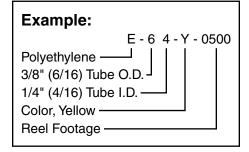
Suggested operating temperature range is -80°F to 150°F (-62°C to 66°C).

Fitting Recommendation

Brass fittings

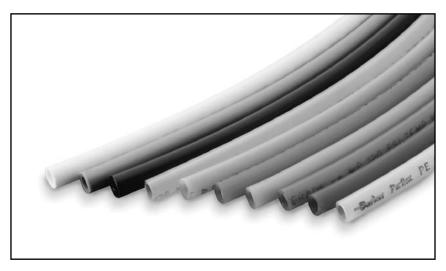
Nomenclature

Part numbers are constructed from symbols that identify the style and size of the fitting. Letters identify style and material. Numbers identify size in 1/16's of an inch.



E Instrument Grade Tubing

| Part Number | Color | O.D. | I.D. | Wall | Reel Length Feet | Working Pressure psi at 73°F | Min. Burst psi at 73°F | Min. Bend Radius Inches | Weight Per 100 Feet |
|----------------|---------|------|-------|-------|------------------------|---------------------------------------|---------------------------------|----------------------------------|---------------------------|
| E-43-0100 | Natural | 1/4 | 0.170 | 0.040 | 100 | 120 | 625 | 4 | 1.1 |
| E-43-0500 | Natural | 1/4 | 0.170 | 0.040 | 500 | 120 | 625 | 4 | 1.1 |
| E-43-1000 | Natural | 1/4 | 0.170 | 0.040 | 1000 | 120 | 625 | 4 | 1.1 |
| EB-43-0100 | Black | 1/4 | 0.170 | 0.040 | 100 | 120 | 625 | 4 | 1.1 |
| EB-43-0500 | Black | 1/4 | 0.170 | 0.040 | 500 | 120 | 625 | 1 | 1.1 |
| EB-43-1000 | Black | 1/4 | 0.170 | 0.040 | 1000 | 120 | 625 | 4 | 1.1 |
| E-43-R-0100 | Red | 1/4 | 0.170 | 0.040 | 100 | 120 | 625 | 4 | 1.1 |
| E-43-R-0500 | Red | 1/4 | 0.170 | 0.040 | 500 | 120 | 625 | 1 | 1.1 |
| E-43-B-0100 | Blue | 1/4 | 0.170 | 0.040 | 100 | 120 | 625 | 4 | 1.1 |
| E-43-B-0500 | Blue | 1/4 | 0.170 | 0.040 | 500 | 120 | 625 | 1 | 1.1 |
| E-43-O-0500 | Orange | 1/4 | 0.170 | 0.040 | 500 | 120 | 625 | 4 | 1.1 |
| E-43-Y-0500 | Yellow | 1/4 | 0.170 | 0.040 | 500 | 120 | 625 | 1 | 1.1 |
| E-43-P-0500 | Purple | 1/4 | 0.170 | 0.040 | 500 | 120 | 625 | 4 | 1.1 |
| E-43-G-0500 | Green | 1/4 | 0.170 | 0.040 | 500 | 120 | 625 | 1 | 1.1 |
| E-53-0500 | Natural | 5/16 | 0.187 | 0.062 | 500 | 145 | 800 | 1-1/8 | 2.1 |
| EB-53-0500 | Black | 5/16 | 0.187 | 0.062 | 500 | 145 | 800 | 1-1/8 | 2.1 |
| E-64-0100 | Natural | 3/8 | 0.250 | 0.062 | 100 | 125 | 675 | 1-1/4 | 2.5 |
| E-64-0500 | Natural | 3/8 | 0.250 | 0.062 | 500 | 125 | 675 | 1-1/4 | 2.5 |
| EB-64-0100 | Black | 3/8 | 0.250 | 0.062 | 100 | 125 | 675 | 1-1/4 | 2.5 |
| EB-64-0500 | Black | 3/8 | 0.250 | 0.062 | 500 | 125 | 675 | 1-1/4 | 2.5 |
| E-64-R-0500 | Red | 3/8 | 0.250 | 0.062 | 500 | 125 | 675 | 1-1/4 | 2.5 |
| E-64-B-0500 | Blue | 3/8 | 0.250 | 0.062 | 500 | 125 | 675 | 1-1/4 | 2.5 |
| E-64-O-0500 | Orange | 3/8 | 0.250 | 0.062 | 500 | 125 | 675 | 1-1/4 | 2.5 |
| E-64-Y-0500 | Yellow | 3/8 | 0.250 | 0.062 | 500 | 125 | 675 | 1-1/4 | 2.5 |
| E-64-P-0500 | Purple | 3/8 | 0.250 | 0.062 | 500 | 125 | 675 | 1-1/4 | 2.5 |
| E-64-G-0500 | Green | 3/8 | 0.250 | 0.062 | 500 | 125 | 675 | 1-1/4 | 2.5 |
| E-86-0100 | Natural | 1/2 | 0.375 | 0.062 | 100 | 90 | 425 | 2-1/2 | 3.6 |
| EB-86-0100 | Black | 1/2 | 0.375 | 0.062 | 100 | 90 | 425 | 2-1/2 | 3.6 |
| E-108-0100 | Natural | 5/8 | 0.500 | 0.062 | 100 | 70 | 325 | 4 | 4.6 |
| EB-108-0100 | Black | 5/8 | 0.500 | 0.062 | Coil | 70 | 325 | 4 | 4.6 |





Your Enclosure Source®

Saginaw Control & Engineering 95 Midland Road Saginaw, MI 48638 Phone: (989)799-6871

Fax: (989)799-4524

http://www.saginawcontrol.com

Part Details - SCE-16EL1206SSLP

Part Number: SCE-16EL1206SSLP Description: S.S. EL Enclosure

Height: 16.00 inches Width: 12.00 inches Depth: 6.00 inches Page Number: 193 List Price: \$590.45 Panel: SCE-16P12 -Product Code: S5

Est. Shipweight: 17.00 lbs. NEMA Rating: 12, 4, 4X

Construction -

- 0.075 In. stainless steel Type 304.
- Seams continuously welded and ground smooth.
- Flange trough collar around all sides of door opening.
- Oil-resistant gasket.
- Collar studs provided for mounting optional panels.
- Concealed hinge.
- Removable and interchangeable doors.
- Black quarter turn latches on three sides of doors.
- Latches are opened or closed with a screwdriver (optional tamper-resistant inserts are available).
- Mounting holes in back of enclosure.
- Mounting hardware, sealing washer and hole plug included.
- Optional mounting feel available.
- Door hardware available.
- · Removable print pocket.
- Ground studs on door and body.

Similar Part Numbers -

- SCE-12EL1206SSLP
- SCE-12EL2406SSLP
- SCE-16EL1208SSLP
- SCE-16EL1606SSLP
- SCE-16EL1608SSLP
- SCE-16EL2008SSLP
- SCE-20EL1606SSLP
- SCE-20EL1608SSLP



CAD Package (STP, PDF, DWG)

Having trouble downloading drawings? Click Here for help.

Application -

Designed to house electrical and electronic controls, instruments and components in areas which may be regularly hosed down or are in very wet conditions. Provides protection from dust, dirt, oil, and water. For outdoor application a drip shield is recommended.

Finish -

#4 brushed finish on all exterior surfaces. Optional subpanels are powder coated white.

Options -

- * Can be special ordered in Type 316 Stainless Steel.
- * Panels can be special ordered in Stainless Steel up to 48P36 size.

Industry Standards -

NEMA Type 4, 4X, 12 & 12 UL Listed Type 4, 4X, & 12 CSA Type 4, 4X & 12 IEC 60529 IP 66

Air Compressor

JENNY

Products Corporation Johnstown Industrial Park, Johnstown, PA 15904 (814)266-8656

Warranty

Limited Warranty

All compressors manufactured by Jenny are warranted to be free from defects in material and workmanship under normal use for a period of 12 months from date of installation or 15 months from date of shipment, whichever comes first.

Liability is limited to repair or replacement of material found defective, free of charge F. O. B. plant. Motors and engines are warranted to the extent of the original manufacturer's warranty. Unauthorized repairs or replacements will not be subject to factory warranty.

Three phase motors must be installed with thermal motor protection (Magnetic Starter) for the warranty to apply.



SINGLE STAGE

VALVE — Large area quick acting, hardened and ground swedish steel discs. Stainless steel spring. Cast iron seats for long life and accurate seating. No special tools required.

PISTON RINGS — Automotive type.

WRIST PIN - Hardened and ground

PISTON — Precision machined alloy aluminum.

CONNECTING RODS — Alloy aluminum "H" section rods — extra large bearing surface.

CRANKCASE - Dust tight - enclosed.

MAIN BEARINGS — Oversize ground precision ball type, support both ends of the crankshaft.

INTAKE UNLOADERS - Brass and stainless - built into head.

VALVE PLATE — One piece — complete exchange in minutes.

COMBINATION FILTER / MUFFLER – Highly efficient filtering of air plus noise reduction. (F series – insert filter type).

COOLING FINS - Large area - on cast iron. Bored and Honed cylinder.

FLYWHEEL — Fan type

CASTING - Close-grain cast iron.

LUBRICATION - Automatic splash type - trouble free and positive action.

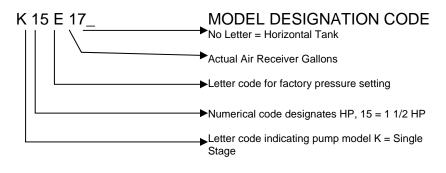
HIGH LEVEL OIL FILL - Cannot be over filled.

OIL DRAIN - Easily accessible.

SINGLE STAGE

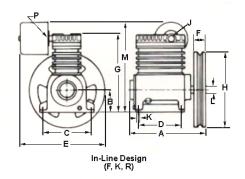
Tank Mounted – Electric – Automatic Start – Stop Control

| | MOD | EL | AIR | PERFOR | RMANCE | APPR | DI | IMENS | IONS |
|-------|---------|------|---------|---------|-------------|--------|----|-------|--------|
| HP | "E" | TANK | "E" MOI | DELS @1 | 120-150 PSI | SHIP | | | |
| HE | MODELS | GAL. | PUMP | CFM | CFM | WT. | L | W | Н |
| | | | RPM | DISP | DEL'D AIR | VV 1 . | | | |
| 1 1/2 | K15 - E | - 17 | 890 | 10.1 | 5.3 | 315 | 49 | 20 | 38 1/2 |





BARE PUMPS



SINGLE STAGE

JENNY single-stage bare pumps are equipped with flywheel and filter as standard equipment. All pumps are cast-iron. Models F through T are designed for start-stop operation. Models FU through WU have built in constant-run application. Discharge line unloaders to allow constant-run operation of models R, U, and T are available.

BARE PUMP SPECIFICATIONS - SINGLE-STAGE AND TWO-STAGE COMPLETE WITH FLYWHEEL AND

FILTER

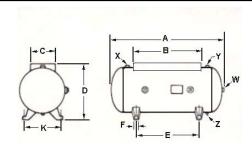
| HEIEK | | | | | | | | | | | | | | | | |
|-------|-------|-----------|------------|----|----------|-------|-------|---------|---------|---------|-----------|----------|-------|-----|----------|----------|
| Model | HP | No Cyl | Ship Wt | A | В | С | D | E | F | G | H DIA. | J NPT | К | L | М | P NPT |
| K | 1 1/2 | 2 | 47 | 10 | 2- 15/16 | 5 7/8 | 5 3/4 | 11- 1/8 | 1- 9/16 | 10- 5/8 | 10-1B | 3/8 | 11/32 | 7/8 | 12- 3/16 | 1/2 |

NOTE: Units of measure-weight-pounds; dimensions-inches; pressure-pounds per sq. inch Bore Size – 2 $\frac{1}{2}$ ", Stroke – 2", Max. Pressure – 150 Psi

AIR RECEIVERS

JENNY air receivers come complete with legs and deck. Horizontal Tank.

Dimensions subject to change. Please consult factory prior to ordering if dimensions are critical to installation.



AIR RECEIVER SPECIFICATIONS - 180 PSI WORKING PRESSURE

| GAL & PART # | CODE | DIA. | O.L. A | PLATFORM | | _ | _ | F HOLE | K | PIPE TAPS (NPT) | | | SHIP | |
|-----------------|-------------|------|--------|----------|---|----|----|-----------|--------|-----------------|-----|-----|------|----|
| | | | | В | С | D | | DIA. | ^ | W | Х | Υ | Z | WT |
| 30U | ASME- NB | 16 | 38 | 20 | 8 | 20 | 22 | 1/2 | 13 3/4 | 1/2 | 1/2 | 1/2 | 1/4 | 88 |

Charter Machine Company recommends that the air compressor be located so that it has a source of clean dry air. This may be accomplished by locating the compressor in another room (away from dewatering equipment) or by plumbing the intake to a clean dry air source.

MARATHON ELECTRIC – MOTORS

Performance Data For Catalog No. E951 Model Number 145TTFR4026

| WINDING | ZT498 | VOLT | 460 | F.L. Amps | 2.1 | FREQUENCY | 60 |
|----------------|-------|--------------|-----|---------------|------|----------------|------|
| Frame | 145 | Power Factor | 81 | Full Load RPM | 1735 | Sync RPM | 1800 |
| Nom. Eff. | 84 | KVA Code | K | NEMA Design | В | Min Eff. | 81.5 |
| Max. Wk. Sq. | 50 | STARTS | 18 | Stall Time | 25 | Sound Pressure | 60 |
| Torque (ft/lb) | 13.5 | KVARMAX | 0.8 | KVAR95 | 0.6 | KVAR90 | 0.3 |
| CONN | 1Y | MTRWGT | 50 | RTRWGT | 17 | RTRWK | 0.12 |
| Sound Power | 69 | | | | | | _ |

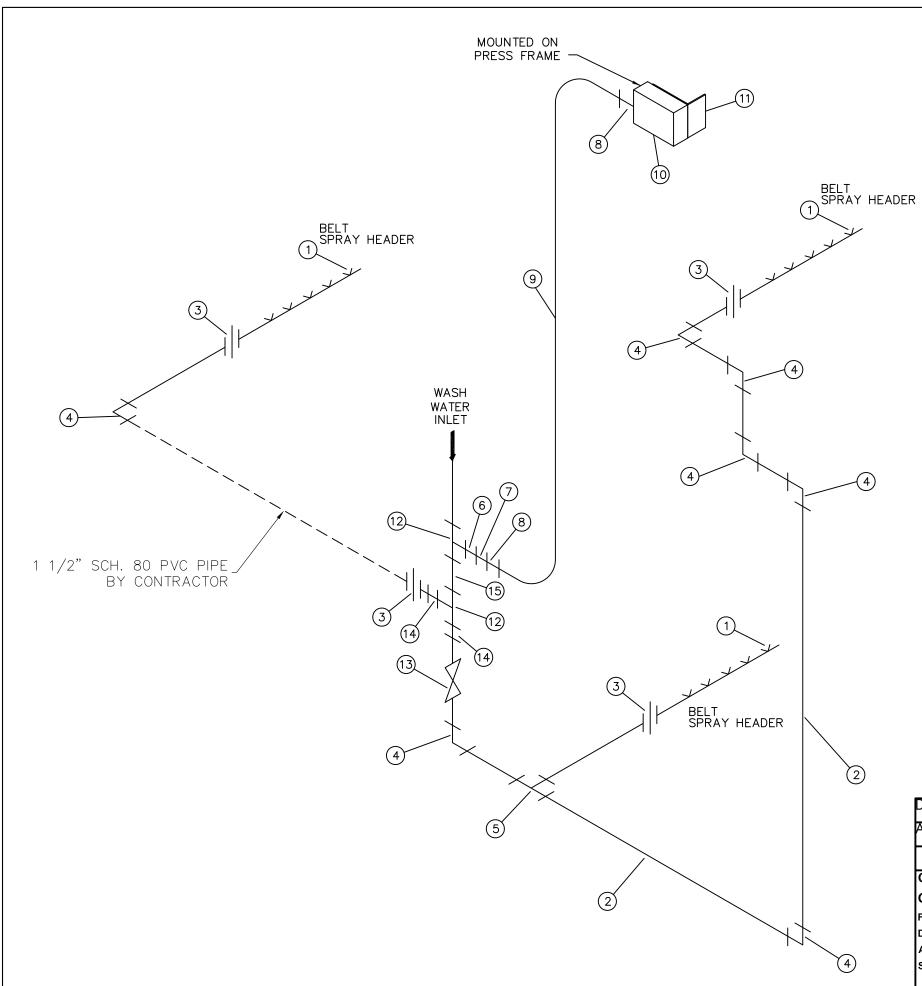
LOAD CURVE

| LOAD | AMP | RPM | TQ | EFF | PF |
|------|-----|------|-----|------|----|
| 0 | | | | | |
| 0 | 1 | 1800 | | | 12 |
| .25 | 1.2 | 1785 | 1.1 | 71 | 43 |
| .5 | 1.4 | 1772 | 2.2 | 81 | 65 |
| .75 | 1.7 | 1758 | 3.4 | 82.5 | 75 |
| 1 | 2.1 | 1735 | 4.5 | 84 | 81 |
| 1.15 | 2.3 | 1730 | 5.2 | 82.5 | 83 |

| Type | AMP | NEMA Amp | Torque (ft/lb) | NEMA Torque |
|------|------|-------------|----------------|-------------|
| L.R. | 16.5 | 20 | 12.5 | 11.3 |
| B.D. | 10.5 | | 16.2 | 12.6 |







| ш - | | MATERIAL DESCRIPTION - | MAT'L | PART NUMBER | REQUIRED | | | FIN | |
|--------------|--------------------|--------------------------------------|-------|-----------------|----------|----|----------|------------|--|
| NOTE ITEM | REF. DRAWING, etc. | REF NUMBER etc. | | GR | GR | GR | GR 04 | WT 1 PC | |
| | | | | CtC. | UI. | UZ | 03 | 04 | |
| | 1 | SPRAY HEADER | SSTL | SEE PROJECT LOG | 3 | | | | |
| | 2 | 1 1/2" PIPE, SCH. 80 | PVC | | 1 | | | | |
| | 3 | 1 1/2" UNION, SOCK, SCH. 80 | PVC | | 2 | | | | |
| | 4 | 1 1/2" ELBOW 90, SOCK, SCH. 80 | PVC | | 7 | | | | |
| | 5 | 1 1/2" TEE, SOCK, SCH. 80 | PVC | | 1 | | | | |
| | 6 | 2" SOC x 1/2" NPT RED BUSHING | PVC | | 1 | | | | |
| | 7 | 1/2" NPT x 1/4" NPT RED BUSHING | BRASS | | 1 | | | | |
| | 8 | 1/4" TUBE x 1/4" NPT 90" FITTING | BRASS | | 1 | | | | |
| | 9 | 1/4" FLEXIBLE TUBING | NYLON | | 1 | | | | |
| | 10 | PRESSURE SWITCH | | | 1 | | | | |
| | 11 | PRESSURE SWITCH BRACKET | 304SS | RB800.3-B-110 | 1 | | | | |
| | 12 | 2" TEE, SOCK. SCH. 80 | PVC | | 2 | | | | |
| | 13 | 1 1/2" SCH. 80 TRUE UNION BALL VALVE | PVC | | 1 | | | | |
| | 14 | 2" SOC X 1 1/2" SOC RED BUSHING | PVC | | 2 | | | | |
| | 15 | 2" PIPE, SCH. 80 | PVC | | 1 | | | | |
| | 16 | | | | | | | | |

NOTES:

- 1) PIPING AND COMPONENTS PRE—ASSEMBLED AND MOUNTED TO THE MACHINE FRAME WILL BE SUPPLIED BY CHARTER MACHINE COMPANY.
- 2) UNLESS OTHERWISE NOTED, COMPONENTS ARE PVC.

| DRAWN TMP 3/5/12 APPROVED | CHARTER MACHINE COMPANY 55 WESTER AVE METUCHEN N.J. 08840 | | | | | |
|---|---|--|--|--|--|--|
| G.E.C. TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONAL DIM ±1/64 | TITLE 3 BELT TOWER PRESS 00.93S WASH WATER ASSEMBLY | | | | | |
| DECIMAL DIM ±.005 ANGLE ± 1/2 SURFACE FINISH 125 | DWG NO. | | | | | |
| | NONE SHEET TOF T | | | | | |



New Shower Header Family...3 Ways Better

- 1. Brush Type Version with easy cleaning capability.
- 2. Exclusive self-locating disc-type shower nozzles eliminate alignment guesswork.
- 3. Multi-purpose flush-out valve for convenient hose connection. Not a welded housing.

Designed-in Versatility

Spraying Systems Co. has taken the conventional shower header and has incorporated sought-after design features that contribute to easier maintenance and better performance.

You can purchase just the basic brushless header. Later you can add a brush type cleaning assembly. Or, if you prefer, a motor-driven cleaning unit can be installed to automate your brush cleaning cycles.

With the brush type design, you simply rotate the interior brush assembly, scrubbing both the inside of the pipe and the nozzle orifices...while continuing to spray. Accumulated debris is removed through the flush-out valve, restoring full liquid flow and preventing contamination of the sprayed surface.

Quality Engineering

Spraying System's shower headers are constructed of types 304L or 316L stainless steel. Disc-type shower nozzles are precision machined to provide accurate spray angles and flow rates. Replacement of nozzles is quick and easy. Lock-ring holds nozzles securely in place.

Nozzle orifices protrude slightly into the pipe and are in line with the plane of the brush movement. This provides efficient cleaning because the bristles of the brush sweep along the full length of the orifice.

Staggered cleaning brush sections are installed at 120° intervals. Large flow passages between sections reduce pressure loss. The cleaning assembly is designed to prevent brush section interference of nozzle performance when the flush-out valve is in the operating position after cleaning cycles. The entire brush assembly is removable and is easy to replace.

Shower Options Provide Design Flexibility

Spraying Systems Co.'s headers are available in many different configurations to accommodate your specific needs.

Pipe diameter 1 ½" are available in lengths as required. The shower headers are designed to operate up to 1000 psi (70 bar). Disc-type shower nozzles are available in a wide variety of spray angles and flow rates. Nozzles may be spaced at any interval.

Elbows, flanges, hose adapters, and a variety of mounting options are available in many sizes...and may be specified for the inlet as well as outlet connection.

For more information concerning Spraying Systems' shower headers, contact Spraying Systems Co. directly or consult your local Spraying Systems Co. representative.

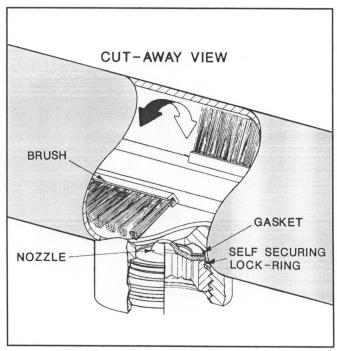


FIG 1 - Brush sections sweep the interior of the pipe and the nozzle orifice with each cleaning cycle.

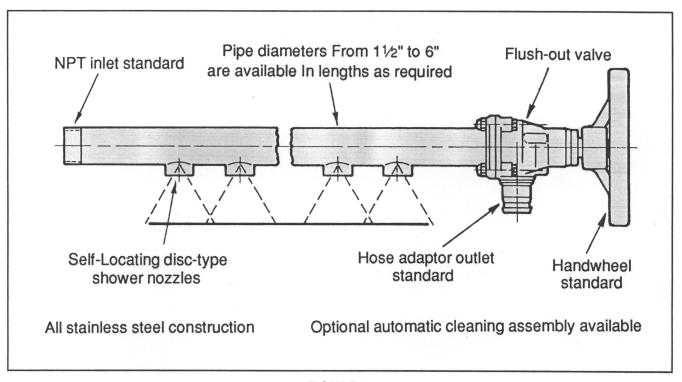


FIGURE 2

FLOW RATES per Nozzle in g.p.m. - I/min

| Spray Angle at 60 PSI (4 | Part | ORIFIC DIAMET | | CA | PACITY II | N GALLON | S PER MIN | UTE | CAP | ACITY IN | LITERS | PER MIN | UTE |
|--------------------------|------|------------------|-----|--------|-----------|----------|-----------|---------|---------|----------|--------|---------|--------|
| bar) | # | INCHES | mm | 20 PSI | 40 PSI | 100 PSI | 250 PSI | 800 PSI | 1.5 bar | 3 bar | 7 bar | 20 bar | 55 bar |
| 60° | 6012 | 0.099 | 2.5 | 0.88 | 1.2 | 2.0 | 3.1 | 5.6 | 3.5 | 4.9 | 7.5 | 12.6 | 21 |

Minimum Water Pressure – 20 psig (1.5 bar)

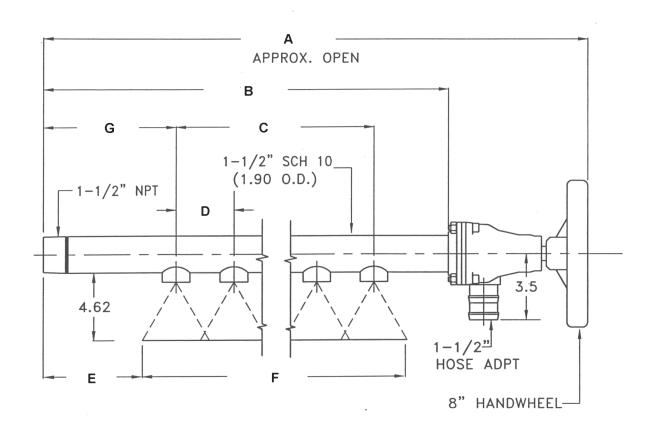
GPM REQ = $\frac{PSI (REQ)}{PSI (GIVEN)}$ X GPM Given

SPRAY SHOWER MILLING / FILTER BELT - DIMENSIONS

| Belt | | Document | | DIME | ENSION | NS (fro | m Figu | ıre 3) | | # of | Total Flow | Header |
|---------------|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------|---------------|---------------------|
| Press Size | Part # | # | A (in) | B (in) | C (in) | D (in) | E (in) | F (in) | G (in) | Nozzle | Rate (Gpm) | Angle H (Fig. 4) |
| 2.2 Meter | 025-191-1487 | P27242-25 | 112 | 104.5 | 82.63 | 4.6 | 9.125 | 87.25 | 11.4 | 19 | 34.4 | 180 |

SPRAY SHOWER GRAVITY BELT - DIMENSIONS

| Belt | | Document | | DIMI | ENSIO | NS (fro | m Figu | ıre 3) | | # of | Total Flow | Header |
|---------------|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------|---------------|---------------------|
| Press Size | Part # | # | A (in) | B (in) | C (in) | D (in) | E (in) | F (in) | G (in) | Nozzle | Rate (Gpm) | Angle H (Fig. 4) |
| 2.2 Meter | 025-191-1487 | P27242-25 | 112 | 104.5 | 82.63 | 4.6 | 9.125 | 87.25 | 11.4 | 19 | 34.4 | 180 |



Operating Pressure - 85 Psig

Orifice Size - 0.099"

Spray Angle - 60°

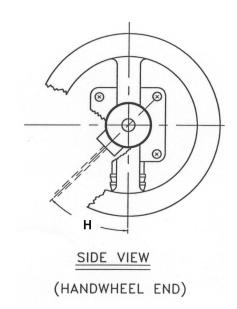
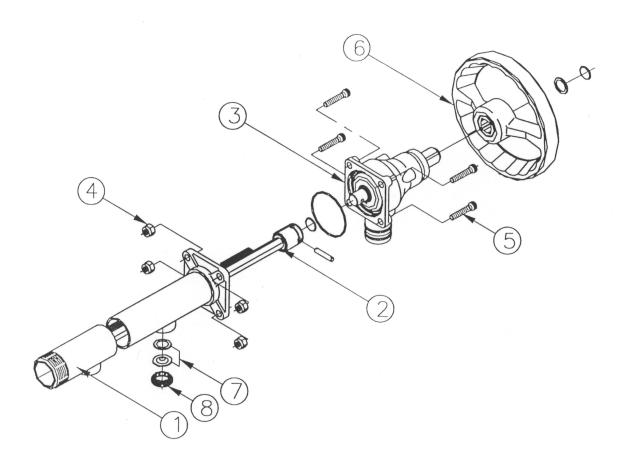


FIGURE3



| 14 | 04 | 2.2m | December the co |
|------|-----|-------------------|---------------------------|
| Item | Qty | Part # | Description |
| 1 | 1 | | 1 ½" Pipe Assembly |
| 2 | 1 | 27449-RB-16-316L | Brush Assy 316L SS |
| 3 | 1 | CP27093-01-CB | Valve Housing Assy 316 SS |
| 4 | 4 | CP27095-13-CB | Self Locking Nut 316 SS |
| 5 | 4 | CP29805-209-CB | Cap Screw 316 SS |
| 6 | 1 | CP27099-01-AL | Handwheel Assy Aluminum |
| 7 | * | 27149-6012-316L | Nozzle w/ Gasket |
| 8 | * | CP27044-001-316SS | LockRing 316 SS |

^{*} Refer to Nozzle Quantities in Previous Tables

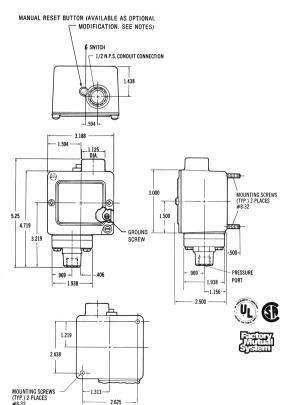
Transamerica Delaval

Barksdale Controls Division • 3211 Fruitland Ave. • PO Box 58843 • Los Angeles, CA 90058 • 213-589-6181

ECON-O-TROL Dia-Seal Piston Models Water Tight Housing (NEMA 4)

Pressure Switches E1H Single Setting





OPERATING CHARACTERISTICS • ORDERING DATA

PRESSURE SWITCHES – All values given in PSI (Gauge)

| Proof | Adjusta | able Rar | ige | | Approx. | Catalog # |
|--------|---------|----------|--------|-------|----------------|-----------|
| (Test) | Decrea | asing | Increa | asing | Actuation | 1⁄4" NPT |
| Press | Min. | Max. | Min. | Max | Value | Internal |
| | | | | | (Differential) | |
| 1000 | 10.0 | 230 | 11.0 | 250 | 1.0 – 20.0 | E1H-H250 |

DETAIL DATA

ELECTRICAL CHARACTERISTICS (Pressure Switches): All models incorporate Underwriter's Laboratories, Inc. listed single pole double throw snap-action switching elements. Electrical rating (continuous inductive) 10 amps 125 or 250 volts AC, 3 amps 480 volts AC. Automatically reset by snapaction of switch.

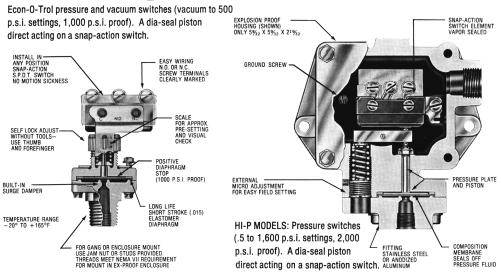
ELECTRICAL CONNECTION (Pressure Switches): Through ½" NPS Conduit Connection to screw terminals on switch. May be wired Normally Open or Normally Closed.

PRESSURE CONNECTION: ¼" NPT internal thread, standard. 1/8" NPT internal and ½" NPT external thread, P6 option.

ADJUSTMENT INSTRUCTIONS: Turn self locking adjustment nut clockwise to raise and counterclockwise to lower the actuation point. All dials are calibrated for increasing settings.



DIA-SEAL PISTON MODELS: This unique design combines diaphragm accuracy with piston switch long life and high proof pressure tolerance.



GENERAL OPERATING ENGINEERING AND SERVICE DATA

TEMPERATURE

Maximum recommended range of pressure media and ambient temperature.

Pressure Switch Type

Bourdon Tube and Diaphragm

Control

Temperature Range

-65°F to 165°F

-20°F to 165°F

Sealed Piston Standard "O"-ring

-40°F to 165°F

For other requirements consult factory. For best results ambient temperature should be kept as constant as possible.

LIFE EXPECTANCY

The same factors governing the life of gauges and other instruments, using bourdon tube or diaphragm sensing elements, apply to pressure switches.

If with each operating cycle the sensing element must flex over the entire operating range for which it was designed, or whether it flexes only over a small portion of that range considerably affects the life expectancy of the unit.

The second factor to speed up metal fatigue of the tube or diaphragm is the speed with which it must repeat the flexing cycles. At normal flexing rate (less that 25 cycles per minute) you may therefore find the following variance in the same type of sensing element:

At full range flexing up to 1,000,000 cycles depending on thickness of diaphragm. The thinner the material, the longer the life.

At 50% of its flexing range up to 3,500,000 cycles (see above).

At 10 to 20% of its flexing range up to 5,000,000 cycles (see above).



01SH10D15T3E2

Technical data

Company Name Contact Phone number E-Mail address

| Op | perating data | | | | | | | | | | |
|-----|----------------------|---------------------|-------|---------------|---------------------|---------|--------------|--------------|--------|-----------------|-------------|
| 1 | Pumpe type | Single head | pur | np | | Fluid | | | | Water | |
| 2 | No. of pumps | | | 1 | | Opera | ing tempera | ature t A | °F | 39.2 | |
| 3 | Nominal flow | US g.p | .m. | 114 | | pH-val | ue at t A | | | 7 | |
| 4 | Nominal head | | ft | 196 | | Densit | y at t A | | lb/ft³ | 62.4 | |
| 5 | Static head | | ft | 0 | | Kin. v | scosity at t | A | ft²/s | 1.689E-5 | |
| 6 | Inlet pressure | | psi | | | | pressure at | | | 14.5 | |
| | Environmental tem | | | 68 | | - | nt of solid% | | | | 0 |
| _ | Available system N | • | ft | | | Altitud | | 33.1.4 3.123 | | 0 | <u> </u> |
| | ımp data | 1 011 | | U . | | Atriaa | | | - ' | U | |
| | • | v afficient atainl | | ataal and au | otion numno | | | | | | |
| | - , | y efficient stainle | | | ction pumps | | | May | inah | 0.5/0 | |
| | Specific designatati | | | | | | a | Max. | | 9 5/8 | |
| 11 | Operating speed | rpm | | U | | Impell | שופ | designed | | 8 3/16 | |
| | Group | | S | | / | | | Min. | | 7 3/16 | |
| | Suction flange | | NPS | | / ASME B16.5 (e-SH) | | | Nominal US g | • | | |
| 14 | Discharge flange | | NPS | 1 / CL150 | / ASME B16.5 (e-SH) | Flow | | Max- US g | | | |
| | Max. casing pressu | - | | | | | | Min- US g | | | |
| | Max. working press | sure psi | | | | - | | Nominal | | 193.2 | |
| | Impeller type | | | lial impellei | | Head | | at Qmax | | 159.9 | |
| | Head H(Q=0) | ft | 250 | | | | | at Qmin | ft | 241.7 | |
| 19 | Max. shaft power | hp | 11.7 | • | | Shaft | ower | | hp | 11.3 | |
| 20 | Pump weight | kg | 39.0 |) | | Efficie | ncy | | % | 49.19 | |
| 21 | Total weight | kg | On | demand | | NPSH | 3% | | ft | 18.5 | |
| Ma | aterials | | | | | | | | | | |
| 22 | | Pump |) | | | | | Shaft S | eal | | |
| 23 | Casing | | | Stainl | ess steel 316L | John (| Crane | Elaston | er B | ellows Shaft S | eal |
| 24 | Impeller | | | Stainl | ess steel 316L | Type 2 | 1 | | | | |
| 25 | Wear Ring | | | Stainl | ess steel 316L | Seal fa | ices | | C | arbon [STD] | |
| 26 | Adapter | | | Gray | ast iron class 20B | Statio | nary ring | | | licon Carbide | |
| 27 | Ball bearing (outbo | oard) | | Steel | | Elasto | | | FI | KM | |
| | Pump shaft | , | | | grade 1213 | Spring | | | _ | ainless steel (| CF8M (316) |
| | Deflector | | | Buna- | | - | metal parts | | | ainless steel (| |
| | Shaft Sleeve | | | | ess steel CF8M (316 | | P 40 | | - | | \ / |
| 31 | | | | | ast iron class 20B | 1 | | | | | |
| 32 | Ball bearing (inbox | ard) | | Steel | 3,400 200 | | | | | | |
| 33 | Impeller Key | ai u j | | Steel | | | | | | | |
| 34 | - | | | | ess steel 316L | | | | | | |
| | Seal Housing | | | | ess steel CF8M | | | | | | |
| | Impeller Washer | | | | | | | | | | |
| | Bearing Frame | | | | cast iron class 20B | | | | | | |
| | Lip Seal | | | | vailable | | | | | | |
| | V-Ring | | | Buna- | | | | | | | |
| | Casing bolt with no | ut (casing to ada | aptei | | ess Steel | | | | | | |
| | Retaining ring | | | Steel | | | | | | | |
| 41 | | | | | | | | | | | |
| | otor data | | | | | | | | | | |
| | Manufacturer | Baldor | | | | | | | | | |
| | Specific design | NEMA 3 ph TEP | | - | | | | | | | |
| | Туре | Frame 254TCZ | _ | • | | | | | | | |
| | Rated power | 15 hp | _ | m no. | | | | | | | |
| 46 | Nominal speed | 3600 rpm | Ser | rvice factor | 1.15 | | | | | | |
| 47 | Frame size | 254TCZ | Ele | ectric voltag | e 460 V | | | | | | |
| 48 | Weight kg | 117.5 | | | | | | | | | |
| Ba | ise plate | | | | | Rema | rks | | | | |
| 49 | Name | | | | | | | | | | |
| 50 | Weight | kg | | | | | | | | | |
| | | | - | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Pro | ject | | ı | Project ID | | 1 | Created by | 1 | | Created on | Last update |
| | | | | | | | | | | 12-27-19 | |
| | | | | | | | | | | | |



01SH10D15T3E2

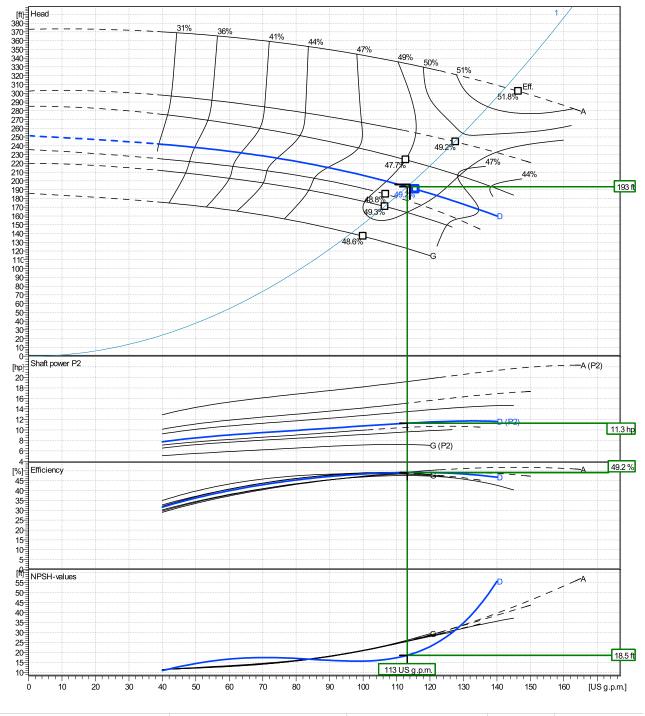
Performance Curve

Company Name Contact Phone number E-Mail address

| | Ø | | ivered F | | Lift Cap | ability | Shaf | t Power | · P2 | Frequency | Hz | 60 |
|------|-------|-----------|------------------|-----------|----------|-----------|---------|---------|-----------|-----------------|-----------|------|
| | | Min. | on Range Max. | η Max. | H(Q=0) | η Max. | P2(Q=0) | Max. | η Max. | Operating speed | rpm | 3500 |
| | inch | US g.p.m. | US g.p.m. | US g.p.m. | `ft ´ | ft | hp | hp | hp | Nominal flow | US g.p.m. | 114 |
| ls | 8.187 | 40 | 140 | 116 | 252 | 191 | | 11.7 | 11.4 | Nominal head | ft | 196 |
| Min. | 7.203 | 1 | 1 | 100 | 186 | 137 | | 1 | 7.19 | Inlet pressure | psi | 0 |
| Max. | 9.640 | 1 | 1 | 146 | 373 | 302 | | 1 | 19.4 | Static head | ft | 0 |

Power datas referced to:

Water [100%] ; $39.2^{\circ}F$; $62.4lb/ft^{3}$; $1.69E-5ft^{2}/s$





01SH10D15T3E2

Close coupled Rotation: 12 oClock [STD] NEMA 3 ph TEPE [STD]Frame 254TCZ - 15 hp

Dimensions

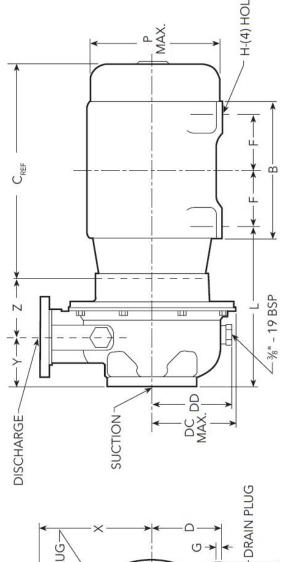
Contact Phone number E-Mail address Company Name

| Dimensions | S | | | | | |
|------------|-------|--|---------------------|--|--|--|
| Omax | nsion | 6 ⁷ /8 6 ⁵ /8 12 ³ /8 | 8′/8 4 4 3′/8 | | | |
| N X X V | Dime | | × | | | |

PRIME PLUG

▲ AB MAX. →

| | Discharge flange | NPS 1 | CL150 | ASME B16.5 (e-SH) | (+/- 2%) | 39 kg | | 117 kg | On demand kg |
|-------------|------------------|-------|-------|-------------------|----------|-------|------------|--------|--------------|
| Connections | Suction flange | NPS 2 | CL150 | ASME B16.5 (e-SH) | Weight | Pump | Base plate | Motor | Total weight |
| LES | | | | | | | | | |



७→

| Project | |
|---------|--|

| Project ID | |
|------------|--|
| | |







OMRON

General - Purpose Limit Switch

D4A-N

Heavy - Duty Switch Features Plug-In Construction

- Oil-tight, watertight construction meets NEMA 4X
- Convenient front mounting, easy installation and maintenance
- Wide temperature range: -40°C to 100°C (-40°F to 212°F)
- Side rotary switches accept a wide selection of levers
- Increased mechanical durability



ALSO USED FOR "NO CAKE SWITCH"

Ordering Information_

SIDE ROTARY SWITCHES

| Descripton | SPDT double break | Part |
|----------------|-------------------|--------------|
| | No indicator | Number |
| High precision | D4A-1102N | 035-225-0175 |

| Adii | 15 | ah | P | rod | lev | ρ |
|------|----|----|---|-----|-----|---|



| Lever radius | Material | Diameter | Catalog # | Part # |
|--------------------|--------------------|-------------------|-----------|--------------|
| 150 mm (5.91) L | Stainless Steel | 3 mm (0.12 in) | D4A-D00 | 035-221-0176 |

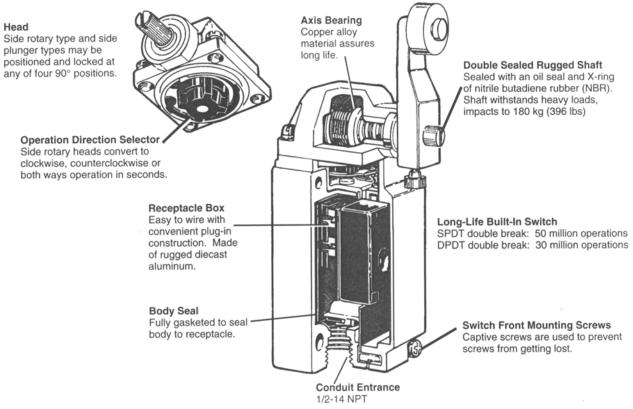
Specifications_

CONTACT CONFIGURATION

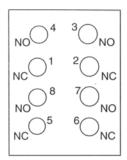
SPDT Double Break with Same Polarity



Construction



TERMINAL ARRANGEMENT



ELECTRICAL SPECIFICATIONS

NEMA A600 Rating (UL/CSA)

| 11EW/ (7.000 Rating (0E/00/1) | | | | | | |
|-------------------------------|---------|---------|-------|------------|---------|-------|
| Circuit | Rated | Amperes | | Continuous | Voltamp | eres |
| | Voltage | Make | Break | carrying | Make | Break |
| | | | | current | | |
| SPDT | 120 VAC | 60 | 6 | 10 | 7200 | 720 |
| double | | | | | | |
| break | | | | | | |

Contact Ratings – 25 m Ω maximum (initial)



BELT BREAK SWITCH

canfield connector

8510 Foxwood Court Youngstown, Ohio 44514 (330) 758-8299 Fax: (330) 758-8912 www.canfieldconnector.com

REED AND ELECTRONIC SENSORS FOR 2" TO 8" BORE TIE ROD CYLINDERS OR 3/4" TO 4" ROUND CYLINDERS

SERIES 7000

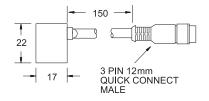
- General Description -

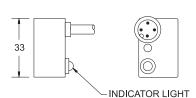
The Canfield Series 7000 proximity sensors are used to sense position on cylinders. They accommodate 2 to 8 inch bore tie rod cylinders or 3/4 to 4 inch round cylinders. This proven design is rugged yet cost effective. The Series 7000 boasts the largest number of custom circuits to match applications found in the market. Examples include; 1 or 4 Amp reed switches, normally open, normally closed or SPDT switch types, reed or electronic sensing elements in the same package style, and the industry's first 120 VAC Hall sensor. A wide range of enclosures and connector options are available. To reduce stocking requirements, two clamp options feature a self-adjusting clamp for NFPA and other tie rod cylinders from 2 to 8 inch bore. Another clamp option features a band clamp from 3/4 to 4 inch round cylinders.

Dimensional Data

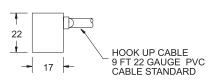
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

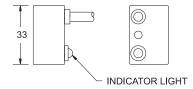
12mm Quick Connect Style 5





Standard Cable Module (9 ft) Style 0







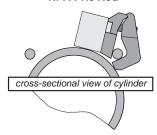


Consult factory for available versions listed by Canadian Standards Association for use with certified electrical equipment.

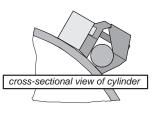
Clamp Styles

(Standard switch shown below. Mix and match with switch styles)

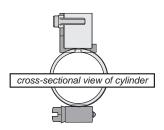
Universal 2" to 6" Bore NFPA Tie Rod



6" to 8" Bore NFPA Tie Rod



3/4" to 4" Round Cylinder



Technical Data

- Temperature Range: Operational from -20° to +80°C.
- Shock: Operational up to 30G (11 ms.) reeds only.
 Not applicable for electronics.
- Vibration: Operational up to 20 G (10 55Hz) reeds only. Not applicable for electronics.
- Sensitivity and orientation: 85 gauss parallel minimum required for proper operation, as measured on sensor surface. Size of sensing area depends on size and strength of magnet and thickness of cylinder wall.

Features -

- One switch for a majority of voltages and cylinder sizes
- 2" to 6" bore, 6" to 8" bore or 3/4" to 4" round cylinders
- Wash down compatible NEMA 6 (most versions)
- Materials: Ultem®, Nylon, PVC wire and stainless steel
- CSA approved versions
- · "Floating" clamp
- Surge suppression
- Compatible with IS (Intrinsically Safe) barriers

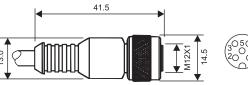
Ordering Information

710- 🔲 00 - 🔲 🔲 📗

12mm female molded locking connector (3 pole)

250VAC/DC 4 Amps max.

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED



Brown = Pin 1 Blue = Pin 3 Black = Pin 4 N/C = Pin 2 N/C = Pin 5

Order part number RC12S-F0M030120 (2m length) RC12S-F0M030150 (5m length)

Clamp Style

- 0 Universal tie rod clamp 2" to 6" bore
- 1 Round cylinder bracket
- 2 Round cylinder 3/4" to 1 3/4" bore
- 3 Round cylinder 1 9/16" to 2 1/2" bore
- 4 Round cylinder 2 5/16" to 3 1/4" bore
- 5 Round cylinder 3 1/16" to 4" bore
- 9 5/8" tie rod clamp 6" to 8" bore

Connector Style

- 0 Standard cable module (9 ft)
- 5 12mm quick connect male*

*Mates with cordset RC12S-F0M030120 (2m) or RC12S-F0M030150 (5m) shown at right.

| Туре | Description | Function | Switching Voltage | Switching Current | Switching Power | Switching Speed | Voltage Drop |
|------|--|---------------------------------|----------------------------|---|--------------------|-----------------------------------|------------------------------|
| 01 | Reed Switch, 2 Wire | Normally Open SPST | 0 - 240V AC/DC 50/60 Hz | 1 Amp max. | 30 Watts max. | 0.6 ms operate 0.05 ms release | 0 Volts |
| 04 | Reed Switch, MOV, LED, 2 Wire | Normally Open SPST | 5 - 240V AC/DC 50/60 Hz | 1 Amp max. .005 Amps min. | 30 Watts max. | 0.6 ms operate 0.05 ms release | 3 Volts |
| 05 | Reed Switch, 2 Wire | Normally Closed SPST | 0 - 120V AC/DC 50/60 Hz | 1 Amp max. | 20 Watts max. | 1.0 ms operate 0.02 ms release | 0 Volts |
| 06 | Reed Switch, LED, 3 Wire | Single Pole, Double Throw | 5 - 120V AC/DC 50/60 Hz | 1 Amp max. .005 Amps min. | 20 Watts max. | 1.0 ms operate 0.02 ms release | 3Volts/load1 9Volte/load2 |
| 09 | Reed Switch, MOV, LED, 2 Wire | Normally Closed SPST | 5 - 120V AC/DC 50/60 Hz | 1 Amp max. .005 Amps min. | 20 Watts max. | 1.0 ms operate 0.02 ms release | 3 Volts |
| 15 | for Reed Magnets, LED, 3 Wire | Normally Open TRIAC output | 12-24 VAC | 600 mA max. 5 Amps Inrush | 15 Watts max. | 1.5 μs operate 0.5 μs release | 1 Volt |
| 16 | AC Electronic Sensor for Reed Magnets, LED,3 Wire | Normally Open TRIAC output | 120 VAC | 600 mA max. 5 Amps Inrush | 72 Watts max. | 1.5 µs operate 0.5 µs release | 1 Volt |
| 21 | Reed Switch, MOV, 2 Wire | Normally Open TRIAC output | 10 - 240 VAC 50/60 Hz | 4 Amps max. 50 Amps Inrush | 100 Watts max. | 0.6 ms operate 0.05 ms release | 1 Volt |
| 23 | Reed Switch, MOV, LED, 3 Wire | Normally Open TRIAC output | 10 - 50 VAC 50/60 Hz | 4 Amps max. 50 Amps Inrush .005 Amps min. | 100 Watts max. | 0.6 ms operate 0.05 ms release | 1 Volt |
| 24 | Reed Switch, MOV, LED, 3 Wire | Normally Open TRIAC output | 24 - 240 VAC 50/60 Hz | 4 Amps max. 50 Amps Inrush .005 Amps min. | 100 Watts max. | 0.6 ms operate 0.05 ms release | 1 Volt |
| 25 | Reed Switch, MOV, 2 Wire | Normally Closed TRIAC output | 10-120 VAC 50/60 Hz | 4 Amps max. 50 Amps Inrush | 100 Watts max. | 0.6 ms operate 0.05 ms release | 1 Volt |
| 29 | Reed Switch, MOV, LED, 3 Wire | Normally Closed TRIAC Output | 10-120 VAC 50/60 Hz | 4 Amps max. 50 Amps Inrush .005 Amps min. | 100 Watts max. | 06 ms operate 0.05 ms release | 1 Volts |
| 31 | Electronic for Reed Magnet, LED & Sourcing, 3 Wire | Normally Open PNP | 6 - 24 VDC | 1 Amp max. | 24 Watts max. | 1.5 µs operate 0.5 µs release | 0.5 Volts |
| 32 | Electronic for Reed Magnet, LED & Sinking, 3 Wire | Normally Open NPN | 6 - 24 VDC | 1 Amp max. | 24 Watts max. | 1.5 µs operate 0.5 µs release | 0.5 Volts |

Each switch supplied with clamp assembly

For convenience and faster shipping, this series is available in Can-Paks.



Ordering Example:

710-000-004

Universal tie rod clamp, Standard cable, reed switch, lighted, MOV surge suppression, normally open, 5 - 240V AC/DC 50/60 Hz

For emergency or normal shutdown of conveyor systems, elevator equipment, bulk handling systems, cranes, production and assembly lines, or any other equipment which may require immediate, positive shutdown.

Switch

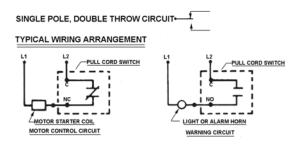
| Part # | Catalog # | SP/ST Switch |
|---------------|-----------|-------------------------|
| 035-225-0247 | PCL2S | Single end left – 2 sw. |
| 025 225 0247 | DCD2C | Single and right 2 av |
| 000 220 00 11 | 1 01120 | Onigio ond right 2 ow. |

Installation Instructions

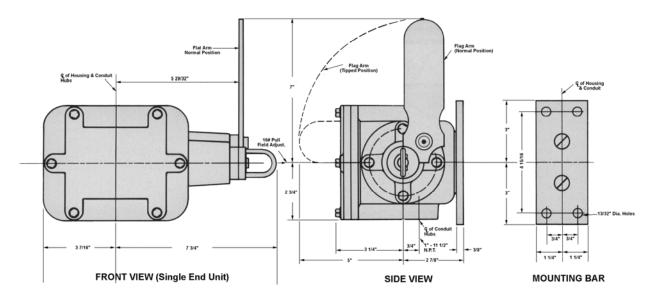
- Switch should be mounted on a flat surface by using two or more of the four 13/32" dia. mounting holes provided. One fastener in each end of the mounting bar will be sufficient.
- Distances between switches should not exceed 200 ft. We suggest you do not use more than 100 ft. of cable per switch end. This suggestion is for maximum safety purposes. Too much cable can result in a "long pull" situation due to slackness in the cable.
- Recommended spacing of cable support eye bolts is 10 ft. Care should be taken to keep the cable from becoming too slack. Care must also be taken that the cable is

- not so "tight" as to be pulling out the cable end connection clevis.
- 4. Wiring should be through the motor control circuit.
- After supply power, actuate by pulling cable to check switch. This will insure that there is not too much slack in the cable and that there are no obstructions to the cable or flag arm.

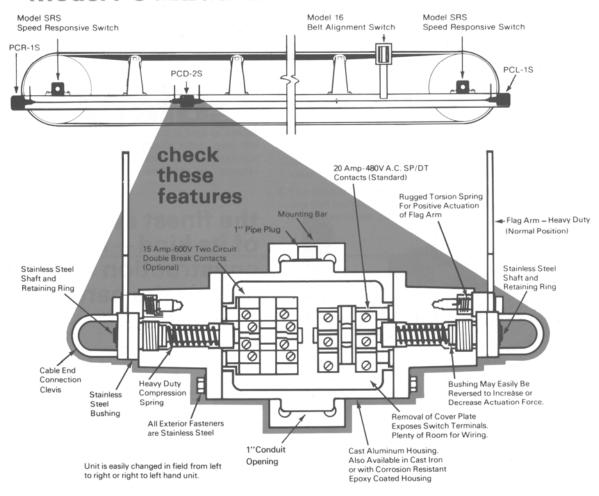
Typical Wiring



MODEL PC Dimensions



Model PC CABLE OPERATED SAFETY STOP SWITCH



OPERATIONS

A cable is connected from a fixed point to the cable end connecting clevis on the end of the unit. A pull on the cable (16 lb. force standard –25 lb. optional) with a movement of less than ½" will actuate the switch and trip the flag arm down, into the walkway, and lock the switch (and flag arm) in the actuated position. Unit is reset by returning the flag arm to the normal position.

TECHNICAL INFORMATION

Enclosure sealed for outside applications.

Standard unit meets NEMA 1, 3, 4X, and 12 requirements.

Conduit opening – 1 inch hole.

Conduit opening in men neier

Housing – Cast aluminum (Std.) Flag arm – Steel with red epoxy paint coating

STANDARD SWITCH

Two SP.DT switch per side.

20 amps, 125, 250, or 480 vac;

10 amps, 125 vac "L" (tungsten lamp load);

1 hp, 125 vac; 1/4 amp, 250 vdc

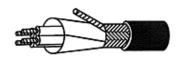
Use two SP/DT switches per end when separate light or audible alarm is required.

Olympic Wire and Cable

7 Madison Road • Fairfield, NJ 07004 973.227.7996 800.526.2269 • Fax: 973.227.1606

email: sales@olympicwire.com

Olympic P/N 144V, VFD and Motor Supply Cable



VFD and Motor Supply Cable

UL TC-ER, WTTC, CSA, CE, Direct Burial, Sunlight Resistant

Tinned copper, PVC/Nylon insulated, Foil and Tinned Copper Braid Shielded, Black PVC Jacket.

SPECIFICATIONS

| Conductor Size | 14 AWG | |
|-------------------|--|--|
| No. of Conductors | 4 | |
| Stranding | 41 Tinned Copper | |
| Insulation | PVC / Nylon | |
| Jacket | PVC, Black | |
| Nom. O.D. | 0.417 in | |
| UL Style | 1277, TC-ER, WTTC | |
| CSA Flame Test | C(UL) TC, FT4 | |
| CSA Type | CIC | |
| Capacitance | 21.6 pF/ft | |
| Temperature | -40°C to 90°C | |
| Voltage | 1000 Flexible VFD Servo 1000 WTTC 600 UL TC | |
| Approval | Flexible VFD Servo MSHA NEC: Class 1, Div. 2 Oil Res II | |

| | ROHS Compliant |
|------------|--|
| Color Code | Black with White Numbers &One Green/Yellow |

12/7/2016 | Page 2 of 2

Olympic Wire and Cable

7 Madison Road • Fairfield, NJ 07004 973.227.7996 800.526.2269 • Fax: 973.227.1606

email: sales@olympicwire.com

Olympic P/N 8302S, 16 AWG, Stranded 7 X .0192, Tray Cable



16 AWG, Stranded 7 X .0192 Cable

UL SUBJECT 1277 OSHA ACCEPTABLE IEEE-383 **UL FLAME TEST IEEE 1202, 1581, 1685**

CSA FLAME TEST FT4

Stranded bare Copper conductors, color coded PVC insulation with overall Nylon jacket, sizes 18 and 16 AWG are rated TFFN, sizes 14, 12 and 10 AWG are rated VW-1 THHN/THWN, conductors are twisted with fillers as needed, Polyester binder tape, stranded tinned Copper drain wire, Alum-Mylar shield (100% coverage), black PVC jacket.

Application:For use in Class 1, Division 2 hazardous locations; for installation in trays, wireways, ducts, conduit and aerially when properly supported by a messenger; approved for direct burial, wet or dry locations and outdoors in cable trays where a sunlight and oil resistant rating is required

SPECIFICATIONS

| Conductor Size | 16 AWG |
|----------------------|---|
| Stranding | 7/.0192 Bare Copper |
| No. of Conductors | 3 |
| Insulation | PVC/Nylon |
| Insulation Thickness | 0.020 in |
| Shielding | Aluminum Mylar with Stranded Tinned Copper Drain Wire |
| Jacket | PVC, Black |
| Jacket Thickness | 0.045 in |
| Nom. O.D. | 0.306 in |
| UL Style | TC-ER |
| Color Code | Black Blue Red |
| Voltage | 600 V |
| Dry Temperature | -25 to 90 °C |

| Wet Temperature | 75 °C |
|-----------------|-------------------------------------|
| RoHS Compliant | ROHS Compliant RoHS Compliant |

Olympic Wire and Cable

7 Madison Road • Fairfield, NJ 07004 973.227.7996 800.526.2269 • Fax: 973.227.1606

email: sales@olympicwire.com

Olympic P/N 8305S, 16 AWG, Stranded 7 X .0192, Tray Cable



16 AWG, Stranded 7 X .0192 Cable

UL SUBJECT 1277 OSHA ACCEPTABLE IEEE-383 **UL FLAME TEST IEEE 1202, 1581, 1685**

CSA FLAME TEST FT4

Stranded bare Copper conductors, color coded PVC insulation with overall Nylon jacket, sizes 18 and 16 AWG are rated TFFN, sizes 14, 12 and 10 AWG are rated VW-1 THHN/THWN, conductors are twisted with fillers as needed, Polyester binder tape, stranded tinned Copper drain wire, Alum-Mylar shield (100% coverage), black PVC jacket.

Application:For use in Class 1, Division 2 hazardous locations; for installation in trays, wireways, ducts, conduit and aerially when properly supported by a messenger; approved for direct burial, wet or dry locations and outdoors in cable trays where a sunlight and oil resistant rating is required

SPECIFICATIONS

| Conductor Size | 16 AWG | | |
|----------------------|---|--|--|
| Stranding | 7/.0192 Bare Copper | | |
| No. of Conductors | 6 | | |
| Insulation | PVC/Nylon | | |
| Insulation Thickness | 0.020 in | | |
| Shielding | Aluminum Mylar with Stranded Tinned Copper Drain Wire | | |
| Jacket | PVC, Black | | |
| Jacket Thickness | 0.045 in | | |
| Nom. O.D. | 0.370 in | | |
| UL Style | TC-ER | | |
| Color Code | Black Blue Brown Orange Red Yellow | | |
| Voltage | 600 V | | |
| Dry Temperature | -25 to 90 °C | | |

| Wet Temperature | 75 °C |
|-----------------|-------------------------------------|
| RoHS Compliant | ROHS Compliant RoHS Compliant |

TRAY & VFD CABLES

VFD Combo DS Type TC-ER Variable frequency drive -

and MTW

VFD cable with one or two shielded pairs





CSA AWM I/II A/B 90°C 1000V FT1 FT2

Marking for VFD Combo DS 08530444: SAB BRÖCKSKES · D-VIERSEN · VFD Combo DS 4 AWG/4c + 16 AWG/2pr 08530444 THHN + TFFN (UL) Type TC-ER 90°C 600V, Oil I, Sunlight Resistant, Direct Burial, FT4 (UL) WTTC 90°C 1000V (UL) MTW 600V flexing AWM Style 21179 1000V c(UL) Type CIC SHIELDED 4 AWG/4c + 16 AWG/2pr 90°C dry 600V FT1, FT2, FT4 CSA AWM I/II A/B 90°C 1000V FT1 FT2 (6

VFD Combo DS is a flexible shielded motor supply cable designed for automated servo systems. VFD Combo DS comes with one or two shielded pairs for use with a braking mechanism or temperature sensor. It is also a machine tool cable for use as specified in the National Electrical Code (NFPA 70) and in the National Fire Protection Association Electrical Standard for Industrial Machinery (NFPA 79). This cable can be used without conduit (exposed runs). Its unique flame retardant jacket makes the VFD Combo DS rated for 600V suitable for tray cable application and also as Control and Instrumentation Cable, UL AWM recognized and CSA approved for 1000 Volt. The VFD Combo DS has an outer PVC jacket and both a foil and a braid shield which helps with problems related to voltage spikes, harmonics, and power distortions frequently associated with variable frequency drives. The VFD Combo DS can be used to connect alternating current variable frequency drives to alternating current variable frequency motors and is recommended to make installations less cumbersome. This motor supply cable is also suitable for installation in wet or dry locations and is UV resistant. The VFD Combo DS can be used in indoor or outdoor applications and is rated for direct burial. The combination of the braid and foil shield makes the cable 100% shielded from excessive interference. VFD Combo DS is permitted to be used in hazardous (classified) locations Class I, Division 2 per NEC Article 501.4 (B), UL Type TC is in acc. to UL standard 1277 and NEC Article 336 (392, 501). Wind turbine power and control cable is intended to be installed in cable trays or raceways within a wind turbine generator. MTW listed cables can be used in NFPA 79 Machine

| | Construction: |
|------------------|--|
| Conductor: | tinned copper strands acc. to DIN VDE 0295 class 5 + IEC 60228 class 5 + HD 383 class 5 from 18 AWG - 12 AWG, from 10 AWG - 2 AWG class k in acc. to ASTM B 172 |
| Insulation: | special formulated PVC/Nylon |
| Color code: | black conductors with consecutive white numbers and a green-yellow earth wire pairs: black conductors with white numbers 5, 6, 7, 8 |
| Stranding: | signal conductors in pairs |
| Screen: | pairwise with alu foil, tinned copper drain wire AWG 26 and braided with tinned copper wires |
| Wrapping: | pairwise with PETP foil |
| Stranding: | screened signal pair(s) and power conductors in layers |
| Wrapping: | non-woven tape |
| Screen: | double shield, alu foil and tinned copper braiding |
| Jacket material: | special sunlight and oil resistant PVC |

| | Technical data: |
|--------------------------------|--|
| Voltage: | (UL) / c(UL): 600 V UL-AWM/CSA-AWM: 1000 V (UL) WTTC: 1000 V |
| Testing voltage: | conductor/conductor 7500 V conductor/screen 3000 V |
| Min. bending radius: | 12 x O.D. |
| Temperature: static: | UL-AWM: (UL) / c(UL) / CSA-AWM: up to +105°C up to +90°C |
| Burning characteristics: | (UL) / c(UL) FT4, c(UL) / CSA-AWM FT1, FT2 |
| Oil resistance: | yes |
| Sunlight resistance: | yes |
| Exposed Runs: | yes |
| Direct Burial: | yes |
| Machinery Area: | yes |
| Absence of harmful substances: | acc. to RoHS directive of the European Union see page O/29 |
| | |

| item no. | dimensions | nominal inch | outer-ø mm | cable weight ≈ lbs/mft |
|------------|------------------------|-----------------|---------------|------------------------------|
| 08531614 | 16 AWG/4c + 18 AWG/1pr | 0.469 | 11.9 | 140 |
| 08531604 | 16 AWG/4c + 14 AWG/1pr | 0.516 | 13.1 | 174 |
| 08531464 | 14 AWG/4c + 18 AWG/2pr | 0.693 | 17.6 | 262 |
| 08531414 | 14 AWG/4c + 18 AWG/1pr | 0.504 | 12.8 | 170 |
| 08531404 | 14 AWG/4c + 14 AWG/1pr | 0.555 | 14.1 | 207 |
| 08531264 | 12 AWG/4c + 18 AWG/2nr | 0 724 | 18.4 | 300 |
| ▶ 08531214 | 12 AWG/4c + 18 AWG/1pr | 0.563 | 14.3 | 224 |
| → 08531204 | 12 AWG/4c + 14 AWG/1pr | 0.610 | 15.5 | 269 |
| 00001004 | 10 AWO/40 + 10 AWO/2pi | 0.700 | 13.2 | 57.1 |
| 08531004 | 10 AWG/4c + 14 AWG/1pr | 0.689 | 17.5 | 344 |
| ▶ 08530864 | 8 AWG/4c + 18 AWG/2pr | 0.937 | 23.8 | 541 |
| 08530804 | 8 AWG/4c + 14 AWG/1pr | 0.878 | 22.3 | 520 |
| ▶ 08530644 | 6 AWG/4c + 16 AWG/2pr | 1.043 | 26.5 | 733 |
| ▶ 08530604 | 6 AWG/4c + 14 AWG/1pr | 1.024 | 26.0 | 705 |
| ▶ 08530444 | 4 AWG/4c + 16 AWG/2pr | 1.217 | 30.9 | 1015 |
| ▶ 08530404 | 4 AWG/4c + 14 AWG/1pr | 1.157 | 29.4 | 982 |

Other dimensions and colors are possible on request.

Outstanding features:

- Interconnection of variable frequency drive control device to variable frequency motors
- NFPA 79 for Industrial Machinery
- Shielded pairs for brake or temperature sensor
- WTTC: UL Subject 2277
- TC: UL Standard 1277
- (UL)/(cUL) listed

Web site: www.sabcable.com

CG 100 N SERIES PLASTIC CABLE GLANDS

NPT thread





| | Technical Data: |
|-------------------|------------------------------|
| Material | Polyamide 6 |
| Seal | Chloroprene (CR) |
| Color | RAL 7001 (Gray) |
| Color | RAL 9005 (Black) |
| Protection Class | IP 68 - 5 Bar |
| Tomporaturo Pango | -20°C to +100°C permanent |
| Temperature Range | -30°C to +150°C intermittent |
| Flammabilty | V2 (According to UL 94) |
| Approvals | UR, UL, CSA |

Liquid tight seal, fast & easy installation, wide clamping range, multi-purpose applications, easy handling.

| Part Number | | Thread | () | | | Thread Diameter (TD) | | Wrenching Flats (SW) | | Height (H) | | |
|-------------|----------------|---------|---------|-------------|--------|-------------------------|--------|-------------------------|--------|---------------|-----------------|--|
| Gray | Black | Size | inches | mm | inches | mm | inches | mm | inches | inches | UL ¹ | |
| NPT | NPT | | | | | | | | | | | |
| PNG-3/8 | PNB-3/8 | NPT 3/8 | .197394 | 5.0 - 10.0 | 0.653 | 17.0 | 0.866 | 22.0 | 0.590 | 1.102 | UR | |
| PNG-1/2 | PNB-1/2 | NPT 1/2 | .236472 | 6.0 - 12.0 | 0.809 | 21.0 | 0.945 | 24.0 | 0.590 | 1.141 | UL | |
| PNG-1/2C | PNB-1/2C | NPT 1/2 | .394551 | 10.0 - 14.0 | 0.809 | 21.0 | 1.063 | 27.0 | 0.590 | 1.220 | UL | |
| PNG-3/4 | PNB-3/4 | NPT 3/4 | .512709 | 13.0 - 18.0 | 1.020 | 26.0 | 1.299 | 33.0 | 0.590 | 1.377 | UL | |
| PNG-1 | PNB-1 | NPT 1 | .709984 | 18.0 - 25.0 | 1.275 | 32.0 | 1.654 | 42.0 | 0.709 | 1.574 | UL | |
| NPT with Re | educing Bushii | ngs† | | | | | | | | | | |
| PNG-3/8R | PNB-3/8R | NPT 3/8 | .118276 | 3.0 - 7.0 | 0.653 | 17.0 | 0.866 | 22.0 | 0.590 | 1.102 | - | |
| PNG-1/2R | PNB-1/2R | NPT 1/2 | .197354 | 5.0 - 9.0 | 0.809 | 21.0 | 0.945 | 24.0 | 0.590 | 1.141 | - | |
| PNG-1/2RC | PNB-1/2RC | NPT 1/2 | .276472 | 7.0 - 12.0 | 0.809 | 21.0 | 1.063 | 27.0 | 0.590 | 1.220 | - | |
| PNG-3/4R | PNB-3/4R | NPT 3/4 | .354630 | 9.0 - 16.0 | 1.020 | 26.0 | 1.299 | 33.0 | 0.590 | 1.377 | - | |
| PNG-1R | PNB-1R | NPT 1 | .472787 | 12.0 - 20.0 | 1.275 | 32.0 | 1.654 | 42.0 | 0.709 | 1.574 | - | |

NPT PLASTIC LOCK NUTS

| Part N | Part Number | | Heigh | t | Diam | eter | Wrench | | | |
|---------|-------------|-------------|--------|-----|--------|------|--------|------|----|--|
| Gray | Black | Thread Size | inches | mm | inches | mm | inches | mm | UL | |
| NPT | NPT | | | | | | | | | |
| LNG-3/8 | LNB-3/8 | NPT 3/8 | 0.197 | 5.0 | 0.984 | 25.0 | 0.866 | 22.0 | - | |
| LNG-1/2 | LNB-1/2 | NPT 1/2 | 0.197 | 5.0 | 1.201 | 30.5 | 1.064 | 27.0 | - | |
| LNG-3/4 | LNB-3/4 | NPT 3/4 | 0.197 | 5.0 | 1.476 | 37.5 | 1.299 | 33.0 | - | |
| LNG-1 | LNB-1 | NPT 1 | 0.236 | 6.0 | 1.831 | 46.5 | 1.850 | 47.0 | - | |

SAB

¹Additional UL approvals in process

† Not currently CSA approved

Website: www.sabcable.com





Your Enclosure Source®

Saginaw Control & Engineering 95 Midland Road Saginaw, MI 48638 Phone: (989)799-6871 Fax: (989)799-4524

http://www.saginawcontrol.com

Part Details - SCE-1412ELJSS6

Part Number: SCE-1412ELJSS6 Description: S.S. ELJ Enclosure

Height: 14.00 inches
Width: 12.00 inches
Depth: 6.00 inches
Page Number: 211
List Price: \$453.85
Panel: SCE-14P12J
Product Code: S7
Est. Shipweight: 13.00 lbs.
NEMA Rating: 12, 4 4X

Construction -

- 0.063 Stainless Steel Type 304
- Seams continuously welded and ground smooth.
- Flange trough collar around all sides of door opening
- Oil-resistant gasket
- Standoffs provided for mounting optional panels
- · Removable hinges.
- Doors open 180 degrees
- Black mini quarter turn latches
- Latches are opened or closed with a screwdriver
- Sealing washers and hole plugs included
- Ground stud on door and body
- Optional mounting feet available

CAD Package (STP, PDF, DWG)

Having trouble downloading drawings? Click Here for help.

Application -

Designed to house electrical controls, instruments and components in areas which may be regularly hosed down or are in very wet or oily conditions. Provides protection from dust, dirt, oil, and water.

Finish -

#4 brushed finish on all exterior surfaces. Optional subpanels are powder coated white.

Industry Standards -

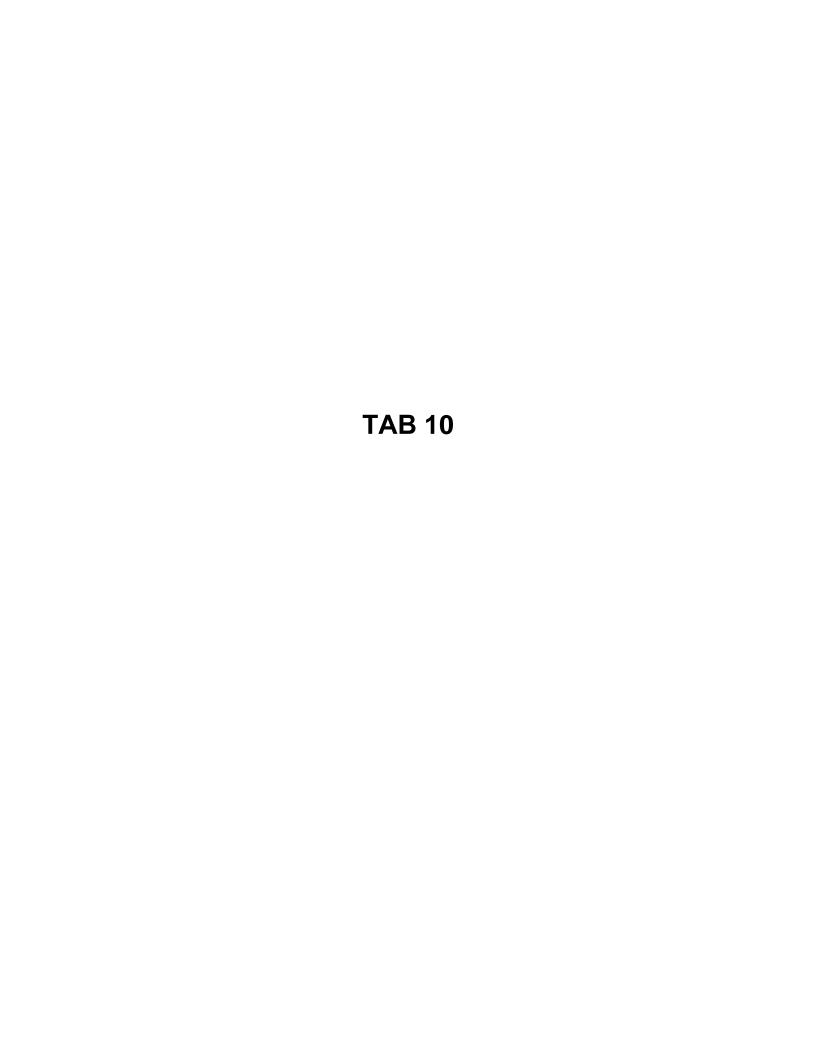
NEMA Type 4, 4X, 12 & 12 UL Listed Type 4, 4X, & 12 CSA Type 4, 4X & 12 IEC 60529 IP 66

Similar Part Numbers -

- SCE-10086ELJSS6
- SCE-1008ELJSS6
- SCE-12108ELJSS6
- SCE-1210ELJSS6
- SCE-1212ELJSS6
- SCE-14128ELJSS6
- SCE-16148ELJSS6
- SCE-1614ELJSS6
- <u>SCE-604ELJSS6</u>
- SCE-606ELJSS6
- SCE-8066ELJSS6
- SCE-806ELJSS6

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UNICASE™ Construction



UNICASE™ Construction refers to an overall design concept that allows proper alignment of the gear meshes and the bearings. All of the main drive train components are contained in a one-piece housing. All bearing bores, pilots, and registers of the housing are machined in one set-up. First, the foot or inspection cover is machined. The housing is then positioned from this first cut to machine all remaining features. Specially designed, dedicated fixtures are used to hold the castings rigidly and accurately for machining. This assures positive bearing and gear alignment.

Covers or openings are minimized, reducing the number of potential leak paths, and subsequently the probability of a leak occurring. A standard Failure Effects and Modes Analysis (FEMA) shows that this is the best design. Although this type of design tends to make assembly more difficult, it results in a superior product. Fortunately, NORD has specially designed tools to assure proper, efficient assembly.

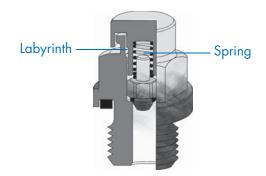
All covers and openings are un-stressed access panels, or are positioned with a large pilot diameter. An un-stressed access panel is the best, because there are no forces trying to break the seal between the components.

In no case is a bearing bore split even if it is internal to the reducer. Designs with split bearing bores require bolts to hold the bore together. It is common for bearings to fail due the outer face being improperly supported, causing a stress riser at seams in bearing bores.

AUTOVENT ™ Breather

When a gear reducer is operated intermittently, it warms up while operating and cools down after being shut off. The oil expands when it heats up and compresses the air inside the housing, resulting in a positive pressure that could cause the oil seals to rupture if left unregulated. Conversely, when the oil is cooling, it will reduce in volume, and outside air, and potentially humidity and dirt, will enter the reducer. A small concentration of water in mineral oil will cause foaming, will reduce the lubricating properties of the oil, and will promote a rapid degradation of the lubricant's chemistry. Internal components, such as bearings and gears, may quickly be damaged by a small quantity of these contaminants alone or in combination with caustic or corrosive fluids.

The Autovent™ operates like a check-valve to allow the reducer to dissipate internal pressure during warm-up, while preventing lubricant contamination during cooling. A spring presses a ball against a machined orifice until the heating of the oil and air inside the reducer exceeds 2 psi. Between 2 and 3 psi, the spring compresses and the ball is displaced, allowing pressure to escape. The internal pressure then drops below 2 psi, the spring elongates, and the ball returns to its initial position, sealing the unit. As the reducer continues to cool, the unit will temporarily develop a slight vacuum.



NORD Gear supplies all reducers, except those that are "lubricated for life", with an Autovent™ as a standard feature. In addition, the Autovent™ gives NORD Gear the ability to ship reducers and gear motors with factory-filled lubricant. Since the spring keeps the valve tightly closed regardless of the reducer's orientation, the unit can be inverted during shipment and not develop an oil leak. A metal canopy protects the ball and spring from damage. During operation, oil splash and mist are generated. In contrast to the Autovent™ breather, an open breather can allow these to migrate out, resulting in an undesirable brownish stain around the vent plug.







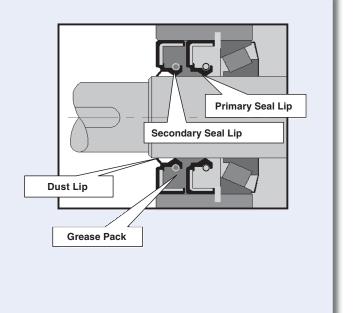


Quadrilip™ Seals

Quadrilip[™] seals are standard for most UNICASE[™] gear frame sizes. The smaller gear units do not have dual seals, but the quality of shaft preparation and seal installation is universal.

The Quadrilip™ system is a sign of quality. The seal system consists of two sealing lips, a dust lip, and a grease chamber between the seals. The grease chamber functions as an additional barrier: it helps protect the inner seal lip from damage, and helps prevent external contamination from working its way in. The grease also lubricates the seal lips and keeps them soft and flexible, and prevents them from wearing quickly by reducing friction between the seal lip and shaft surface.

All shaft seal surfaces are either roller burnished or plunge ground, and are an important part of the seal system. With these processes a smooth surface finish of 12-24 pinch rms can be achieved without machine lead that causes the seal surface to act as a pump to force oil out from the reducer or gearmotor.



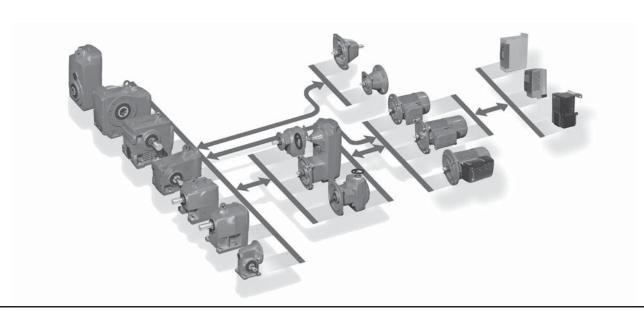
Modular Design

NORD's modular design philosophy provides you with a competitive edge by allowing you to configure drive systems to exactly fit to your applications. More than 20,000,000 combinations of totally unique gearmotors and speed reducers are possible - assembled in-line or right-angle, mounted by foot or flange, featuring solid or hollow shafts with either metric or inch extensions - to give you complete freedom to specify a drive solution that's perfect for you.

Benefits

- More output speeds
- More mounting arrangements/Greater flexibility
- Fewer gear stages/Lower costs
- Metric and inch products

NORD engineers stand ready to assist you with your custom applications. Most standard drives can be modified to your purposes, and custom designs can be developed for special applications.





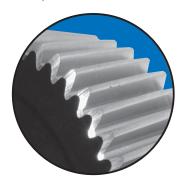






Gearing

The gears are made from high strength steel forgings. The teeth are case-hardened then precision finished using either grinding or skive-hobbing methods. As a result, high tooth-to-tooth accuracy is ensured which delivers steady output motion. Tooth stresses are controlled to assure very long durability with infinite life of the gear teeth. Gear torque ratings are thus optimized for a high degree of reliability.



Gear Quality Level: AGMA Class 11-13.

Gear Hardness: Case hardened to 58-62 Rockwell-C.

Gear Finish: All high-speed gears are ground; low-speed gears are skive finished after hardening.

Edge Deburred Gearing. Designed for infinite life

High-Strength Gearcases

Standard housing material is Class 35 Cast Iron. Some units utilize a corrosion resistant aluminum alloy or diecast aluminum alloy housing material.

NORD's robust housings maintain heavy wall sections. Some competitors have reduced material used in their housings for cost savings. Material has been reduced to the point that the walls are too thin and can flex under load. This will misalign the gears and bearings. In addition, bearing outer races need to be supported with a stiff backing to achieve their rating. Thin housings may not properly support the outer bearing races. Housings are internally painted with a primer to seal casting process residue and fill any surface imperfections.

Lubrication

NORD Gear supplies most all gear units factory-filled with the appropriate oil lubrication type and fill-level per the specified reducer mounting position. The current exceptions include Clincher™ Series parallel-shaft gear units: SK10282, SK10382, SK11282, SK11382, SK12382, and SK9096.1 which are supplied without oil.

It is important that proper oils are used in a gear reducer. By supplying the appropriate lubricant type and amount, NORD Gear eliminates the "guess work" for the consumer.

Properly selected oil will have the required additives to prevent the unwanted formation of foam, oxidation, and rust. As well, the proper extreme pressure additive may be used for hardened alloy steels, or more importantly, not used when it will be a detriment to the bronze gearing in worm reducers. For additional technical information please reference the Lubrication section of this catalog beginning on page 36.

Please see the lubrication table on page 42 for the standard and optional reducer lubrication types, and their service temperature ranges.

High-Performance Motors & Brakemotors

NORD motors are designed to run cool for longer service life. Low rotor inertia and high starting torque allow peak performance in the most difficult applications for inverter and vector duty per NEMA MG 1-2006 Section 31.4.4.2 voltage spikes. Our motors are internationally accepted, conforming to North American NEMA MG 1 and international IEC electrical specifications. High performance options include brakes, encoders, and forced cooling fans.



G1000 - Subject to Change Without Notice









Compact Coupled (NEMA C-face Input)

NORD Gear supplies reducers with special couplings that eliminate the need for quill-type input with NEMA and IEC frame motors. This allows for superior input shaft alignment and smooth torque transfer, reducing incidents of bearing, shaft, and key failures. Smaller reducers use a proprietary one piece nylon, curved tooth gear coupling with a bronze insert. These materials were selected for their ability to accommodate misalignment, as well as corrosion protection. The bronze insert eliminates steelto-steel contact allowing ease of motor disassembly even after years of service. Quill-type inputs have steel-to-steel contact between the motor shaft and the quill-input shaft of the reducer. This metal-to-metal contact will undergo fretting corrosion, especially in corrosive or moist environments. Each reducer is shipped from the factory with a sticker on the coupling that shows the proper coupling placement from the motor mounting surface.





Energy Efficient

Combining the UNICASE™ close dimension control and torsionally stiff, stable housings with high quality gearing results in higher operating efficiencies. Our industry leading 98.5% efficiency per gear stage results in significant power savings over the long haul.

Lowering your operating costs is one of our greatest goals! NORD research and development focuses on energy efficiency, with gearboxes, motors, and frequency inverters designed for lower energy consumption. Our fully diverse line of in-line or right-angle units and motors has been developed to suit your needs.

Stainless Steel Paint

NORD stainless steel paint is a plural component, aliphatic polyurethane paint with 316 stainless steel flakes with outstanding physical properties and excellent appearance. This paint has excellent adhesion to cast iron, steel, aluminum and most plastics and can be used as a topcoat or as a primer. The NORD stainless steel paint also has outstanding exterior durability and corrosion resistance, and superior chemical resistance when exposed to most industrial solvents, lubricants and cutting oils. The NORD stainless steel paint is excellent for both indoor and outdoor duty and is non-flammable.

It is designed as a USDA incidental contact coating acceptable for use in food, drug and cosmetic industries. Incidental contact means that the paint may not contain antimony: arsenic, cadmium, lead, mercury, selenium or other materials such as carcinogens, mutagens, or teratogens classified as hazardous substances.

Recapping NORD Stainless Steel Paint Features:

- Solvent based polyurethane paint for increased durability
- Outstanding exterior durability and corrosion resistance
- Superior chemical resistance when exposed to industrial solvents (laquer thinner, acetone, gasoline, Xylol), lubricants, and cutting oils
- Cured coating develops 2H hardness, yet exhibits excellent high impact resistance
- Heat and humidity resistant (tested for 500 hours at 100%) humidity and 100°F)
- USDA/H1 compliant incidental contact
- Colors Stainless steel gray, white, blue, red, black, and orange

2.0 hp Gearmotors







| Motor Power | Output Speed | Output Torque | Service Factor | AGMA Class | Gear Ratio | | ndard irings | Heavy Duty Bearings (VL) | | Model Type | Weight | Dim. Page |
|----------------|--|--|--|--|---|--|--|--|--|---|--------|--------------|
| P _n | n ₂ | T _a | f _B | | i _{tot} | F _{QN} OHL | F _{AN} Thrust | F _{Q VL} | F _{A VL} Thrust | | Ď | |
| [hp] | [rpm] | [lb-in] | | | | [lb] | [lb] | [lb] | [lb] | | [lb] | |
| 2.0 | 80 68 60 53 48 40 34 30 | 1583 1861 2098 2386 2641 3160 3713 4185 | 2.2 1.9 1.7 1.5 1.3 1.1 1.0 0.8 | - - | 20.87 24.53 27.65 31.45 34.81 41.65 48.95 55.17 | 1550 1517 1483 1436 1386 1262 1085 878 | 3933 4075 4178 4295 4365 4500 4500 | 2025 2025 2025 2025 2025 2025 2009 1904 1793 | 3933 4075 4178 4295 4365 4500 4500 | SK 9012.1 - 90L/4 SK 9012.1 - 90LH/4 | 97 | 484 |
| | 81 72 63 54 48 41 36 32 26 23 20 | 1556 1753 1994 2315 2641 3104 3498 3978 4853 5453 6174 | 3.0 2.6 2.7 2.3 2.0 1.7 1.5 1.4 1.1 1.0 0.9 | - | 20.51 23.11 26.29 30.52 34.81 40.92 46.11 52.44 63.97 71.88 81.38 | 2025 2025 2025 2025 2025 2025 2025 2005 1931 1764 1618 1395 | 3902 4010 4120 4255 4365 4500 4500 4500 4500 4500 | 2025 2025 2025 2025 2025 2025 2025 2025 | 3902 4010 4120 4255 4365 4500 4500 4500 4500 4500 | SK 9016.1 - 90L/4 SK 9016.1 - 90LH/4 | 99 | 492 |
| | 153 134 119 106 93 58 52 45 41 36 32 | 825 943 1055 1183 1353 2158 2431 2777 3093 3484 3981 | 3.0 3.0 2.9 2.7 2.7 2.5 2.3 2.1 1.3 1.3 | | 10.88 12.43 13.91 15.6 17.83 28.44 32.04 36.61 40.77 45.93 52.48 | 1638 1703 1757 1814 1827 1773 1748 1712 1674 1620 1537 | 2567 2700 2700 2700 2700 2700 2700 2700 27 | | | SK 92772 - 90L/4 SK 92772 - 90LH/4 | 118 | 480 |
| | 74 68 64 57 53 50 42 37 34 32 28 25 21 | 1700 1863 1978 2215 2381 2523 3017 3392 3718 3946 4419 5039 3983 7501 | 3.1 2.8 3.0 2.8 3.0 2.5 2.5 2.2 2.0 1.9 1.7 1.5 | | 22.41 24.56 26.07 29.2 31.38 33.26 39.77 44.71 49.01 52.02 58.25 66.42 78.89 98.88 | 1949 1982 2018 2034 2018 2005 1953 1906 1859 1823 1737 1602 | 2700 2700 2700 2700 2700 2700 2700 2700 | 2700 2700 2700 2700 2700 2700 2700 2700 | 2363 2403 2444 2507 2547 2563 2669 2725 2759 2795 2844 2905 2937 3008 | SK 9022.1 90L/4 SK 9022.1 - 90LH/4 | 115 | 500 |

(AGMA Class $I = f_B = 1.0 - 1.39$ $II = f_B = 1.4 - 1.99$ $III = f_B \ge 2.0$ * = $f_B < 1.0$) (Model Type in blue is an Energy Efficient motor)





DIMENSIONS

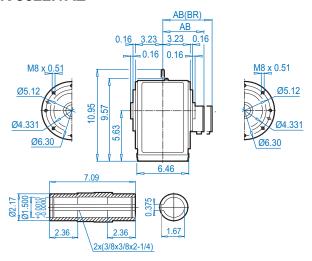


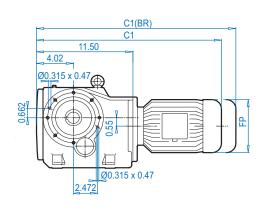




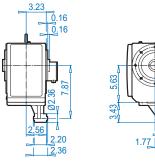
SK 9022.1 + Motor

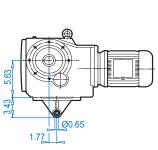
SK 9022.1AZ

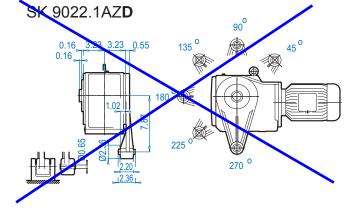




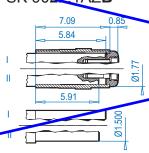
SK 9022.1AZ**K**



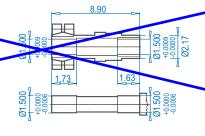


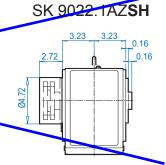


SK 9022 1AZB ⇒ □ 574









Motor dimensions

| Standard efficiency | 63S/L | 71S/L | 80S/L | 90S/L | 100L | | For Other Connection Possibilities please see |
|---------------------|-------|-------|-------|---------|-------|-------|---|
| Energy efficiency | | | 80LH | 90SH/LH | 100LH | 112MH | ⇒ |
| AB | 4.53 | 4.88 | 5.59 | 5.79 | 6.65 | 7.05 | |
| AB (BR) | 4.84 | 5.24 | 5.63 | 5.83 | 6.26 | 6.69 | |
| C1 | 19.21 | 20.79 | 21.77 | 23.39 | 24.57 | 25.47 | |
| C1 (BR) | 21.42 | 23.07 | 24.29 | 26.34 | 28.15 | 29.13 | |
| FP | 5.12 | 5.71 | 6.50 | 7.20 | 7.91 | 8.98 | |

(BR) denotes Brakemotor







Performance Data

Energy Efficient (EPAct)

230/460V - 60Hz / EE

Inverter duty • TEFC

Synchronous speed 1800rpm @ 60Hz • 4-pole • Three-phase

Voltages: 230/460V - 60Hz • 1.15 Service Factor Continuous Duty • 40°C Ambient • up to 3300ft Elevation

Class B temperature rise • Class F insulation











| Motor Type | | wer ⁹ n | Nn Full-load | | n I Current | la/In | Code Letter | Torque Tn | Ta/Tn | Tk/Tn | pf | Eff. | Jm Inertia |
|---------------|------|-----------------------|-----------------|---------------------------|------------------------|-------|----------------|--------------|-------|-------|------|------|---------------|
| | [hp] | [kW] | [ram] | 230V ^{a)} [A] | 460V ^{a)} [A] | [%] | | [lb-in] | | | | [%] | [lb-ft²] |
| | [ub] | | [rpm] | | | | | | | | | | |
| 80LH/4 | I | 0.75 | 1750 | 3.88 | 1.94 | 600 | L | 36.0 | 4.6 | 4.3 | 0.59 | 82.5 | 0.051 |
| 70SH/4 | 1.5 | 1.1 | 1740 | 4.3 | 2.15 | 630 | J | 53.1 | 3.5 | 3.8 | 0.76 | 94.0 | 0.085 |
| 90LH/4 | 2 | 1.5 | 1745 | 6.3 | 3.15 | 670 | K | 72.1 | 4.3 | 4.5 | 0.71 | 84.0 | 0.092 |
| 100LH/4 | 3 | 2.2 | 1765 | 9.6 | 4.3 | 790 | <u> </u> | 105 | 3.6 | 4.7 | 0.73 | 97.5 | 0.178 |
| 112MH/4 | 5 | 3.7 | 1770 | 14.4 | 7.2 | 810 | L | 176 | 4.0 | 4.8 | 0.76 | 87.5 | 0.304 |
| 132SH/4 | 7.5 | 5.5 | 1780 | 20.9 | 10.5 | 820 | L | 259 | 4.3 | 4.6 | 0.74 | 89.5 | 0.75 |
| 132MH/4 | 10 | 7.5 | 1770 | 27.0 | 13.5 | 735 | J | 356 | 3.2 | 4.0 | 0.78 | 89.5 | 0.84 |
| 160MH/4 | 15 | 11 | 1765 | 35.8 | 17.9 | 810 | J | 527 | 2.6 | 3.2 | 0.85 | 91.0 | 1.23 |
| 160LH/4 | 20 | 15 | 1765 | 49 | 24.5 | 850 | K | 712 | 2.8 | 3.5 | 0.85 | 91.0 | 1.35 |
| 180MH/4 | 25 | 18.5 | 1770 | 61 | 30.5 | 840 | K | 879 | 2.8 | 3.6 | 0.83 | 92.4 | 3.56 |
| 180LH/4 | 30 | 22 | 1770 | 72 | 36 | 880 | K | 1046 | 3.1 | 3.9 | 0.83 | 92.4 | 4.51 |
| 200LH/4 | 40 | 30 | 1770 | 94 | 47 | 830 | J | 1424 | 3.0 | 3.6 | 0.86 | 93.0 | 7.60 |
| 225SH/4 | 50 | 37 | 1782 | - | 59 | 810 | J | 1758 | 3.0 | 3.4 | 0.84 | 94.1 | 9.5 |
| 225MH/4 | 60 | 45 | 1782 | - | 70 | 820 | J | 2109 | 3.0 | 3.5 | 0.85 | 94.3 | 11.6 |
| 250MH/4 | 75 | 55 | 1790 | - | 86 | 820 | J | 2619 | 2.9 | 3.4 | 0.86 | 95.1 | 20.4 |
| 280SH/4 | 100 | 75 | 1786 | - | 116 | 830 | J | 3506 | 2.9 | 3.5 | 0.85 | 94.5 | 36.3 |
| 280MH/4 | 125 | 90 | 1786 | - | 146 | 800 | J | 4385 | 2.8 | 3.3 | 0.85 | 94.9 | 43.4 |
| 315SH/4 | 150 | 110 | 1791 | - | 174 | 760 | Н | 5246 | 2.8 | 3.1 | 0.85 | 95.5 | 58.8 |
| 315MaH/4 | 200 | 150 | 1791 | - | 225 | 890 | J | 6995 | 3.3 | 3.5 | 0.86 | 95.9 | 86.9 |

a) Motors frame 225 and larger are standardly provided as single-voltage 460V and not as dual voltage

Full load power Full load speed Pn Nn ln Full load current Locked-rotor current la

Locked-rotor current ratio (%) la/In

Full-load torque Tn Locked-rotor torque Ta

Ta/Tn Locked-rotor torque ratio Break-down torque Τk Tk/Tn Break-down torque ratio

Power factor pf Eff Normal efficiency Jm Motor inertia



3.0 hp Gearmotors







| Motor Power | Output Speed | Output Torque | Service Factor | AGMA Class | Gear Ratio | Star Bea | ndard rings | Heav Bearin | y Duty igs (VL) | Model Type | Weight | Dim. Page |
|----------------|-----------------|------------------|-------------------|---------------|------------------|-----------------|---------------------------|-------------------|-----------------------------|------------------------|--------|--------------|
| P _n | n ₂ | T _a | f _B | | i _{tot} | F _{QN} | F _{AN} Thrust | F _{Q VL} | F _{A VL} Thrust | | Ē | |
| [hp] | [rpm] | [lb-in] | | | | [lb] | [lb] | [lb] | [lb] | | [lb] | |
| 3.0 | 43 | 4416 | 1.7 | II | 39.77 | 1737 | 2700 | 2660 | 2446 | SK 9022.1 - 100L/4 | 123 | 500 |
| | 38 | 4964 | 1.5 | II | 44.71 | 1620 | 2700 | 2585 | 2477 | SK 9022.1 - 100LH/4 | | |
| | 35 | 5442 | 1.4 | II . | 49.01 | 1499 | 2700 | 2511 | 2477 | | | |
| | 33 29 | 5776 6468 | 1.3 1.2 | I | 52.02 58.25 | 1400 1143 | 2700 2700 | 2453 2318 | 2518 2531 | | | |
| | 26 | 7375 | 1.0 | | 66.42 | 590 | 2700 | 2099 | 2547 | | | |
| | 22 | 8760 | 0.9 | * | 78.89 | 370 | 2700 | 1643 | 2547 | | | |
| | 57 | 3293 | 3.1 | III | 29.66 | 2171 | 3263 | 3375 | 2464 | SK 9032.1 - 100L/4 | 168 | 508 |
| | 48 | 3954 | 2.5 | III | 35.61 | 2248 | 3263 | 3375 | 2540 | SK 9032.1 - 100LH/4 | 100 | 300 |
| | 45 | 4225 | 2.7 | III | 38.05 | 2286 | 3263 | 3375 | 2576 | | | |
| | 42 | 4481 | 3.1 | III | 40.36 | 2311 | 3263 | 3375 | 2610 | | | |
| | 36 | 5296 | 2.6 | III | 47.7 | 2376 | 3263 | 3375 | 2669 | | | |
| | 34 | 5545 | 2.5 | III | 49.94 | 2381 | 3263 | 3375 | 2678 | | | |
| | 29 27 | 6570 7115 | 2.1 1.9 | III II | 59.17 | 2450 2459 | 3263 | 3375 3375 | 2747 2756 | | | |
| | 22 | 8429 | 1.6 | II | 64.08 75.91 | 2502 | 3263 3263 | 3375 | 2810 | | | |
| | 20 | 9346 | 1.5 | ii | 84.17 | 2513 | 3263 | 3375 | 2833 | | | |
| | 18 | 10382 | 1.3 | 1 | 93.5 | 2504 | 3263 | 3375 | 2815 | | | |
| | 15 | 12300 | 1.1 | - 1 | 110.77 | 2185 | 3263 | 3375 | 2833 | | | |
| | 11 | 17626 | 0.8 | * | 158.74 | | 3263 | 2828 | 2678 | | | |
| | 31 | 6184 | 3.8 | III | 55.69 | 6271 | 9000 | 6300 | 4448 | SK 9042.1 100L/4 | 271 | 516 |
| | 27 | 7023 | 3.3 | III | 63.25 | 6246 | 9000 | 6300 | 4550 | SK 9042.1 - 100LH/4 | | |
| | 25 | 7618 | 3.3 | III | 68.61 | 6228 | 9000 | 6300 | 4644 | | | |
| | 22 | 8459 | 2.9 | III | 76.18 | 6197 | 9000 | 6300 | 4727 | | | |
| | 20 18 | 9597 10611 | 2.6 2.3 | III III | 86.43 95.56 | 6152 6107 | 9000 9000 | 6300 6300 | 4835 4914 | | | |
| | 14 | 13079 | 1.6 | II | 117.79 | 5974 | 9000 | 6300 | 5058 | | | |
| | 13 | 14745 | 1.7 | ii | 132.79 | 5868 | 9000 | 6300 | 5090 | | | |
| | 11 | 17759 | 1.4 | - II | 159.94 | 5636 | 9000 | 6300 | 5213 | | | |
| | 8.7 | 21666 | 1.1 | | 195.12 | 5249 | 9000 | 6300 | 5204 | | | |
| | 7.5 | 26095 | 0.9 | | 235.01 | 4669 | 9000 | 6300 | 5263 | | | |
| | 17 | 11370 | 3.1 | III | 102.4 | 8550 | 10125 | 8550 | 8179 | SK 9052.1 - 100L/4 | 437 | 524 |
| | 14 | 13328 | 3.1 | III | 120.03 | 8498 | 10125 | 8550 | 8501 | SK 9052.1 - 100LH/4 | | |
| | 12 10 | 16118 18792 | 2.0 2.3 | III | 145.16 169.24 | 8397 8280 | 10125 10125 | 8550 8550 | 8890 9194 | | | |
| | 8.6 | 22028 | 1.9 | III II | 198.38 | 8111 | 10125 | 8550 | 9509 | | | |
| | 6.9 | 27433 | 1.5 | ii | 247.06 | 7758 | 10125 | 8550 | 9914 | | | |
| | 5.9 | 32158 | 1.3 | I | 289.61 | 7369 | 10125 | 8550 | 10125 | | | |
| | 8.2 | 22967 | 3.3 | III | 206.84 | 14546 | 11250 | 14850 | 11250 | SK 9072.1 - 100L/4 | 745 | 532 |
| | 6.9 | 27289 | 2.8 | III | 245.76 | 14436 | 11250 | 14850 | 11250 | SK 9072.1 - 100LH/4 | , 40 | 002 |
| | 5.5 | 34544 | 2.2 | III | 311.1 | 14202 | 11250 | 14850 | 11250 | SK 9072.1/32 - 100L/4 | 820 | 552 |
| | 4.4 | 42847 | 1.8 | II | 385.88 | 13865 | 11250 | 14850 | 11250 | SK 9072.1/32 - 100LH/4 | 020 | JJZ |
| | 3.6 | 52545 | 1.4 | ii ii | 473.22 | 13361 | 11250 | 14850 | 11250 | | | |
| | 2.8 | 66430 | 1.1 | Ï | 598.27 | 12411 | 11250 | 14850 | 11250 | | | |
| | 2.2 | 85227 | 0.9 | * | 767.55 | 10573 | 11250 | 14850 | 11250 | | | V |

(AGMA Class $I = f_B 1.0 - 1.39$ $II = f_B 1.4 - 1.99$ $III = f_B \ge 2.0$ * = $f_B < 1.0$) (Model Type in blue is an Energy Efficient motor)



DIMENSIONS

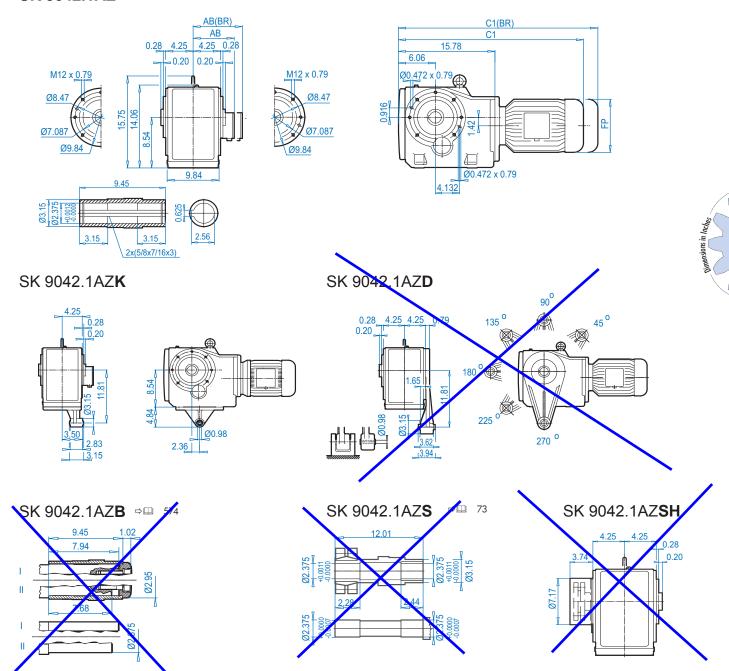






SK 9042.1 + Motor

SK 9042.1AZ



Motor dimensions

| Standard efficiency | 90S/L | 100L | | 132S/M | 160M/L | | For Other Connection |
|---------------------|---------|-------|-------|----------|--------|-------|---|
| Energy efficiency | 90SH/LH | 100LH | 112MH | 132SH/MH | 160MH | 160LH | Possibilities please see ⇒ □ 555 & 557 |
| AB | 5.79 | 6.65 | 7.05 | 8.03 | 8.90 | 8.90 | |
| AB (BR) | 5.83 | 6.26 | 6.69 | 7.72 | 8.90 | 8.90 | |
| C1 | 26.65 | 27.83 | 28.74 | 32.13 | 34.61 | 34.61 | |
| C1 (BR) | 29.61 | 31.42 | 32.40 | 36.34 | 41.19 | 41.19 | |
| FP | 7.20 | 7.91 | 8.98 | 10.47 | 12.60 | 12.60 | |

(BR) denotes Brakemotor







Performance Data

Energy Efficient (EPAct)

230/460V - 60Hz / EE

Inverter duty • TEFC

Synchronous speed 1800rpm @ 60Hz • 4-pole • Three-phase

Voltages: 230/460V - 60Hz • 1.15 Service Factor Continuous Duty • 40°C Ambient • up to 3300ft Elevation

Class B temperature rise • Class F insulation











| Motor Type | | wer ⁹ n | Nn Full-load | | n I Current | la/In | Code Letter | Torque Tn | Ta/Tn | Tk/Tn | pf | Eff. | Jm Inertia |
|---------------|------|-----------------------|-----------------|---------------------------|----------------|-------|----------------|--------------|-------|-------|------|-----------------|---------------|
| | [hm] | [kW] | [umus] | 230V ^{a)} [A] | 460V°) | [%] | | [lb-in] | | | | F9/ 1 | [lb-ft²] |
| | [hp] | | [rpm] | | [A] | | - | | | | | [%] | |
| 80LH/4 | 1 | 0.75 | 1750 | 3.88 | 1.94 | 600 | L | 36.0 | 4.6 | 4.3 | 0.59 | 82.5 | 0.051 |
| 90SH/4 | 1.5 | 1.1 | 1740 | 4.3 | 2.15 | 630 | J | 53.1 | 3.5 | 3.8 | 0.76 | 84.0 | 0.085 |
| 90LH/4 | 2 | 1.5 | 1745 | 6.3 | 3.15 | 670 | K | 72.1 | 4.3 | 4.5 | 0.71 | 84.0 | 0.092 |
| 100LH/4 | 3 | 2.2 | 1765 | 8.6 | 4.3 | 790 | L | 105 | 3.6 | 4.7 | 0.73 | 87.5 | 0.178 |
| 112MH/4 | 5 | 3.7 | 1770 | 14.4 | 7.2 | 810 | L | 176 | 4.0 | 4.0 | 0.76 | 87.5 | 0.304 |
| 132SH/4 | 7.5 | 5.5 | 1780 | 20.9 | 10.5 | 820 | L | 259 | 4.3 | 4.6 | 0.74 | 89.5 | 0.75 |
| 132MH/4 | 10 | 7.5 | 1770 | 27.0 | 13.5 | 735 | J | 356 | 3.2 | 4.0 | 0.78 | 89.5 | 0.84 |
| 160MH/4 | 15 | 11 | 1765 | 35.8 | 17.9 | 810 | J | 527 | 2.6 | 3.2 | 0.85 | 91.0 | 1.23 |
| 160LH/4 | 20 | 15 | 1765 | 49 | 24.5 | 850 | K | 712 | 2.8 | 3.5 | 0.85 | 91.0 | 1.35 |
| 180MH/4 | 25 | 18.5 | 1770 | 61 | 30.5 | 840 | K | 879 | 2.8 | 3.6 | 0.83 | 92.4 | 3.56 |
| 180LH/4 | 30 | 22 | 1770 | 72 | 36 | 880 | K | 1046 | 3.1 | 3.9 | 0.83 | 92.4 | 4.51 |
| 200LH/4 | 40 | 30 | 1770 | 94 | 47 | 830 | J | 1424 | 3.0 | 3.6 | 0.86 | 93.0 | 7.60 |
| 225SH/4 | 50 | 37 | 1782 | - | 59 | 810 | J | 1758 | 3.0 | 3.4 | 0.84 | 94.1 | 9.5 |
| 225MH/4 | 60 | 45 | 1782 | - | 70 | 820 | J | 2109 | 3.0 | 3.5 | 0.85 | 94.3 | 11.6 |
| 250MH/4 | 75 | 55 | 1790 | - | 86 | 820 | J | 2619 | 2.9 | 3.4 | 0.86 | 95.1 | 20.4 |
| 280SH/4 | 100 | 75 | 1786 | - | 116 | 830 | J | 3506 | 2.9 | 3.5 | 0.85 | 94.5 | 36.3 |
| 280MH/4 | 125 | 90 | 1786 | - | 146 | 800 | J | 4385 | 2.8 | 3.3 | 0.85 | 94.9 | 43.4 |
| 315SH/4 | 150 | 110 | 1791 | - | 174 | 760 | Н | 5246 | 2.8 | 3.1 | 0.85 | 95.5 | 58.8 |
| 315MaH/4 | 200 | 150 | 1791 | - | 225 | 890 | J | 6995 | 3.3 | 3.5 | 0.86 | 95.9 | 86.9 |

a) Motors frame 225 and larger are standardly provided as single-voltage 460V and not as dual voltage

Full load power Full load speed Pn Nn ln Full load current Locked-rotor current la

Locked-rotor current ratio (%) la/In

Full-load torque Tn Locked-rotor torque Ta

Ta/Tn Locked-rotor torque ratio Break-down torque Τk Tk/Tn Break-down torque ratio

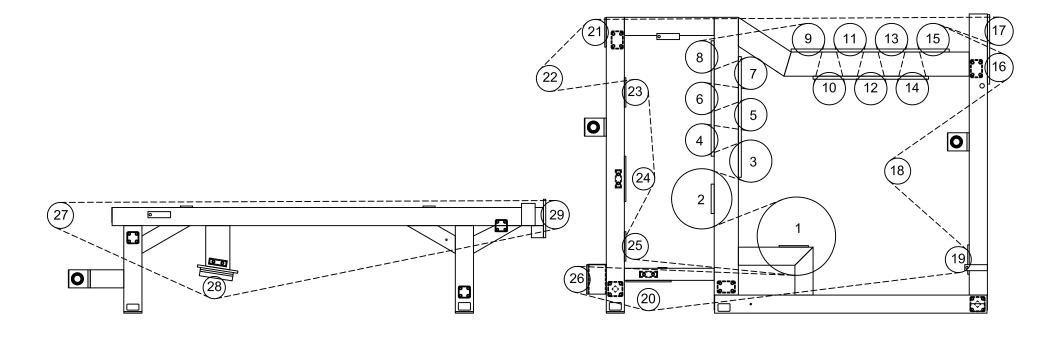
Power factor pf Eff Normal efficiency Jm Motor inertia





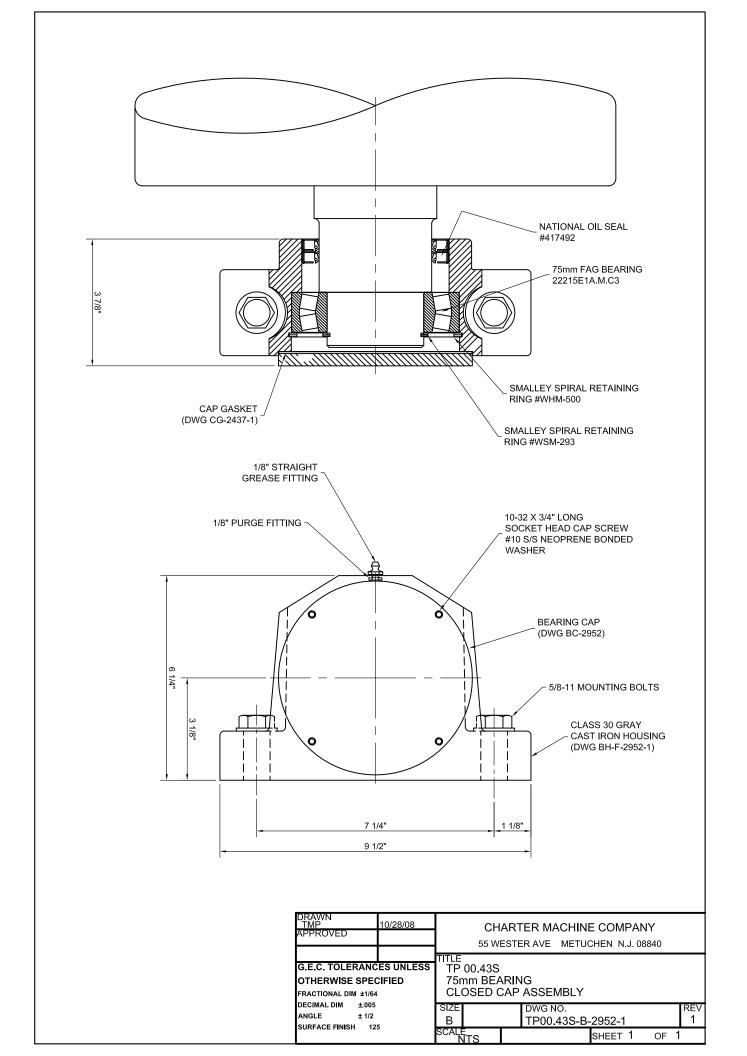


| ITEM No. | ROLLER DIA | BEARING SIZE |
|-------------|---------------|-----------------|
| 1 | 26" | 75 mm |
| 2 | 20" | 75 mm |
| 3 | 14" | 75 mm |
| 4 | 10 3/4" | 75 mm |
| 5 | 10 3/4" | 75 mm |
| 6 | 10 3/4" | 75 mm |
| 7 | 10 3/4" | 75 mm |
| 8 | 10 3/4" | 75 mm |
| 9 | 10 3/4" | 75 mm |
| 10 | 10 3/4" | 75 mm |
| 11 | 10 3/4" | 75 mm |
| 12 | 10 3/4" | 75 mm |
| 13 | 10 3/4" | 75 mm |
| 14 | 10 3/4" | 75 mm |
| 15 | 10 3/4" | 75 mm |
| 16 | 9 3/8" | 75 mm |
| 17 | 9 3/8" | 75 mm |
| 18 | 8 5/8" | 75 mm |
| 19 | 8 5/8" | 75 mm |
| 20 | 7 3/8" | 75 mm |
| 21 | 8 5/8" | 75 mm |
| 22 | 8 5/8" | 75 mm |
| 23 | 8 5/8" | 75 mm |
| 24 | 7 3/8" | 75 mm |
| 25 | 8 5/8" | 75 mm |
| 26 | 8 5/8" | 75 mm |
| 27 | 8 5/8" | 75 mm |
| 28 | 7 3/8" | 75 mm |
| 29 | 9 3/8" | 75 mm |

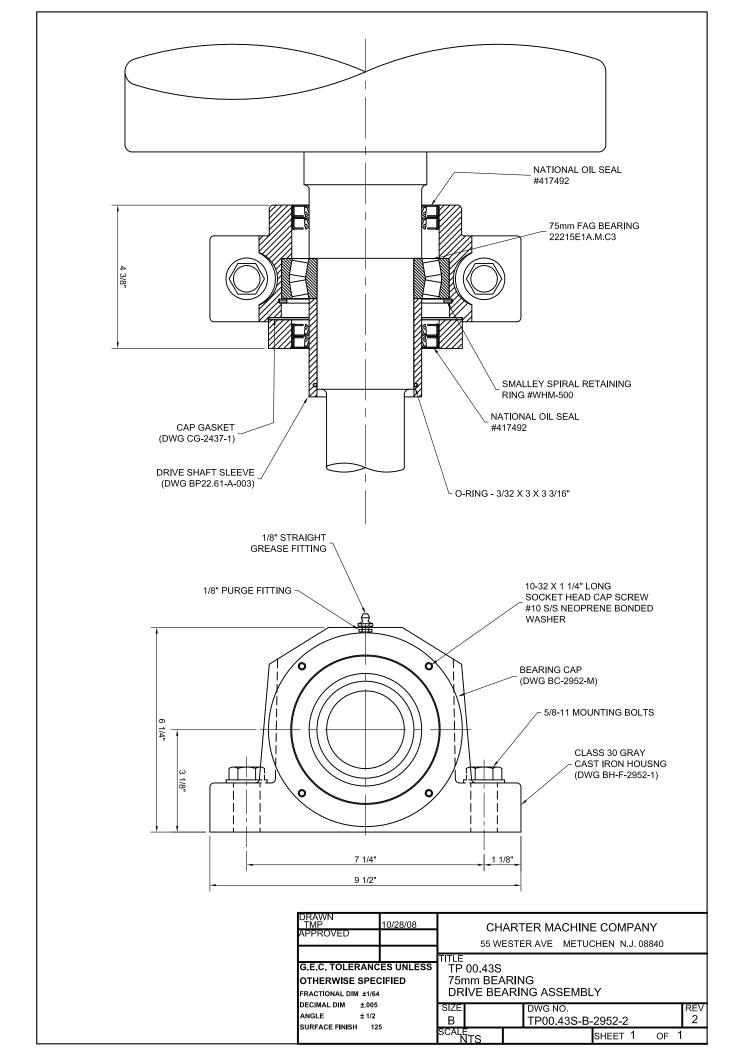


| DRAWN TMP APPROVED | 8/12/10 | CHARTER MACHINI 55 WESTER AVE METU | | | | | | |
|--------------------------|---------|---------------------------------------|--------------|--------------|---------|------|--|-----|
| | | TITLE | | | | | | |
| G.E.C. TOLERANC | l 3 BEL | 3 BELT TOWER PRESS 00.593S | | | | | | |
| OTHERWISE SPE | CIFIED | ROLLER & | | | | | | |
| FRACTIONAL DIM ±1/64 | | BEARING LOCATIONS | | | | | | |
| | | | WING EGG | 711011 | 0 | | | |
| DECIMAL DIM ±.005 | | SIZE | | DWG NO. | | | | REV |
| ANGLE ± 1/2 | | В | | 3BTP0 | 0.593 | S-04 | | 0 |
| SURFACE FINISH 125 | | SCALE | | | SHEET 1 | OF 1 | | |
| | | | NONE SHEET I | | | | | |











FAG Spherical Roller Bearings

The FAG spherical roller bearing is well known for its heavy-duty capabilities. It incorporates two rows of symmetrical barrel-shaped rollers, which can align themselves freely in the spherical outer ring raceway, thereby providing compensation for shaft deflection and bearing seat misalignment.

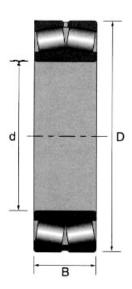
FAG spherical roller bearings are produced in E1-type design depending on their size and series. Unlike other spherical roller bearings, these bearings have no center lip on the inner

ring, allowing for a maximum number of longer rollers with a large diameter. The close contact between the rollers and the raceways yields a uniform stress distribution, and the optimization of roller size permits distinctly higher load carrying capacity than conventional spherical roller bearings.

FAG E1 spherical roller bearings are designed for exposure to high radial, or axial loads, unbalanced forces, vibration stress, angular misalignment, and constant high temperature.

FAG Spherical Roller Bearing E1

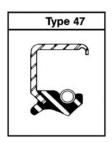
E1A.M.C3 – E1-type, maximum capacity, modified internal design, lubricating groove and three lubricating holes in the outer ring, machined brass cage, roller riding, and radial clearances larger than normal.

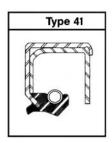


| Shoft | FAG | Dort No. | | Dimension | | Load | Weight | |
|-------|---------------|--------------|--------|-----------|----|---------------|--------------|--|
| Shaft | Part No. | Part No. | d (mm) | D | В | Rating (lbs.) | Weight (lbs) | |
| 2.95" | 22215E1A.M.C3 | 045-243-0113 | 75 | 130 | 31 | 48,558 | 3.79 | |

NATIONAL OIL SEAL

| Shaft | Hsg. Bore | Seal O.D. | Seal Width | Lip Mat'l | Part # | Type/ Illus. |
|--------|-----------|-----------|------------|-----------|--------|-----------------|
| 3.437" | 4.501 | 4.506 | .375 | Nitrile | 417492 | 41 |
| 2.437 | 3.125 | 3.130 | .375 | Nitrile | 471887 | 47 |





| NITRILE LIP SEAL PROPERTIES | | | | | | | |
|-----------------------------|-------------------|------------------------|------------------|--|--|--|--|
| Durometer | Oil Resistance | Abrasion Resistance | Service Temp. | | | | |
| 60 -80 | Very Good | Excellent | -50° / 250°F | | | | |

Spring loaded – preferred industrial design Dual Lip – extra contaminate exclusion Shaft Speeds - 0 - 1000 feet per minute Max. Pressure - 7 PSI Shaft Finish - 15 to 25 micro-inch Shaft Hardness - Abrasive Above C-45 Rockwell Shaft Run Out - 0 - 800 rpm, .025" TIR Shaft to Bore Misalignment - 0 to 800 rpm,.015" ECC.

Protecting Metal Surfaces with Nylon 11 Powder Coating

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Corrosion alone is responsible for more than 5 ½ billion dollars damage to metal parts and structures in the United States each year. The effects of mechanical wear are incalculable.

One of the most effective methods of preventing metal failures is to protect their surface against corrosion and wear with a coating of nylon 11.

The coating is applied in powdered form either by electrostatic deposition or by the fluid bed process and fused on to the surface of the metal. Coating thickness can be as low as .0025" and as thick as .050.

Protection of a metal surface with Rilsan Nylon 11 coating offers the following advantages.

- (a) **Excellent corrosion resistance**: Rilsan coatings resist a broad range of chemical environment. Salt spray testing in excess of 2000 hours and immersion in sea water for 6 years cause no corrosion of the metal substrates.
- (b) Improved abrasion resistance and longer life: The low coefficient of friction of Rilsan can be used to advantage on such parts as cams, gears, sliding components, and other moving parts to reduce wear and suppress mechanical noise.
- (c) **High impact resistance**: A coated steel tube with a 300 micron (12 mils or .012") thick layer was repeatedly struck with a 1 kg (2.2 lb.) weight, without the slightest sign of peeling or exposure of the base metal, even though tube was deformed.
- (d) **Good sanitary properties**: Rilsan coatings are inert to fungus growth and are highly stain resistant. These properties are important for maintenance and clean up and the preservation of colorful and clear finishes.
- (e) **Good outdoor weathering**: Rilsan Coatings are resistant to ultra-violet radiation. The degree

of resistance may be enhanced by the incorporation of additives and colorants designed to counter the adverse effects of UV radiation. For applications where long-term UV resistance is important, we recommend you to consult with us to ensure the optimum formulation for your needs.

(f) **Good electrical properties**: Rilsan Nylon 11 coatings have good dielectric properties. The thicker the coating the better its insulating effect.

RILSAN Nylon 11 Coating Applications

Some of the applications for which Rilsan Nylon 11 powder coating will improve the performance, appearance or service life include:

- (a) Institutional furniture such as hospital beds to provide electrical insulation; office furniture to resist scratching and assure long life; playground equipment to eliminate maintenance.
- (b) Industrial pipe and related fittings to resist corrosion and abrasion.
- (c) Food processing machinery and equipment such as racks, shelves, conveyors, mixing blades, etc. to reduce costs by replacing stainless steel, eliminate corrosion and staining, reduce cleaning costs.
- (d) Farm equipment & fertilizer conveyor screws, scales, pipe, stalls, etc.
- (e) Material handling equipment racks, processing baskets, conveyor rollers.
- (f) Dishwasher tubs and baskets.
- (g) Outdoor furniture.
- (h) Marine applications rackings, hardware, etc.
- (i) Miscellaneous shopping carts, ornamental iron, high pressure gas tanks, and for replacing chrome plating and stainless steel for a broad range of industrial products.

Powder Coating Techniques

Two basic processes are used for powder coating metals with Rilsan fine powders: The Fluid Bed Process and the Electrostatic Deposition Process. Roediger shall use the Electrostatic Projection Process for the rolls.

Electrostatic Projection

In the electrostatic projection process, powders are passed through a nozzle carrying a high electrical potential. The powder particles become charged and are attracted to the metal part, which is at zero potential. The thickness of the coating is a function of spraying time and applied voltage.

Since Rilsan Nylon 11 is thermoplastic it is only necessary to melt the adhered powder in an oven to fuse the coating to the metal surface. Fusion temperatures range from 400°F to 450°F.

Most metal parts can be coated with Rilsan Nylon 11, provided they can be raised to the temperature necessary for the coating operation without undergoing a physical change or dimensional distortion.

The various steps in the preparation and coating of a metal part with Nylon 11 are illustrated on these pages. Preparation of the part for coating is basically the same whether the part is to be coated by the electrostatic or fluid bed process. All surfaces must

be cleaned to remove oil, grease and rust. Also, a primer coat is often recommended to improve the adherence of the Nylon 11 powder to the surface of the metal. Primers marketed by Rilsan include Rilsan Primer P and Rilprim P104.

Rilsan Primer P is a one component, general purpose primer for parts to be subjected to moderate working conditions.

Advantages of the Electrostatic Process

- Best for thin decorative and functional coatings; .0025 to .008 inch.
- Ready masking on non-coated areas.
- Easy correction of coating errors prior to fusion
- Lower cost where thin films are adequate.

The application of Rilsan Nylon 11 powder coating – whether by fluid bed or electrostatic deposition – involves a number of process variables and powder selections that are beyond the scope of this brochure. Rilsan's technical personnel should be consulted on specific requirements and on how best to optimize either of these processes to meet those requirements.

Properties of Rilsan Coating Powders

Rilsan Nylon 11 is a thermoplastic polyamide produced by Rilsan Corporation from a vegetable source, rather than a petroleum source. It is one of the oldest coating powders in existence.

The most significant characteristic of Rilsan Nylon 11 powder is its ease of application due to its optimum melt zone, permitting latitude in processing and providing resistance to cratering and pinholes.

Particle size and viscosity characteristics of Rilsan powders are controlled so that the melt viscosity is high enough to prevent sagging and running, yet fluid enough to achieve proper leveling, flow-out and wetting of the substrate.

High gloss finishes (Gardner Gloss of 65-95%) are obtained by water quenching. Air cooling results in finishes of 30 to 70% gloss.

Rilsan fine powders are available in a wide range of standard colors, as well as in custom colors matched to customer requirements.

Some applications will require the use of a primer prior to the application of the final Rilsan coating to assure proper adhesion and uniformity of coating thickness.

Rilsan RDP-17-1 is a water based, non-flammable dispersion of Nylon 11 coating powder which can be applied by employing wet-paint, air spray equipment.

For optimum results, it should be applied as is, without thinning with water or any commercial solvent which may alter the viscosity or other liquid characteristics.

The film thickness, which is dependent upon spraying conditions, is comparable to most commodity powder coating material. Film properties are similar to those achieved by depositing Nylon 11 by the conventional electrostatic technique.

Economics of Rilsan Powder Coating

The true value of a surface coating is a function of how well it performs the job for which it was originally considered.

For example, a coating which fails prematurely, but which costs half as much as a coating that protected the metal surface for the life of the part, would hardly be called a bargain.

One must therefore carefully consider performance in conjunction with cost.

Since powder coatings are sold by the pound, yet are used to cover surfaces, an expression of the relationship between cost and coverage must be made. This relationship is as follows:

| Coverage (ft ² * mil/lb.) | = | 192 Spec. Gravity |
|---|---|----------------------|
| Cost/ft ² * mil | = | Cost/lb. Coverage |

The specific gravity of Nylon 11 powders varies according to the pigment used. These variations are not too great since minimal levels of pigment are used.

Coverage rates per pound for Rilsan Nylon 11 coatings range from 160 square feet per mil thickness to 185 square feet per mil thickness. Whites and tint colors usually fall in the lower range, while black and mass-tone colors are on the higher scale.

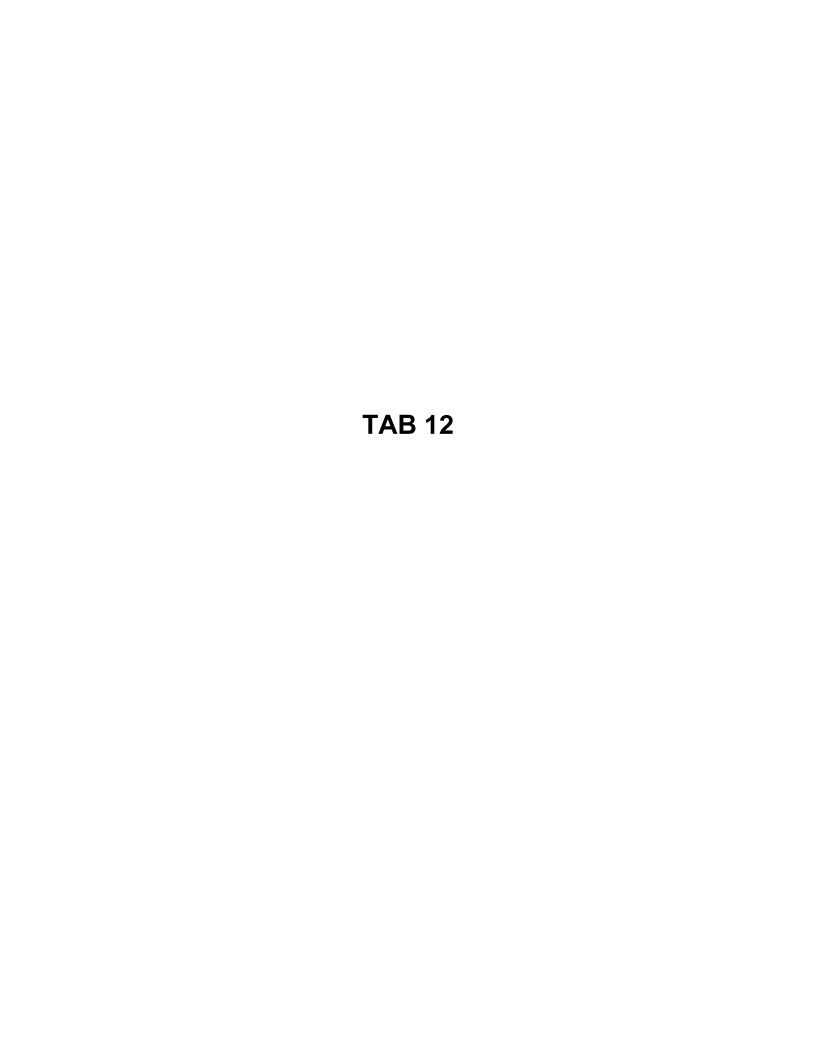
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The most accurate information on the economics of Nylon 11 powder coating is obtainable from a qualified custom coater. Rilsan representatives will be glad to offer recommendations.

| PROPERTIES | RDP Pigmented |
|---|---------------|
| TROI EITHES | Electrostatic |
| 60° Gloss – air cooled | 68 |
| Coverage Et ² * mil/Dound | 162 |
| Coverage, Ft ² * mil/Pound Coverage, Ft ² * mil/Gallon | 102 |
| Film Thickness – Minimum Mils | 2.5 |
| - Maximum Mils | 7-8 |
| ELECTRICAL: | 7-0 |
| Dielectric Strength | 1600 (7) |
| PHYSICAL: | 1000 (1) |
| | 190 |
| Melt Point °C | 1.19 |
| Specific Gravity | |
| Bulk Density, Kilogram/Liter | 0.39 |
| Coefficient of Friction (2) | .32/.17 17 |
| Tabor Abrasion (3) | 100 |
| Impact – Primed (4) | |
| - Unprimed | 100 |
| Adhesion, Initial – Primed (5) | 4.0 |
| - Unprimed | 2.0 |
| Adhesion after 1 hour water boil | |
| - Primed – Rilprim P104 | - |
| - Unprimed - | - |
| Adhesion After 3 hour water boil | 4.0 |
| - Primed | 4.0 |
| - Unprimed | 0 |
| THERMAL: | |
| Coefficient of Thermal Expansion | |
| -30° C to $+30^{\circ}$ C, in./in. = 10^{-5} /°C | 9.4 |
| Heat of Fusion (of powder) cal/gm | 8.5 |
| APPROVALS | |
| USDA | Yes |
| CHEMICAL RESISTANCE: (6) | |
| Strong Alkalies | A |
| Strong Acids | X |
| Weak Acids | В |
| Grease, Oil | A |
| Commercial Solvents | A |
| Weathering | A |

- (1) Volts/Mil at 13 mils Film Thickness ASTM D149 Short Time Method
- (2) Against Steel Static/Dynamic
- (3) Tabor Abrasion mg Loss/1000 Cycles, CS-17 Wheel, 1000 g Load.
- (4) Direct and Reverse, 160 in. lb. Gardner, -Electrostatic 0.032" Thick Mild Steel Panel
- (5) Rating Scale is: 4 Excellent, 3 Good, 2 Fair, 1 Poor and 0 – None
- (6) Rating Scale: A Good; B Should be checked by application tests; X – Poor
- (7) Volts/Mil at 6 mils Film Thickness ASTM D149 Short Time Method
- (8) Up to 50 mils Depending on Preheating Conditions







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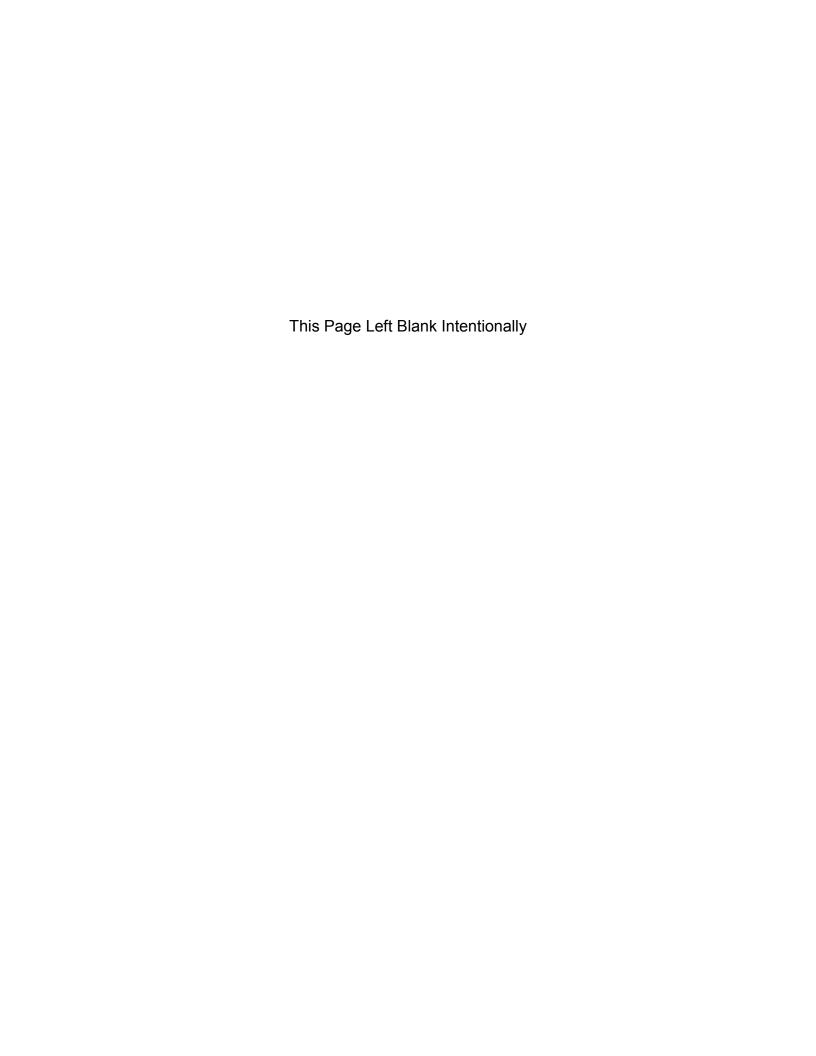
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EP RUBBER

The cost of neoprene is its greatest disadvantage. It is a good multipurpose rubber, but there are other types that offer much better oil, ozone, weather, and oxidation resistance at a lower cost when they are used for specific applications.

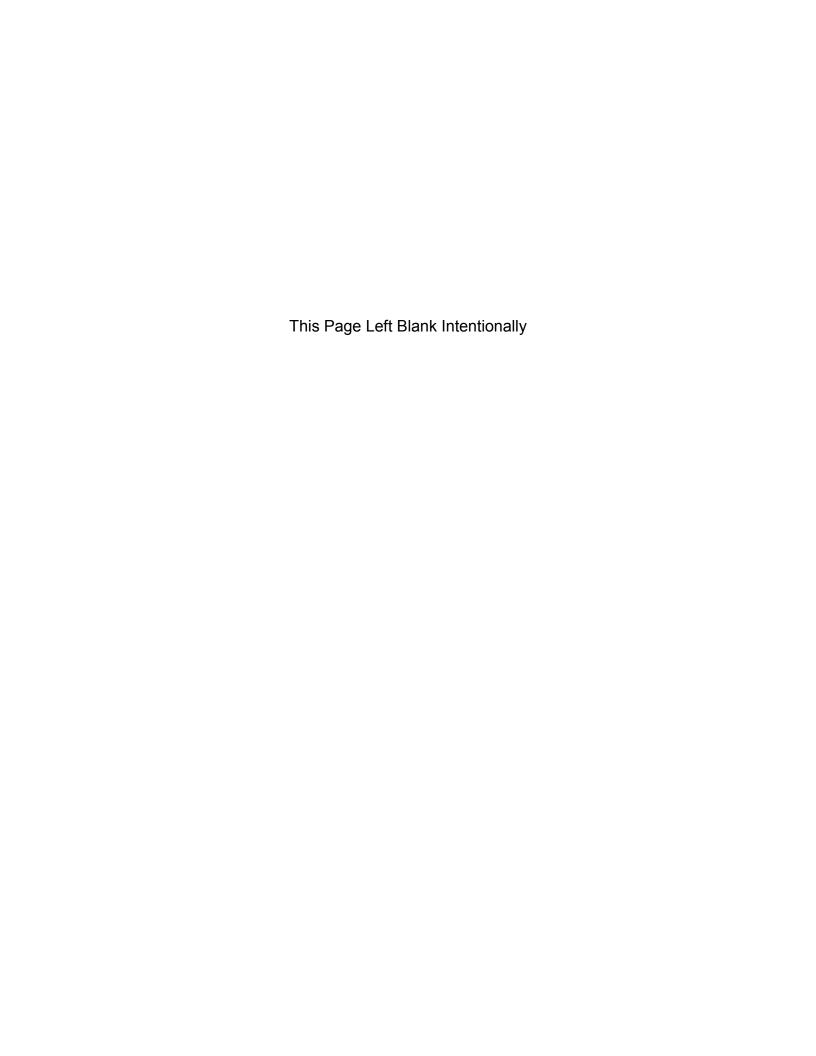
EP Rubber (chemical identification: ethylene propylene and methylene – EPR, ethylene propylene and terpolymer – EPDM)

Two basic types of EP rubber are available in today's market. They are ethylene propylene (EP) which uses a peroxide cure system and ethylene propylene diene methylene terpolymer (EPDM) which uses a sulfur cure system. These polymers are recognized for their resistance to weathering and high temperatures. The EP rubbers have slightly better heat resistance than the EPDM rubbers; however, the EPDM rubbers are easier to process and manufacture.

EPDM rubbers are used extensively in outdoor applications. They will withstand the abuse of all types of weather including sunlight, ozone and oxidants, and they exhibit excellent resistance to animal and vegetable oils, water, steam, oxygenated solvents (acetone, methyl ethyl ketone and other ketones). Color retention in colored compounds is excellent. Compounds exhibit good dielectric qualities and high heat resistance. Low temperature properties are excellent.

The resilience and tensile strengths of EPDM rubbers are low, and resistance to petroleum derivatives is extremely poor.

| Technical Data | EPDM (Ethylene |
|-------------------------------------|----------------|
| | Propylene) |
| Relative Cost (Ref Cost SBR = 1.00) | 1.80 |
| Specific Gravity – base Polymer | 0.86 |
| Durometer Hardness Range | 30-90 |
| Maximum Tensile Strength (PSI) | 3000 |
| Elongation % (Max) | 600 |
| Abrasion Resistance | G |
| Tear Resistance | G |
| Maximum Service Temp (Deg F) | 300 |
| Minimum Service Temp (Deg F) | -70 |
| Oil Resistance | F,P |
| Fuel Resistance | F,P |
| Weather Aging | X |
| Oxidation | X |
| Heat Aging | X |
| Water Swell Resistance | X |
| Flame Resistance | Р |
| Adhesion to Metal | G |
| Electrical Resistivity | X |



GALVANIZING

Quality of galvanizing will meet or exceed A.S.T.M. A-123-53 specifications.

1. SOIL AND GREASE REMOVAL

A hot alkaline cleaner is usually used to remove oil, grease, shop oil, and soluble paints. This will not however, remove such things as epoxies, vinyls, asphalt, or welding slag. These soils must be removed by grit blasting, sandblasting, or other mechanical cleaning.

2. PICKLING

An acid bath is used to remove surface rust and mill scale to provide a chemically clean metallic surface.

3. PREFLUXING

A steel article may be immersed in a liquid flux predip (zinc ammonium chloride solution) to remove oxides and to prevent oxidation prior to dipping into molten zinc.

4. GALVANIZING

The article is immersed into molten zinc at approximately 850° F (455° C) which may be covered with an additional kettle flux. This results in a formation of a zinc and zinc-iron alloy coating which is metallurigically bonded to the steel.

5. FINISHING

After the article is withdrawn from the galvanizing bath, excess zinc is removed by draining, by vibrating or, for small items, by centrifuging. The galvanized item is then cooled in air or quenched in water.

6. INSPECTION

Thickness and surface condition inspections are the final steps in the process.

Main frame coating is crucial to the protection of the main frame. The metal shall be prepared by angular steel grit blasting to near white metal (SSPC-SP10). The base coating shall be hot dip galvanized to a thickness of at least five (5) mil. Galvanized surfaces shall be cleaned in accordance with SSPC-SP1 and passivated.

TABLE I

COMPARISON OF COATING WEIGHT REQUIREMENTS FOR HOT DIP GALVANIZED PRODUCTS (ASTM Specifications)

| | A STM | ASTM | Minimum Weigl per sq. | linimum Weight of Zinc Coating, oz. per sq. ft. of surface ^a | |
|--|-----------------|--|------------------------------|--|--|
| Class of Material | SPEC. | Average of Specimens Tested ^b | Any Individual Specimen | | |
| Iron & Steel Products (Except Hardware & Related Products) | | | | | |
| Specified Base Metal Thickness, in. (mm) 22 gage (0.0299)(0.76) to under 1/16 (1.6) 1/16 (1.6) to under 1/8 (3.2) 1/8 (3.2) to under ½ (6.4) ½ (6.4) or over | A123 | 1.10 1.50 2.00 2.30 | 0.85 1.25 1.80 2.00 | | |
| For wire in assemblies (diameters): Under 3/16 (4.8) 3/16 (4.8) to under 1.4 (6.4) 1.4 (6.4) or over | | 1.00 1.50 2.00 | 0.75 1.25 1.80 | | |
| HARDWARE Class A. – Castings: gray iron, malleable iron, steel Class B. – Rolled, pressed, and forged articles (except those that would be included under classes C and D) B-1. – 3/16 in. (4.76 mm) and over in thickness and | | 2.00 | 1.80 | | |
| over 15 in. (381 mm) in length | A153 | 2.00 1.50 | 1.80 1.25 | | |
| Class C. – Fasteners over 3/8 in. (9.52 mm) in diameter and similar articles. Washers 3/16 and 1/4 in. (4.76 and 6.35 mm) thick | | 1.30 1.25 | 1.10 1.00 | | |
| Class D. – Fasteners (3.8 in. and under in diameter), rivets, nails, and similar articles. Washers under 3/16 in. (4.76 mm) thick | | 1.00 | 0.85 | | |
| HIGH-STRENGTH BOLTS (A325) | A153 Class C | 1.25 | 1.00 | | |
| TOWER BOLTS (A394) | A153 Class C | 1.65 | 1.50 | | |

^a In the case of long pieces, such as anchor rods and similar articles over 5 ft. in length, the weight of coating and uniformity test shall be the average of the determination made at each end and the middle of the article. In no case shall the average of the measurements in any of the three areas be below the minimum shown in the "Any Individual Specimen" column.

^b The number of specimens to be tested per order shall be as specified in ASTM A123, the product specification, or as specified by the purchaser.

TABLE II
CONVERSION FROM ZINC COATING WEIGHT TO COATING THICKNESS

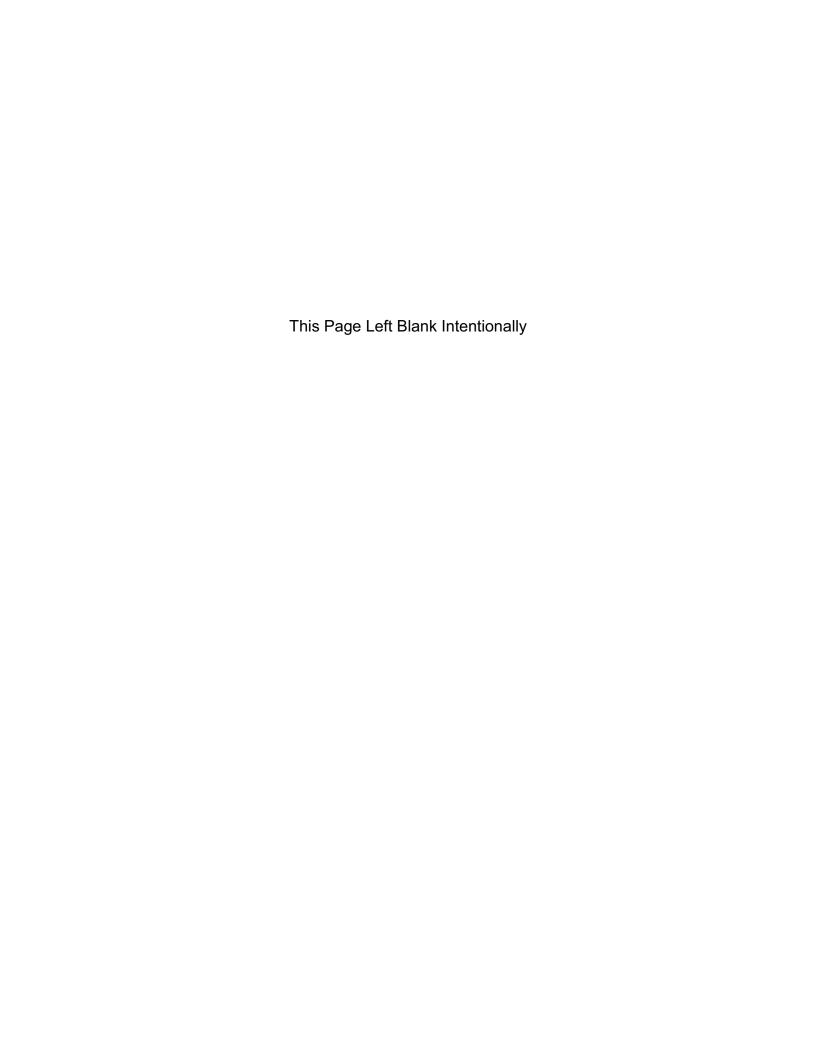
| Coating Weight | | | |
|------------------------|---------|-----------|--------------|
| Surface | Surface | Thickness | Thickness |
| Oz/Ft ² | g/m² | Mils* | um (microns) |
| 1.00 | 305.2 | 1.70 | ` 43 |
| 1.10 | 335.7 | 1.87 | 47 |
| 1.25 | 381.5 | 2.12 | 54 |
| 1.30 | 396.8 | 2.21 | 60 |
| 1.50 | 457.8 | 2.55 | 65 |
| 1.80 | 549.4 | 3.06 | 77 |
| 2.00 | 610.3 | 3.40 | 86 |
| 2.50 | 762.9 | 4.25 | 108 |
| 3.00 | 915.5 | 5.10 | 130 |
| * 1 mil = 0.001 inches | | | |

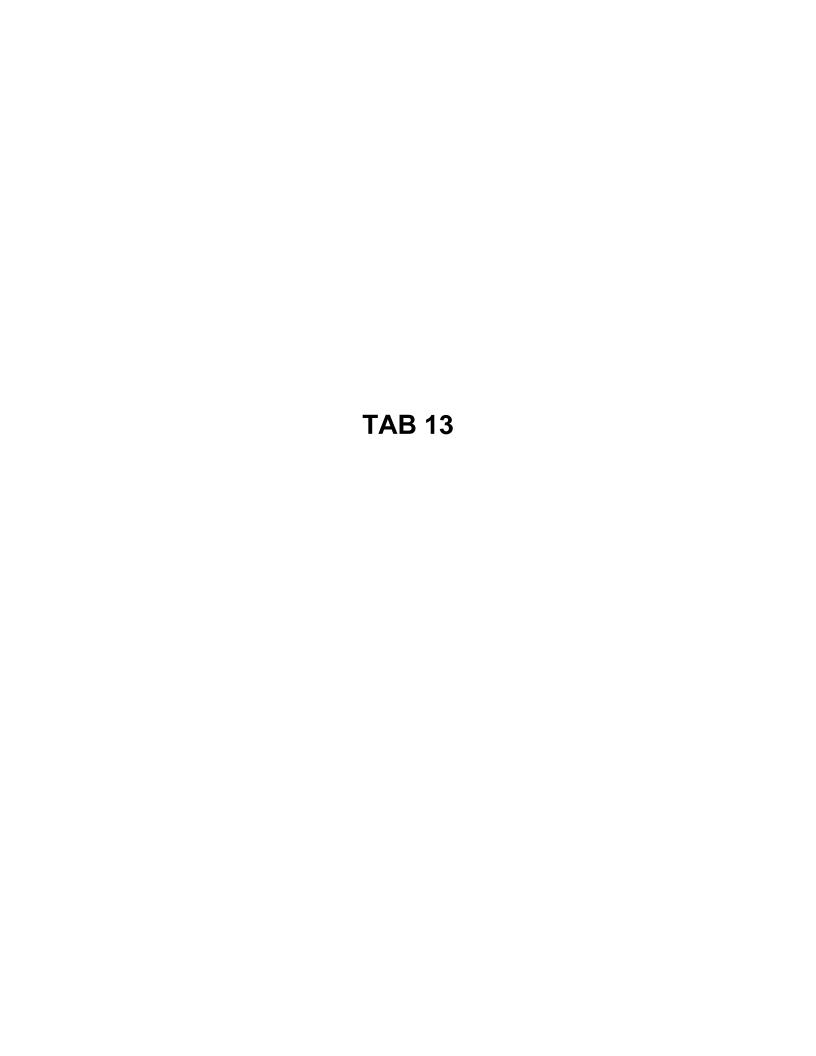
TABLE III COMPARISON OF THE COATING MASS REQUIREMENTS FOR HOT DIP GALVANIZED PRODUCTS (CSA SPECIFICATION G164-M)

| Classification of Material | Minimum Mass of Zinc Coating | Equivalent Minimum Thickness ¹ um |
|---|------------------------------|---|
| | g/m ² | (microns) |
| Castings; Iron and Steel | 550 | 78 |
| 2. Rolled, Drawn, Pressed and Forged Steel Articles | | |
| (except Classifications 3, 4 and 5 listed below) | | |
| 1 mm and up to but not including 2 mm | 260 | 37 |
| 2 mm and up to but not including 3 mm | 400 | 57 |
| 3 mm and up to but not including 4 mm | 500 | 71 |
| 4 mm and up to but not including 5 mm | 560 | 80 |
| 5 mm thick and heavier | 610 | 87 |
| 3. Screws, Bolts, Nuts, Rivets, Nails | | |
| and similar fasteners 10 mm and under in diameter | | |
| Washers | | |
| 5 to 6 mm thick | 260 | 37 |
| 4. Screws, Bolts, Nuts, Rivets, Nails | | |
| and similar fasteners over 10 mm and up to 12 mm diameter | | |
| Washers | | |
| 5 to 6 mm thick | | |
| | 300 | 42 |
| 5. Bolts, Nuts, and Threaded Fasteners | | |
| over 12 mm diameter | | |
| Washers | | |
| Over 6 mm thick | 460 | 65 |

NOTES:

- (1) Based upon mathematical calculations, 100 g of zinc per square meter of surface corresponds to a coating thickness of 14.3 um.
- (2) In the case of products galvanized after being assembled from various material classifications listed in Table III, the coating mass of each class shall be as shown in Table III.









Style # HF7-7041 Filter Fabric Specifications

| Fiber : | Polyester* |
|---------------------|----------------------------|
| Color: | White |
| Count : | 64 X 24 (per inch) |
| Weave: | 6 X 2 Modified Satin |
| Warp Diameter : | 500 Microns |
| Weft Diameter : | 800 Microns |
| Weight: | 38.9 (oz. per square yard) |
| Tensile Strength : | 1560 (lbs/inch) |
| Air Permeability : | 385 CFM |
| Water Permeability: | 345 (mm3/mm2/S) |
| Thickness: | .083" |
| Micron Opening : | 0 X 325 |
| Micron Retention : | 260 |
| Open Area : | 19% |

* Constructed of special polyester monofilaments that have propriety additives offering enhanced cake release and resistance to abrasion.

Operate filter belt (bottom) 10-15 psi higher than milling belt (top)







POLYMER INJECTION POINT LOCATION IN SLUDGE PIPING SYSTEM

General Notes

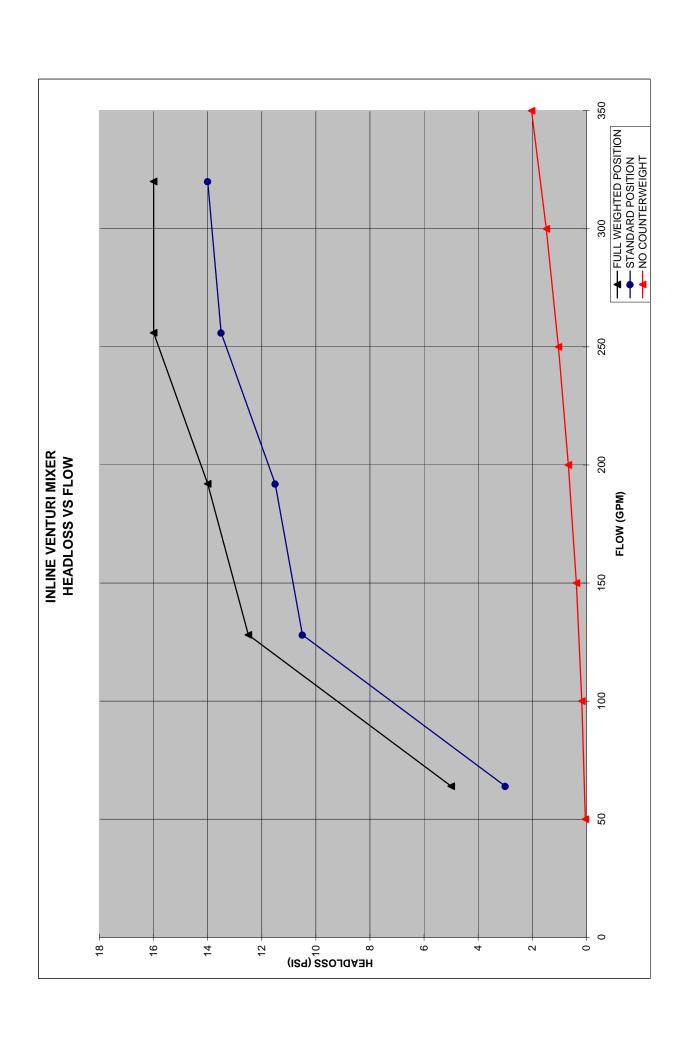
Customer and Engineer are advised that the performance of the dewatering equipment is affected by the location of the polymer injection point.

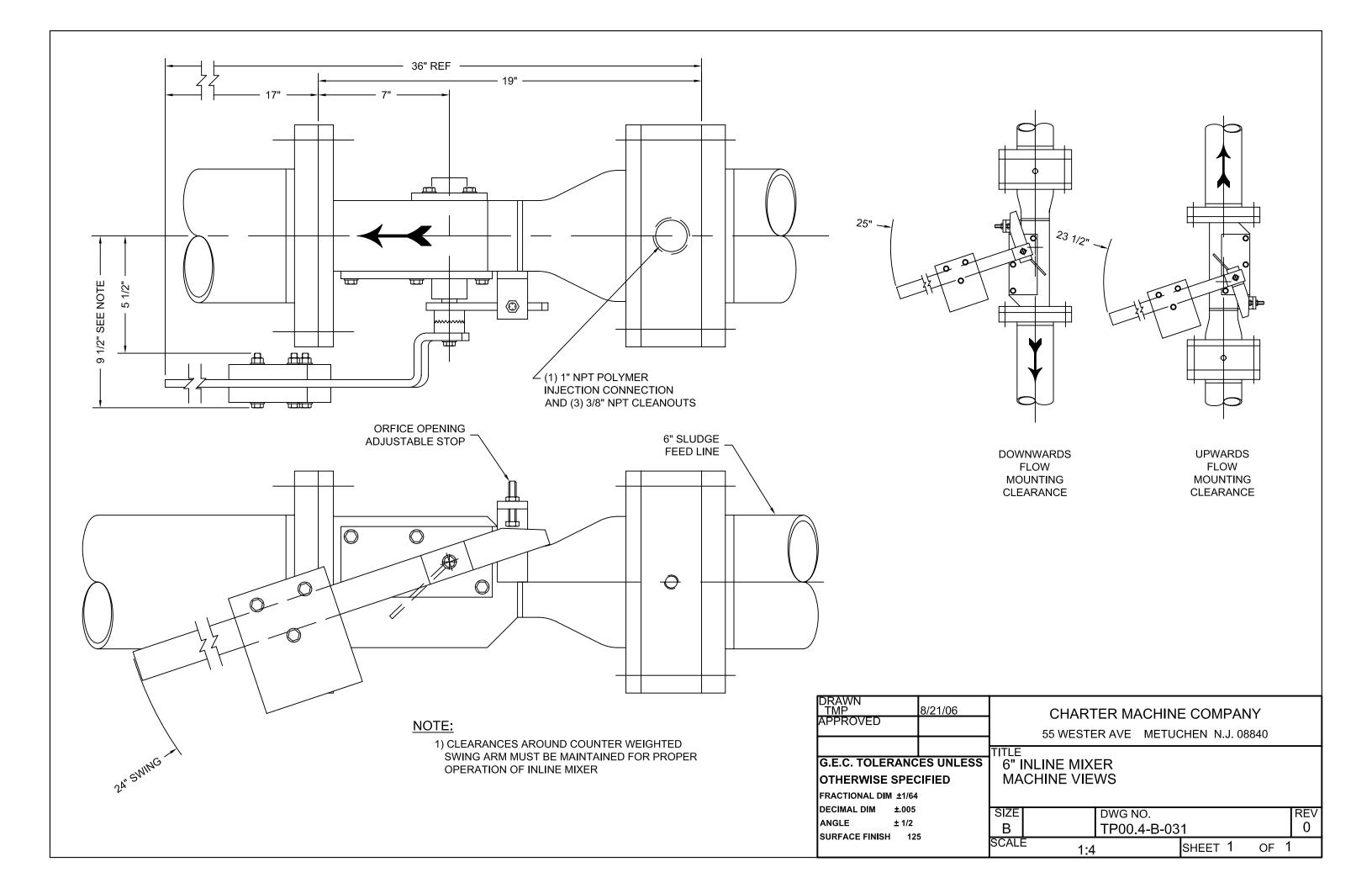
Final location of the polymer injection point and mixer assembly can only be determined based upon actual testing of the dewatering system. Due to the variability of process parameters in any installation, Charter Machine recommends provisions be made in the sludge feed piping to allow location of the polymer injection points and mixer assembly at the following locations:

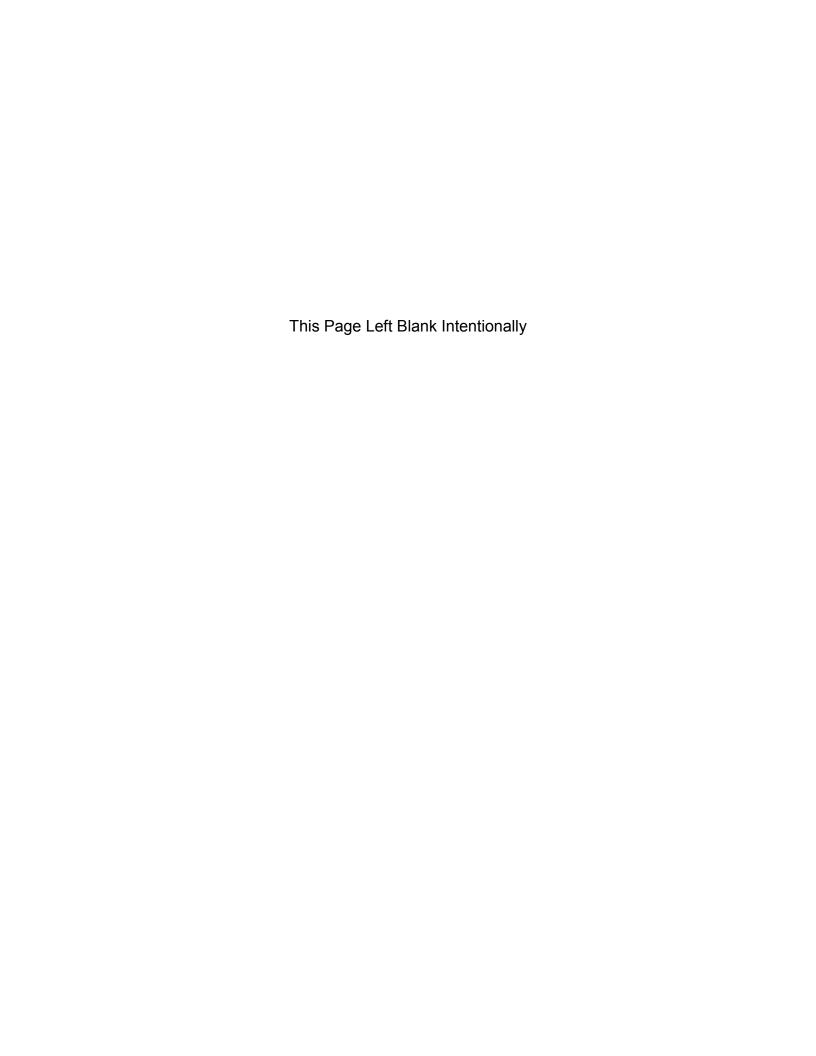
- a. Approximately 15 to 20' prior to the inlet of the dewatering equipment.
- b. Approximately 30 to 40' prior to the inlet of the dewatering equipment.
- c. Approximately 45 to 60' prior to the inlet of the dewatering equipment .
- d. If practical, at the sludge pump inlet.

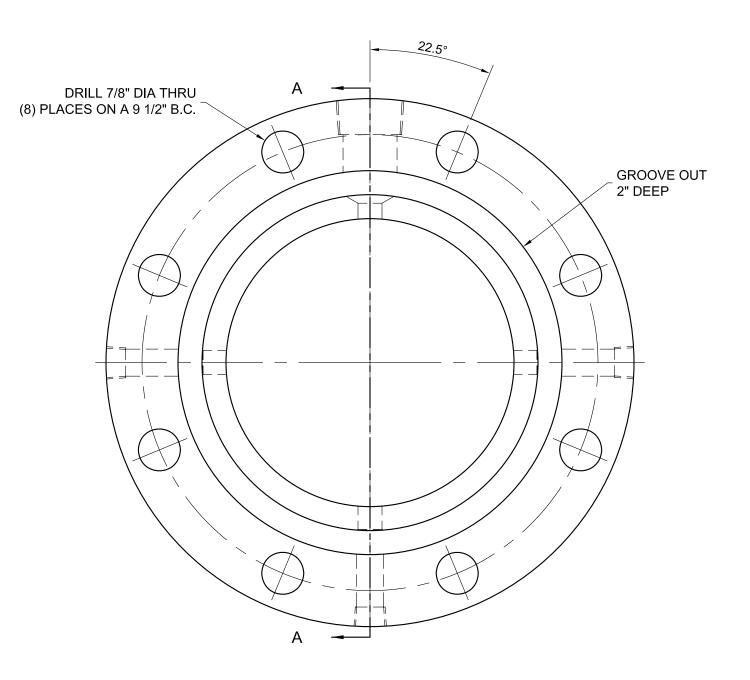
A 6" flanged polymer mixer assembly will be supplied. The mixer assembly is 19" long. The mixer assembly should be located at a convenient point in the sludge line, where a flanged connection would typically be installed.

Charter Machine requests that the polymer feed line be plumbed to each of the potential polymer injection points and that a ball valve be installed at each injection point. Upon start-up, the polymer injection ring and mixer assembly shall be moved to determine the best location for polymer application and the amount of mixing required for the particular sludge. Any unused polymer injection locations can be isolated from the sludge line and used as polymer sampling ports if so desired.

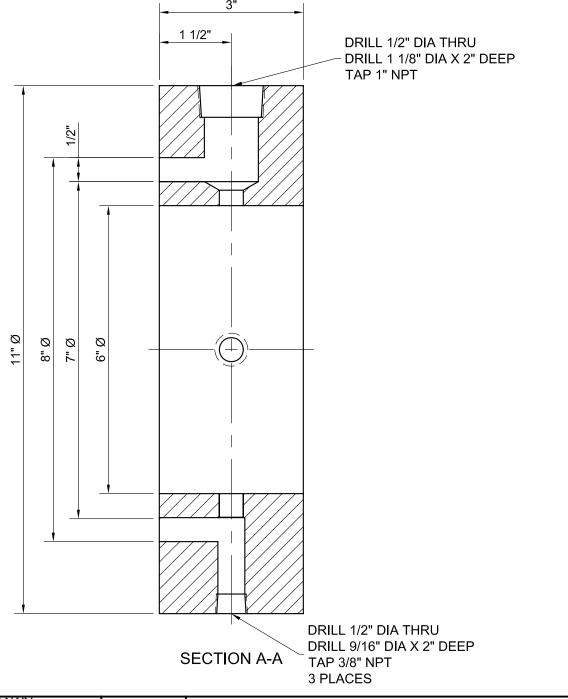








| | | Parts List | | |
|------|-----|---------------------|----------|--------|
| ITEM | QTY | DESCRIPTION | MATERIAL | WEIGHT |
| | | | | (LBS) |
| 1 | 1 | PLATE- 3" X 11" DIA | UHMW | 6.0 |



DRAWN
TMP
8/21/06
APPROVED

CHARTER MACHINE COMPANY
55 WESTER AVE METUCHEN N.J. 08840

G.E.C. TOLERANCES UNLESS
OTHERWISE SPECIFIED

FRACTIONAL DIM ±1/64
DECIMAL DIM ±.005

ANGLE ± 1/2
SURFACE FINISH 125

TITLE
6" INLINE MIXER
POLYMER INJECTION RING

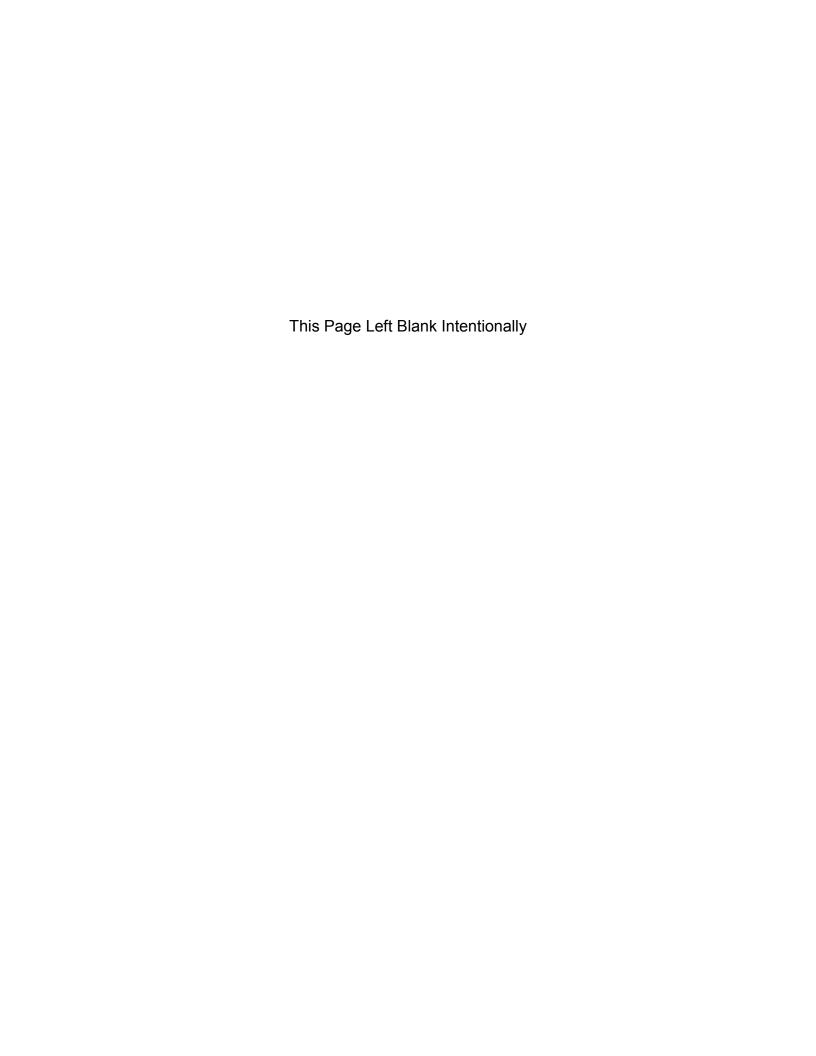
 SIZE
 DWG NO.
 REV

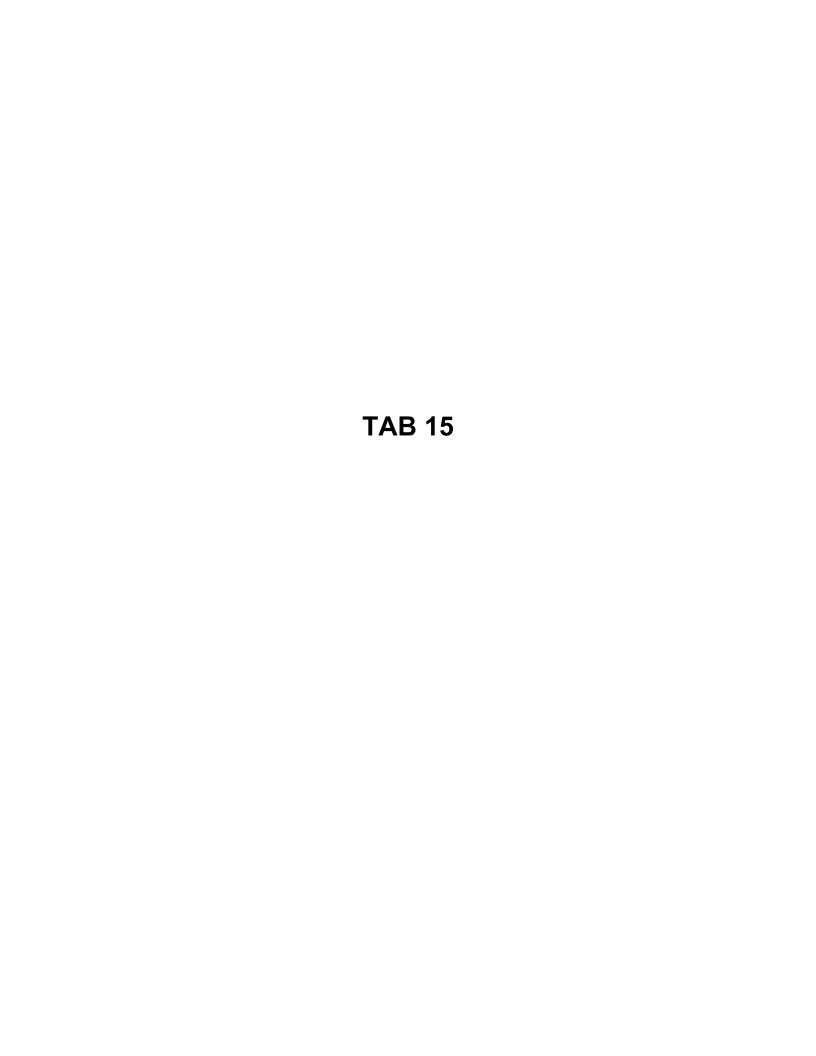
 B
 TP00.4-B-014
 0

 SCALE
 1:4
 SHEET 1 OF 1

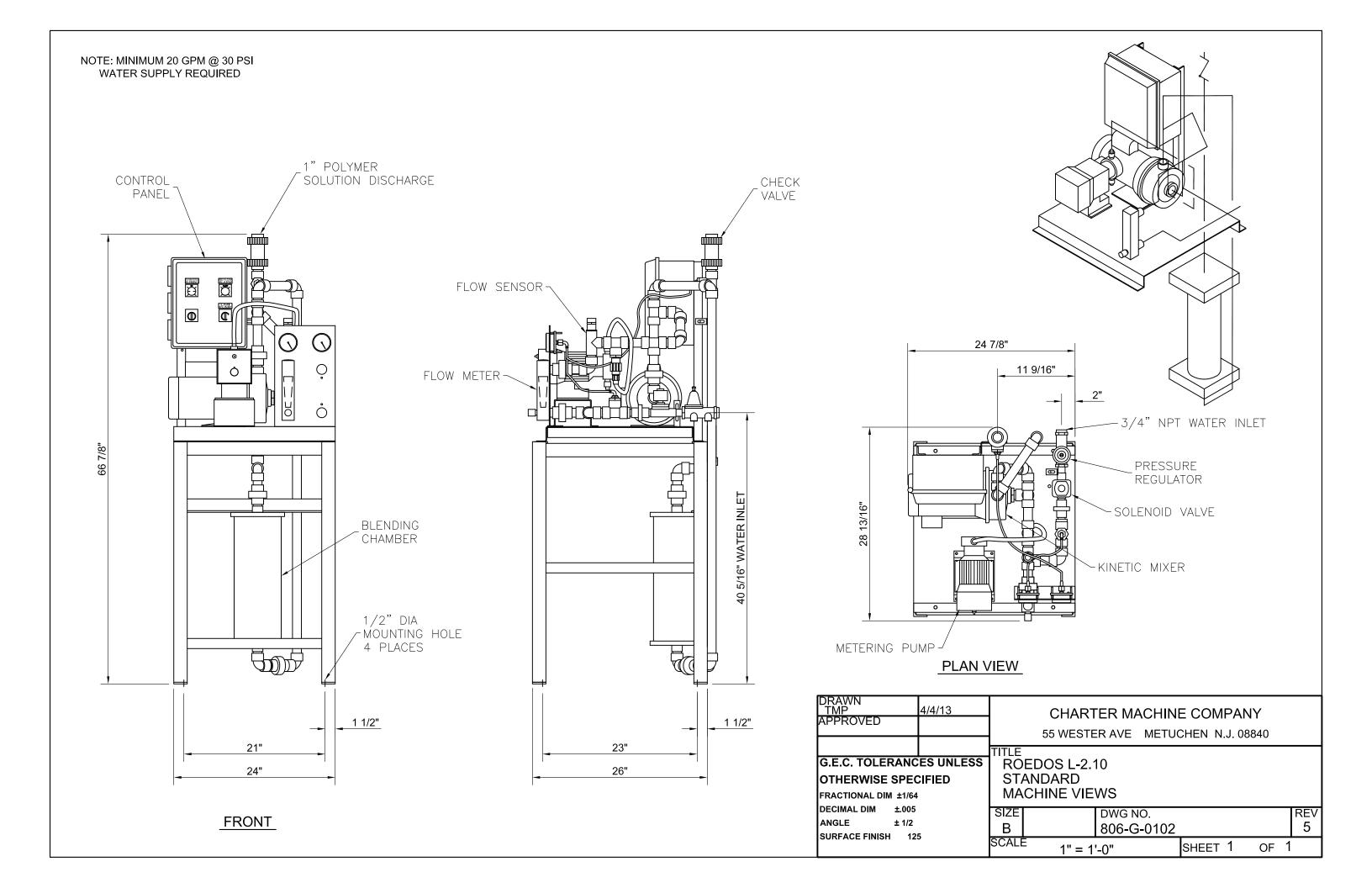
GENERAL NOTES:

1. BREAK ALL SHARP EDGES AND REMOVE ALL BURRS.











DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

SPECIFICATIONS POLYMER PREPARATION SYSTEM

ROEDOS MODEL L-2.10

CHARTER MACHINE COMPANY

ROEDOS L-2.10 POLYMER SYSTEM SPECIFICATION

Part 1 – General

1.01 Description of Work

- A. The Polymer preparation/feed unit shall be capable of automatically metering, diluting, activating and feeding an emulsion polymer with water.
- B. The system shall be capable of controlling separately the water flow and the polymer injection dosage.
- C. The polymer equipment shall be furnished as a complete assembled unit to the Contractor, complete with 304 stainless steel stand.
- D. The polymer unit shall be furnished and supplied as an integrated component of the sludge processing equipment.

1.02 Quality Assurance

- A. All equipment furnished under this section shall be the product of a manufacturer who has a minimum of ten (10) years experience in the design and manufacture of polymer systems. The equipment shall be designed, constructed and installed in accordance with the best practices and methods.
- B. All equipment and controls specified in this section shall be furnished by a single supplier who shall assume full responsibility for the proper operation of the complete polymer system.
- C. Any alternate equipment offered that differs from these specifications and drawings shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc., required to accommodate the equipment shall be made at no additional cost to the owner, be the responsibility of the contractor and shall be approved by the engineer.

1.03 Submittals

A. Submit copies of material required to establish compliance with this section. Submittals shall include the following as a minimum:

- 1. Drawings showing all details of construction, dimensions, weights and anchor bolt locations
- 2. Descriptive literature, catalogs or bulletins of the equipment.
- Bill of materials.
- 4. Complete piping and wiring diagrams, control schematics and suitable control panel outline drawings.
- 5. Manufacturers warranty for the polymer system including all associated auxiliary equipment that is incorporated to provide the complete operating system.
- B. Operation and maintenance manuals shall be provided. The manuals shall be prepared as regarding this installation and shall include all required cut sheets, drawings, equipment lists and descriptions that are required to properly operate and maintain the system.

1.04 Warranties

A. All equipment provided in this specification shall be warranted against defects in material and workmanship for eighteen (18) months after delivery or twelve (12) months after acceptance whichever comes first. Damages due to makeup water particulates will not be considered as a warranty defect and will be the responsibility of the owner.

Part 2 – Products

2.01 Manufacturers

Charter Machine Company; Model L-2.10

2.02 System Description

- A. Water Control (Potable Water)
 - 1. Make up water flow shall be variable and measurable by means of a control valve and a sight glass rotometer.
 - 2. Make up water flow capacity shall be 2-20 gpm provided at 30 psi minimum.

- 3. The inlet stream shall have an electronic flow sensor with immersed in-line element capable of transmitting a signal for a low/no flow alarm. Element shall be removable without plumbing disassembly.
- 4. Unit shall have an electric solenoid valve for on/off control of dilution water flow.
- 5. Water supply shall be potable water.
- B. Polymer Make-up Pump (LMI-C131-25HV, 0-8GPH)
 - 1. A polymer make-up pump shall be integrated in the system. The pump shall be a diaphragm electrical pulsation type, with separate speed and stroke controls.
- C. Multi-zone Mixing Chamber (High Energy)
 - Polymer shall be injected in the water stream by the feed pump to a kinetic mixing chamber to create a thorough mixing energy. The design shall include a motor driven impeller to create a high impact energy and low fluid shear. Solution shall undergo a tapered mixing intensity slope as it passes through a second recovery zone. Polymer activation efficiency shall be consistent over the entire dilution water range.
 - 2. A portion of the mixed polymer is then re-circulated through the mixing chamber ensuring optimum mixing has occurred.
 - 3. A transparent section after the mixing chamber shall be provided to observe the solution consistency.
- D. Multi-Zone Acrylic Polymer Blending Chamber (Low Energy)
 - 1. The mixed polymer solution is then transferred to an exclusive acrylic blending chamber allowing the pre-mixed polymer solution to be gently mixed and provide additional retention time to achieve the highest performance.

E. Assembly and Frame Work

- 1. All components and parts shall be of corrosion resistant construction.
- 2. All sheet metal work and frame assemblies shall be of type 304 stainless steel.

F. Controls

- 1. A local-off-remote switch for the mixing chamber shall be provided.
- 2. A hand-off-auto switch for the polymer injection pump shall be provided.
- 3. The system shall be provided with positive flow logic to signal an alarm in the event of low dilution water flow. This alarm will disable the polymer injection pump from operating when the injection pump is run in the automatic mode.
- 4. The polymer preparation system shall be capable of remote start/stop operation.
- 5. A speed potentiometer for the polymer make-up pump speed rate shall be provided.
- 6. All controls are to be mounted in a NEMA 4X FRP enclosure and wired directly to its components. A common power feed cord (10 ft. min) with a standard male plug for a 120V, 20-amp receptacle shall be furnished. (*Receptacle by others*)

Part 3 – Service

3.01 Field Service

A. The manufacturer shall include the services of a factory trained field engineer for the purposes of installation inspection, equipment start-up, polymer selection, performance testing and training of plant personnel regarding proper operation and maintenance of the equipment.

B. The Contractor will coordinate date for the initial start-up and field test. The Contractor shall ensure that all electrical, instrumentation and controls necessary to operate and document performance of the pumping units is functional at the time of startup.

END OF SECTION

KING INSTRUMENT COMPANY

12700 Pala Drive, Garden Grove, CA 92841

PANEL-MOUNT ACRYLIC ROTAMETER HORIZONTAL CONNECTION



This meter is machined from a solid acrylic block. The float is rod guided. A metering valve is also supplied. The meter body has white screen printed back, and rear inlet / outlet ports.

CAPACITIES

Water - 20 GPM

SCALE LENGTH

4" (100 mm)

PRESSURE / TEMPERATURE

125 PSIG / 130°F Water

PERFORMANCE

Full Scale Accuracy – ±5% Repeatability – 1%

ORDER INFORMATION

ACRYLIC TUBE PANEL MOUNTED ROTAMETER, WATER, With Valve

RYAN HERCO NUMBER - 5829-244

KING INSTRUMENT NUMBER - 7520

PART NUMBER – 025-326-0165

MATERIALS

| PART | MATERIAL |
|-----------------|---------------------|
| Metering Tube | Cast Acrylic |
| Float | 316 Stainless Steel |
| Guide Rod | 316 Stainless Steel |
| End Connections | 1" MPT PVC |
| O-Rings | EPR |
| Metering Valve | Brass |

DIMENSIONS

STYLE 6C BLOCKS

A - 9 1/8"

B - 1 3/4"

C - 1 13/16"

D - 87/8"

 $E - 1 \frac{1}{4}$ "

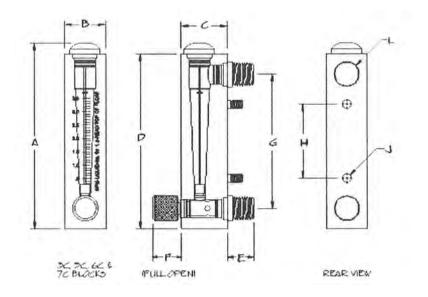
F - 17/8"

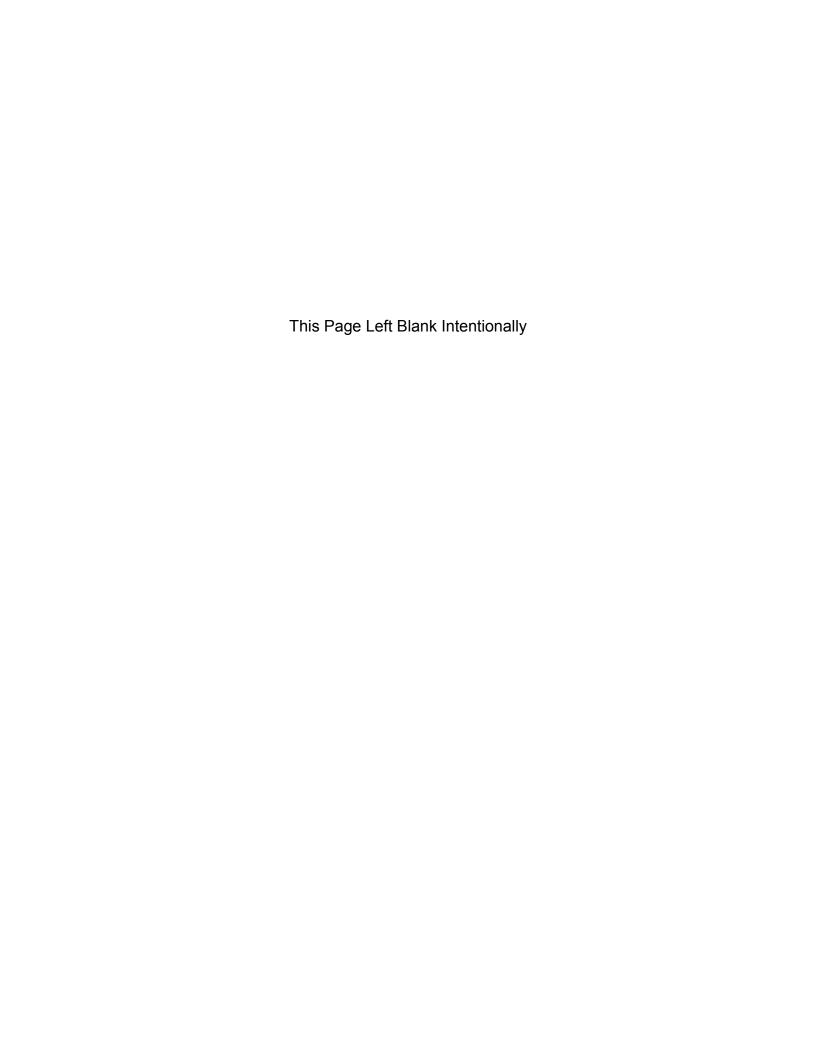
 $G - 6 \frac{1}{2}$ "

H - 4"

J - 1/4"

L - 13/8"





Bourdon Tube Pressure Gauge Stainless Steel Construction Model 21X.53

WIKA Datasheet 21X.53

Applications

- Intended for adverse service conditions where pulsating or vibration exists (with liquid filling)
- Hydraulics & compressors
- Suitable for gaseous or liquid media that will not obstruct the pressure system

Special Features

- Vibration and shock resistant (with liquid filling)
- Stainless steel case
- Pressure ranges up to 15,000 psi



Bourdon Tube Pressure Gauge Model 21X.53

Standard Features

Design

ASME B40.100 & EN 837-1

Sizes

2", 21/2" & 4" (50, 63 & 100 mm)

Accuracy class

2" & 2½": ± 2/1/2% of span (ASME B40.100 Grade A)
4": ± 1% of span (ASME B40.100 Grade 1A)

Ranges

Vacuum / Compound to 200 psi Pressure from 15 psi to 15,000 psi Pressure from 15 psi to 10,000 psi - 2" size or other equivalent units of pressure or vacuum

Working pressure

2 & 2½": Steady: ¾ full-scale value

Fluctuating: 2/3 full-scale value Short time: full-scale value

4": Steady: full-scale value

Fluctuating: 0.9 x full-scale value Short time: 1.3 x full-scale value

Operating temperature

Ambient: -40°F to +140°F (-40°C to +60°C) - dry

-4°F to +140°F (-20°C to +60°C) - glycerine filled -40°F to +140°F (-40°C to +60°C) - silicone filled

Medium: +140°F (+60°C) maximum

Temperature error

Additional error when temperature changes from reference temperature of 68°F (20°C) $\pm 0.4\%$ for every 18°F (10°C) rising or falling. Percentage of span.

Weather protection

Weather tight (NEMA 4X / IP 65)

Pressure connection

Material: copper alloy

Lower mount (LM) or center back mount (CBM) - 2" & 21/2" Lower mount (LM) or lower back mount (LBM) - 4"

 $\frac{1}{2}$ NPT, $\frac{1}{4}$ NPT or $\frac{1}{2}$ NPT limited to wrench flat areaABS (2"

& 21/2") and white aluminum (4")



Bourdon tube

2½" Size- Material: Copper alloy
30" Hg (VAC) to 800 psi - C-type (soldered)
1000 psi to 15,000 psi - helical type (soldered)
Changes to stainless steel at 7,500 psi brazed
4" Size- Material: Copper alloy ≤ 1,000 psi
316 stainless steel ≥ 1,500 psi
30" Hg (Vac) to 1,000 psi- C-type (soldered)
1,500 psi to 15,000 psi- helical type (brazed)
Changes to stainless steel at 1,500 psi

Movement

Copper alloy

Dial

White ABS (2" & 21/2") and white aluminum (4")

Pointer

Black aluminum

Case

304 stainless steel with vent plug and stainless steel crimp ring. Suitable for liquid filling.

Case connection sealed with O-ring, (O-ring material dependent on the case fill):

- 2½": EPDM O-ring for Glycerine case fill; Viton O-ring for Silicone fill
- 4": EPDM O-ring for Glycerine or Silicone case fill; Viton
 O-ring for Halocarbon or Fluorolube fill

Window

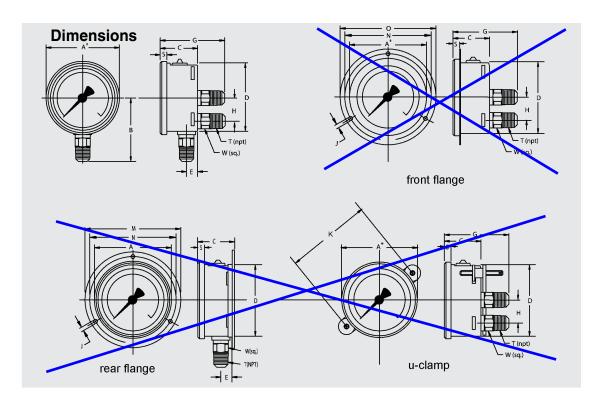
Polycarbonate with Buna-N gasket

Case fill

Glycerine 99.7% - Type 213.53

Optional extras

- Brass restrictor
- Stanless steel front or rear flange 21/2" & 4"
- Zinc-plated steel or SS U-clamp bracket (field installable)
- External zero adjustment (2½" only)
- Red drag pointer or mark pointer
- Silicone or Fluoroube case filling
- Special corrections limited to wrench flat area
- Custom dial layout
- Other pressure scales available
 - bar, kPa, MPa, kg/cm² and dual scales



| Siz | ze | | | | | | | | | | | | | | | | | | |
|-----|--------------|----|---------------|------|------|---------------|---------------|------|------|------|-----------|---------------|----------------|---------------|------|-------------|----------------|----------|--------|
| | | | Α | В | С | D | Е | G | Н | | K | М | Ν | 0 | S | Т | W | Weight | |
| 2 | " # | nm | 55 | 48 | 30 | 50 | <u> 12</u> | 53 | - | 3.6 | <u>72</u> | 71 | 60 | 17 | 5.5 | | 1 4 | 0.27 lb. | dry |
| | ir | n | 2.17 | 1.89 | 1.18 | 1.97 | 0.47 | 2.09 | - | 0.14 | 2.83 | 2.80 | 2.36 | 2.80 | 0.22 | 1/4" | 0.55 | 0.33 lb. | filled |
| 21/ | <u>ʻe" m</u> | nm | 69 | 54 | 32 | 62 | 13 | 54 | - | 3.6 | <u>72</u> | 88.1 | 75 | 85 | 6.5 | | 1 4 | 0.36 lb. | dry |
| | in | 4 | 2.69 | 2.13 | 1.26 | 2.45 | 0.51 | 2.13 | - | 0.14 | 2.83 | 3.47 | 2.95 | 3.35 | 0.26 | <u>1/4"</u> | 0.55 | 0.44 lb. | filled |
| 4 | <u>"</u> # | nm | 107 | 87 | 48 | 100 | 15.5 | 79.5 | 30 | 4.8 | 109 | 132 | 116 | 132 | 8 | | 22 | 1.10 lb. | dry |
| | ir | 7 | 4.21 | 3.43 | 1.89 | 3.91 | 0.61 | 3.13 | 1.18 | 0.19 | 4.29 | 5.20 | 4.57 | 5.20 | 0.31 | 1/2" | 0.87 | 1.76 lb. | filled |

Note: For 1/4" NPT connections on 4" gauges, reduce B dimension by 5mm/0.2"

Recommended panel cut-out:

2"- U-clamp: 51mm front flange: n/a 2½"- U-clamp: 63mm front flange: 65mm front flange: 104mm front flange: 104mm front flange: 104mm

WIKA Datasheet 21X.53 · 12/2011



WIKA Instrument Corporation

1000 Wiegand Boulevard Lawrenceville, GA 30043-5868 Tel: 888-WIKA-USA • 770-513-8200

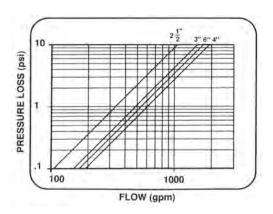
Fax: 770-338-5118 E-Mail: info@wika.com www.wika.com



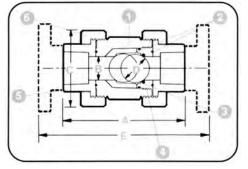
BALL CHECK VALVES

Hayward Plastic "True Check" Ball Check Valves prevent reversal of flow in piping systems. They are ideal where backflow could potentially cause damage to pumps, filters, or process equipment. Line pressure unseats the solid plastic ball to open the valve. When inlet flow ceases, the back pressure seats the ball on a special square cut elastomer seat, thus stopping back flow.

NOTE: Check valves should be installed a minimum of 10 pipe diameters away from pump.







FEATURES

Safe Block Design
Square cut seating ring
Horizontal or vertical installation
Seats with minimum back pressure
Free floating ball never seats in same
position twice

PARTS LIST

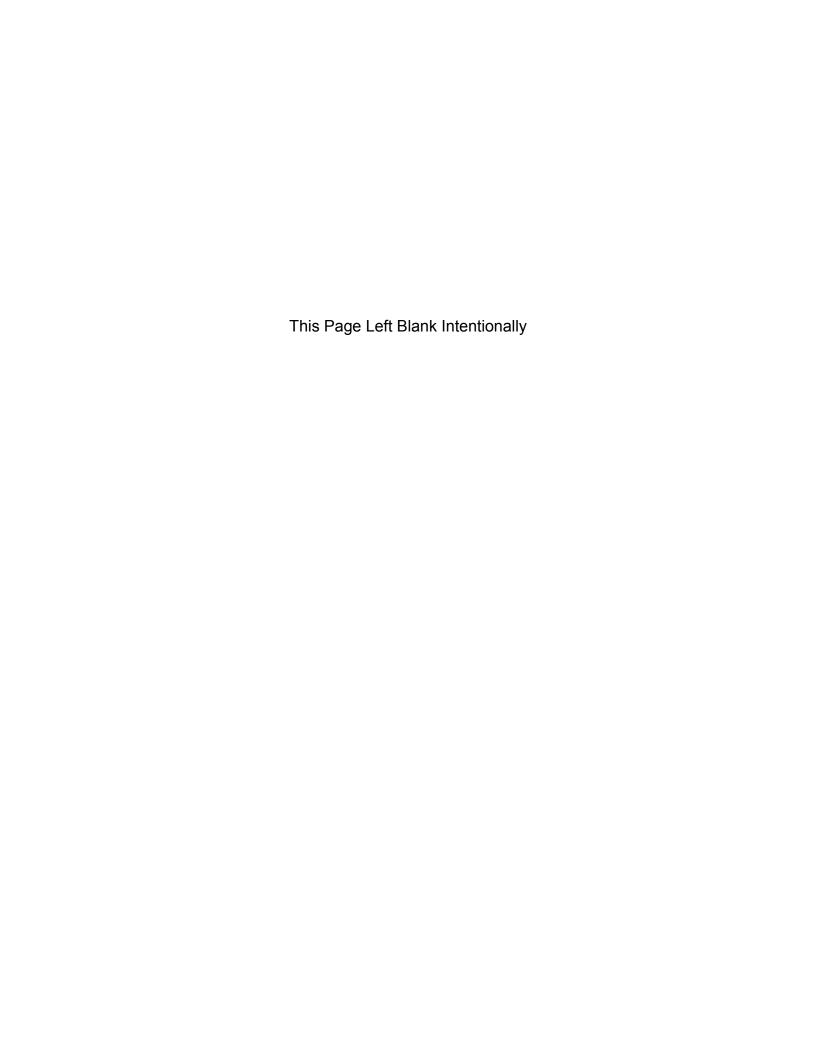
- 1 Body
- 2 O-Ring Seals
- 3 Square Cut Seal
- 4 Seal Retainer
- 5 End Connector
- 6 Union Nuts

Dimensions

| Size | Α | В | С | D | E | F | G | Weight |
|------|------|------|------|------|------|------|------|--------|
| | | | | | | | | |
| 1" | 5.25 | 1.00 | 3.00 | 1.25 | 7.75 | 5.88 | 2.88 | 1.25 |
| | | | | | | | | |
| | | | | | | | | |

Material; PVC End Connection Socket Seal EPDM

Pressure Rating 150 psi @ 70° F non-shock



ASCO Red-Hat II Series 8210 2 WAY PILOT OPERATED General Service Solenoid Valves Brass Bodies



Specifications

Solenoid Enclosures: Valves listed in this series have either Red-Hat II molded epoxy solenoids. Red-Hat II valves are identified by the change letter "G" in their catalog numbers.

Standard Enclosures:

Red-Hat II – Type Nema 4X Combination General Purpose **Electrical: Standard Voltages** 24, 120, 240, 480 volts, AC, 60 Hz (or 110, 220 volts, AC, 50 Hz)

Coil: Continuous duty molded Class F.

Nominal Ambient Temperature

Ranges: Red Hat II Valves/AC Construction: 32°F to 125°F

Valve Parts in Contact with Fluids:

Body – Brass Seals and Discs – Buna N Disc Holder – Nylon Core Tube – 305 s.s. Core and Plugnut – 430 F s.s. Springs – 302 s.s. Shading Coil – Copper Approvals: CSA certified, UL listed as indicated

SPECIFICATIONS

| | | | | Ope | rating P | ressure Di (psi) | fferential | Max Fluid | Standard So Red-Ha | olenoid End t II – Type | | Watt Rating |
|------------------|--------------------|------------------|-----------------|--------------|----------------------|---------------------|---------------------------|----------------|-----------------------|----------------------------|---------------|----------------------------|
| Pipe Size | Part Number | Orifice Size | Cv Flow | Min | | Max. A | С | Temp °F | Bra | ass Body | | / Class of Coil Ins. |
| (in) | | (in) | Factor | IVIII | Air- Inert Gas | Water | Light Oil @ 300 SSU | AC | Catalog Number | Constr Ref No. ← | UL Listing | AC |
| Normal | lly Closed (Closed | when de- | energized), | Buna-N | Seatin | g | | | | | | |
| 1/2 | 025-304-0100 | 5/8 | 4 | 5 | 200 | 150 | 135 | 180 | 8210G2 | 6D | θ | 6.1/F |
| 3/4 | 025-304-0102 | 3/4 | 6.5 | 5 | 250 | 150 | 100 | 180 | 8210G3 | 11D | Φ | 6.1/F |
| 1 | 025-304-0098 | 1 | 13 | 5 | 150 | 150 | 100 | 180 | 8210G4 | 12D | 0 | 6.1/F |
| 1 1/2 | 025-304-0099 | 1 1/4 | 22.5 | 5 | 150 | 150 | 100 | 180 | 8210G22 | 18D | • | 6.1/F |
| 2 | 025-304-0101 | 1 3/4 | 43 | 5 | 150 | 125 | 90 | 180 | 8210G100 | 20P | • | 6.1/F |

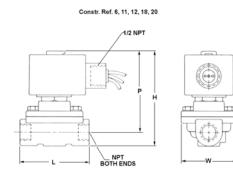
Notes: ← Letter "D" denotes diaphragm construction; "P" denotes piston construction

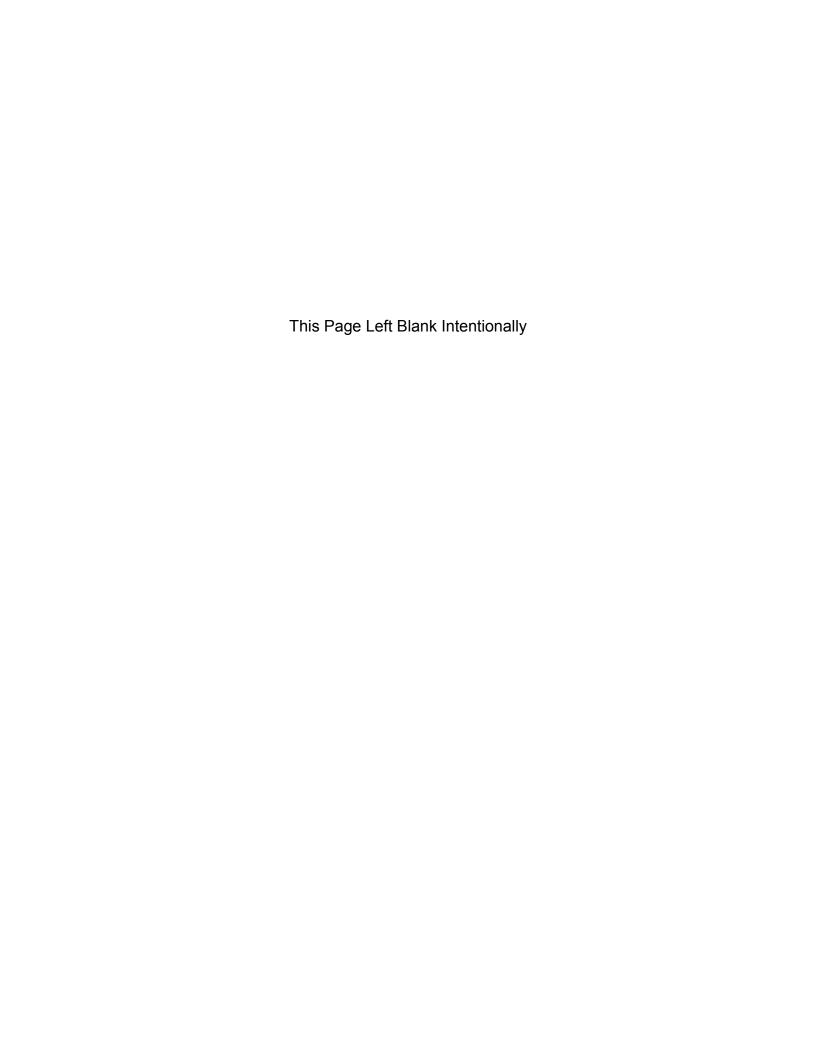
ELECTRICAL INFORMATION

| Standard | | ating and Ponsumption | ower | Spare Coil Part # |
|------------------------|--------|-----------------------|--------|-------------------|
| Coil and | | AC | | General Purpose |
| Class of Insulation | Watts | VA | VA | AC |
| modiation | vvalis | Holding | Inrush | |
| F | 6.1 | 16 | 40 | 238210 |

CONSTRUCTION DIMENSIONS

| 00110 | | | 1010110 | |
|---------------|------------------|------------------|---------|-------------------|
| Constr Ref # | Н | L | Р | W |
| 6 | 3 13/32 | 2 3/4 | 2 27/32 | 2 5/16 |
| 11 | 4 5/32 | 3 25/32 | 3 17/32 | 2 3/4 |
| 12 | 5 5/8 | 3 3/4 | 4 | 2 15/16 |
| 18 | 6 1/8 | 4-3/8 | 4 5/32 | 3 3/4 |
| 20 | 7.5/16 | 5 1/16 | 4.0/16 | 4 11/16 |







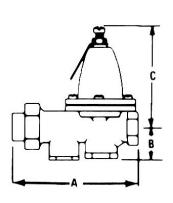
Watts Industries, Inc. 815 Chestnut Street North Andover, MA 01845

SERIES 25AUB WATER PRESSURE REDUCING VALVE

Bronze Body Pressure Regulator

For supply water pressures up to 300 lbs. and can be adjusted from 25 to 75lbs. The standard is 50 lbs. The by-pass feature incorporated into these valves accurately controls build-up of system pressure and thermal expansion by equalizing the system and the supply when the relief setting is in excess of available supply main pressure. NPT union inlet X female outlet. Max. temperature 160° F.

Renewable stainless steel seat. Stainless steel integral strainer. High temperature resisting reinforced diaphragm.



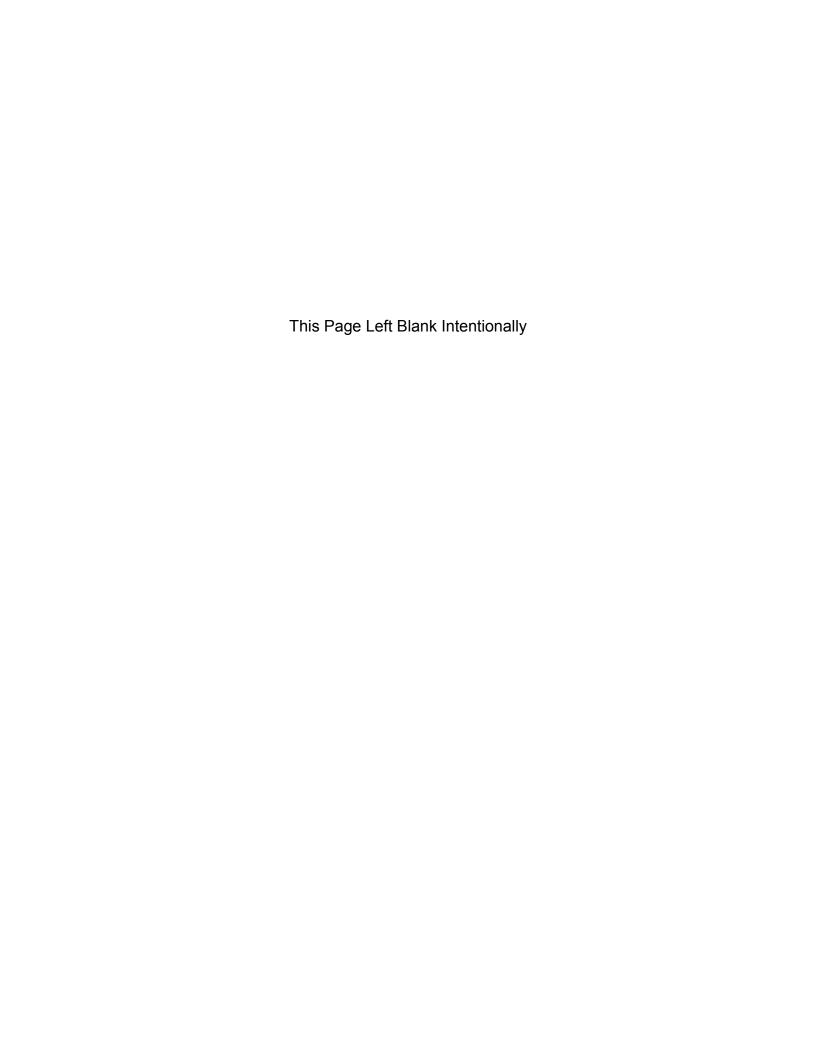


| Size (Inches) | A | В | С | Flow* (gpm) | Weight (lbs.) | Watts Part Number | Part Number |
|------------------|-------|-------|-------|----------------|---------------|----------------------|--------------|
| 3/4 | 5-1/2 | 1-1/4 | 3-7/8 | 25 | 3-1/2 | 3/4-25AUB | 025-124-0087 |
| 1 | 6 | 2 | 4 | 38 | 6 1/2 | 1-25AUB | 025-124-0085 |
| 1 1/2 | 9 | 2 1/4 | 5-1/2 | 60 | 10 | 1 1/2-25AUB-HP | 025-124-0086 |
| 2 | 9-1/4 | 3-1/4 | 5-1/2 | 85 | 15 | 2-25AUB-HP | 025-124-0088 |

^{*} Based on a difference of 50 lbs. or more between initial pressure and regulator lock-up. Where difference is less deduct 20% from capacity shown.

HP option –High pressure range 75-125 lbs. Set for 90 lbs. no flow pressure.

Series 25AUB meet the requirements of A.S.S.E. Std. 1003, ANSI A112.26.2, CSA Std. B356, Southern Standard Plumbing Code and are listed by IAPMO.



Gems Sensors, Inc.

One Cowles Road Plainville, CT 06062-1198



FS-400P SERIES – LOW COST UNITS FOR PLASTIC PIPING

Flow Rate Settings: 0.5 GPM or 2.0 GPM

Port Size: 1" IPS

Primary Construction Material: Clear PVC

Setting Type: Fixed

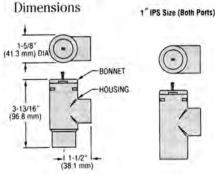
Designed for low cost flow/no flow monitoring. This series has a clear transparent PVC housing which is ideal for use where visual flow confirmation is desirable. These corrosion-resistant switches offer broad chemical compatibility. Only one moving part, their rugged construction offers long life with minimum maintenance. Ideal for water heating or purification, equipment cooling and general chemical processing use.

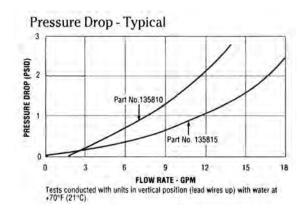
Specifications

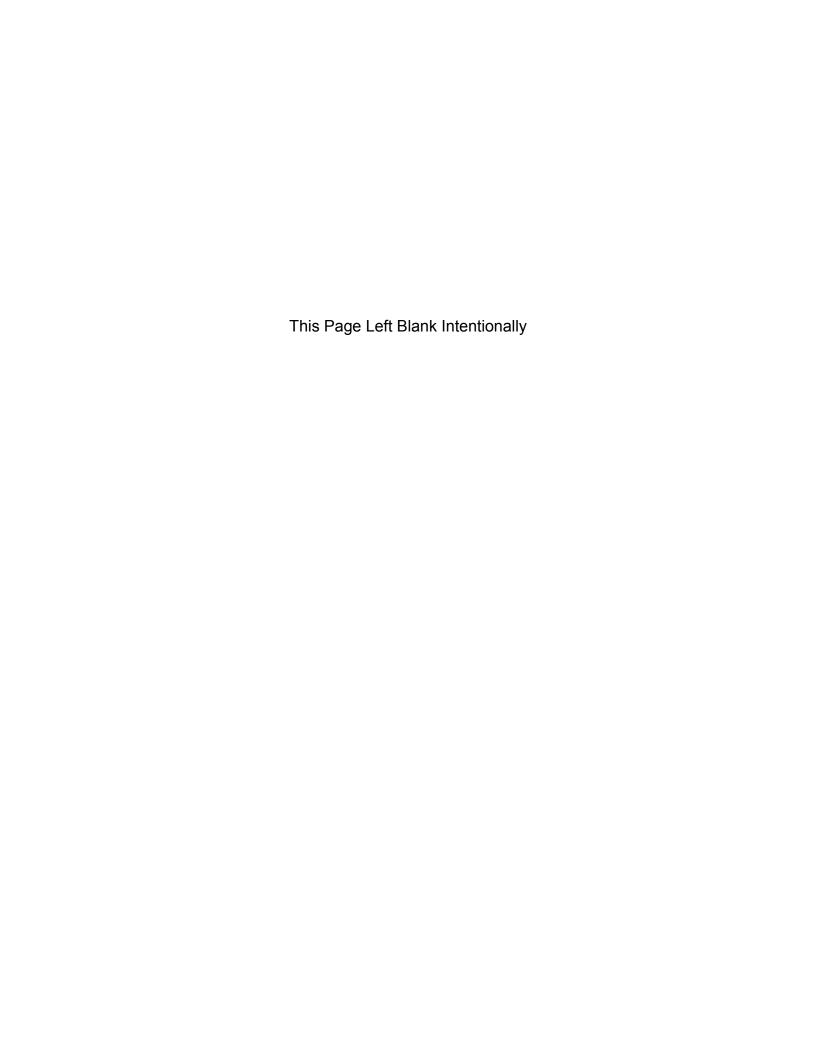
| Opecinications | |
|---|--|
| Materials Housing, Shuttle and Bonnet | PVC |
| O-ring | Buna N |
| Other Wetted Parts | Ероху |
| Operating | 120 PSIG @ +70°F to 100°F @ +21°C to 37.8°C |
| Pressure, Maximum | 50 PSIG @ +101°F to 120°F @ +38.3°C to 48.9°C |
| Operating Temperature, Maximum | +120°F (+48.9°C) |
| Set Point Accuracy | ±20% |
| Set Point Differential | 20% Maximum |
| Switch | SPST, 20VA N.O. @ No Flow |
| Inlet/Outlet | 1" IPS |
| Mounting Attitude | Vertical, Inlet Down |
| Electric Termination | No. 22 AWG, PVC lead wires |
| Actuation on Increasing Flow | 2.0 GPM ±20% |

Gems Part Number - 135815 Part Number - 025-326-0176









Specification Sheet

Series C

GENERAL

Chemical metering pumps shall be positive displacement, Liquifram $^{\text{m}}$ type pumps that are UL and CUL approved. Output volume shall be adjustable while pumps are in operation from zero to maximum capacity of:

```
C10, C70, C90 - 1.3 GPH (4.9 liters per hour)
C11, C71, C91 - 2.5 GPH (9.5 liters per hour)
C12, C72, C92 - 4.0 GPH (15.1 liters per hour)
C13, C73, C93 - 8.0 GPH (30.0 liters per hour)
C14, C74, C94 - 20.0 GPH (76.0 liters per hour)
C77 - 10.0 GPH (38.0 liters per hour)
C78 - 25.0 GPH (95.0 liters per hour)
```

Chemical metering pumps shall be capable, without a hydraulically backed diaphragm, of injecting solutions against pressures up to:

```
C10, C70, C90 - 300 psig (20.7 bar)
C11, C71, C91 - 150 psig (10.3 bar)
C12, C72, C92 - 100 psig (6.9 bar)
C13, C73, C93 - 60 psig (4.1 bar)
C14, C74, C94 - 25 psig (1.7 bar)
C77 - 80 psig (5.5 bar)
C78 - 30 psig (2.1 bar)
```

SERIES C1

Adjustment shall be by means of readily accessible dial knobs, one for changing stroke length and the other for changing stroke frequency (speed). Both knobs are to be located opposite the liquid handling end.

SERIES C7

Control of Series C7 metering pumps shall be selectable between internal and external pulsing by means of a 3-position center-off switch. Stroke length shall be adjustable by means of readily accessible dial knob. When in external pulsed mode, Series C7 units shall accept signals without the use of electrical timer or internal timer. Pressure capacity shall be adjustable to reduce noise, vibration and wear.

SERIES C9

Series C9 metering pumps shall have a clear liquid crystal display. Control shall be selectable between internal and external pulsing by means of a tactile keypad. Internal stroke frequency shall be adjustable from 1 stroke per hour to 100 strokes per minute. Pressure capacity shall be keypad adjustable to reduce noise, vibration and wear. Metering pump shall be capable of dividing or multiplying pulse inputs from 1 to 999 or responding directly or inversely to a 4-20mA input signal.

DRIVE

The pump drive shall be totally enclosed with no exposed moving parts. Solid state electronic pulser shall be encapsulated and supplied with quick connect terminals at least 3/16" (4.75 mm) wide. Electronics shall be housed in chemical resistant enclosure at the rear of the pump for maximum protection against chemical spillage. Electrical power consumption shall not exceed 87 watts under full speed and maximum pressure conditions. Pump weight shall not exceed 28 lbs (12.7 kg).

AUTOMATIC PRESSURE RELIEF

To eliminate need for pressure relief valve, LiquiframTM shall automatically stop pulsating when discharge pressure exceeds pump pressure rating by not more than 35%.

MATERIAL

Chemical metering pump housing shall be of chemically resistant glass fiber reinforced thermoplastic with a glass fiber reinforced polypropylene EPU carrier¹. All exposed fasteners shall be stainless steel. Chemical metering pump valves shall be ball type, with ceramic balls². Valve seat and seal ring shall be renewable by replacing the combination seat-seal ring³ or cartridge valve assembly. Pump head shall be of transparent acrylic⁴ material capable of resisting the pumped chemical. Fittings and connections at pump head shall be PVC⁵.

CHECK VALVES AND TUBING

A total of 16 ft (4.8 m) of polyethylene tubing shall be provided per pump complete with compression connections. A foot valve with integral one piece strainer shall be provided for the suction line, and an injection check/back pressure valve with 1/2" NPT male connection for the injection point. The injection check valve shall incorporate a dilating orifice which prohibits scale formation and accumulation of crystalline deposits.

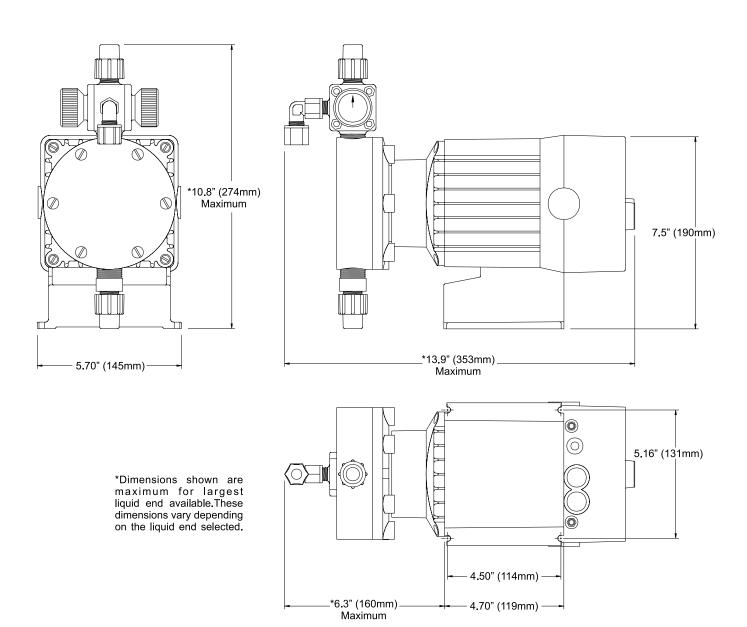
Notes:

- 1. With plastic coated cast iron EPU carrier for Series C77 and C78.
- 3. Hypalon®, PTFE, Viton® or Polyprel® may be specified
- 5. PVDF, Polypropylene, or Type 316 stainless steel may be specified. 6. 6 ft. polyethylene for the suction side only. 1/4" or 1/2" male pipe thread may be specified.
- 2. Type 316 stainless steel or PTFE may be specified.
- 4. PVC, polypropylene, or Type 316 stainless steel may be specified.
- 6. 6 ft. (1.8 m) of vinyl suction tubing may be specified in place of specified.



8 Post Office Square Acton, MA 01720 USA TEL: (978) 263-9800 FAX: (978) 264-9172 http://www.lmipumps.com







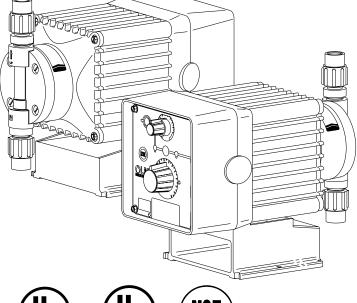
Configuration Data

Model **C92** 1 - **75HV**

Electronic Metering Pumps

Control & Output Code Manual Control Speed (stroking frequency) and stroke length manually adjustable. C10 -- 1.3 GPH (4.9 l/h) ... 300 psi (20.7 Bar) C11 -- 2.5 GPH (9.5 l/h) ... 150 psi (10.3 Bar) C13 --- 8.0 GPH (30 I/h) 60 psi (4.1 Bar) C14 ---- 20 GPH (76 l/n) 25 psi (1.7 Bar) Instrument Responsive/Manual Control Manual adjustment features of C1 Series plus switch conversion to external control for automatic systems. C70 -- 1.3 GPH (4.9 l/h) ... 300 psi (20.7 Bar) C71 --- 2.5 GPH (9.5 I/h) ... 150 psi (10.3 Bar) C72 --- 4.0 GPH (15.1 I/h) ... 100 psi (6.9 Bar) C73 - 8.0 CPH (30 l/h) 60 psi (4.1 Bar) (76 l/h) 25 psi (1.7 Bar) C74 --- 20 GPH -- 10 GPH (38 l/h) 80 psi (5.5 Bar) C78 --- 25 GPH (95 l/h) 30 psi (2.07 Bar) C90 --- 1.3 GPH (4.9 l/h) ... 300 psi (20.7 Bar) C91 --- 2.5 GPH (9.5 l/h) ... 150 psi (10.3 Bar) (30 l/h). C93 - 8.0 GPH ... 60 psi (4.1 Bar)

(76 l/h) 25 psi (1.7 Bar)









Voltage Code

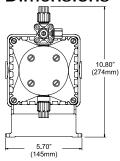
C94 --- 20 GPH

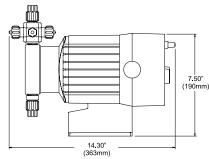
1 ------ 120 VAC US Plug
2 210 VAC US Plug
0 220 210 VAC DIN Plug
5 210 250 VAC, UK Plug
6 210 250 VAC, AUSTINZ Plug
7 220 210 VAC, SWISS Plug

Liquid End

See next page for complete liquid end specifications and selection.

Dimensions

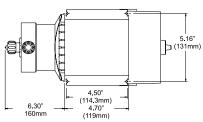




Specifications

| Series | Mir | kes Per nute ustable) Max | Stroke Length (Adjustable) Recommended Minimum | Average Input Power @ Max Speed | Shipping Weight |
|---|-----|------------------------------------|---|---------------------------------------|--------------------|
| C10, C70, C90 C11, C71, C91 C12, C72, C92 C13, C73, C93 C14, C74, C94 | 1 | 100 | 10% | 44 watts | 20 lbs (9.1 kg) |
| C77 C78 | 1 | 100 | 10% | 87 watts | 28 lbs (12.7 kg) |

^{*} Dimensions shown are maximum for largest liquid end available. These dimensions vary depending on the liquid end selected.





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Configuration Data & Materials of Construction

| | | | & Materials | | | | | | |
|--------------------|--------------------------|------------|--------------------------|---------------------|------------------------------|---------------------|------------|----------------------------|--------------------------------|
| Drive | Liquid | Size | | | of Construction | | | Tubing & Co | |
| Assembly | End No. | Code | Head & Fittings | Balls | Liquifram™ | Seal Ring | Accessory | Discharge | Suction |
| C90 🔲 - | | | | | | | | | |
| C70 🔲 - | 297 | 0.9 | 316 S.S. | 316 S.S. | Fluorofilm™ | 316 S.S. | | Pipe 1/4" | |
| C10 🔲 - | 94S** | 0.9 | PVC | Ceramic | Fluorofilm™ | PTFE | 4FV | Pipe 1/4" | NPT M |
| | 0/001 + | 4.0 | A 11 /DOO | T . | EL CL TM | D00 / D / 100 | 451/ | DE 0751 | 100 |
| | 360SI † | 1.8 | Acrylic/PGC | Ceramic | Fluorofilm™ | PGC / Polyprel® | 4FV | PE .375' | · O.D. |
| 004 🗔 | 361SL † | 1.8 | PGC/PGC | Ceramic | Fluorofilm™ | PGC / Polyprel® | 4FV | PE 375 | |
| C91 | 362SI [†] | 1.0 | PVDF / PVDF | Ceramic | Fluorofilm™ | PVDF/ Polyprel® | 4FV | PE .375' | |
| C92 | 363SI [‡] | 1.8 | PVDE / PVDE | Ceramic | Fluorofilm™ | PVDF/ PTFE | 4FV | PE .375' | |
| C71 - | 277 | 1.8 | 316 S.S. Acrylic/PVDF | 316 S.S. | Fluorofilm™ Hypalon® | 216 5.5. | 451/ | Pipe 1/4" | |
| C72 □ - | 71FS 71S [†] | 1.8 1.8 | Acrylic/PVC | Coromio | Hyparon i luorofilm™ | Hypalon® PTFE | 4FV 4FV | PE .5" O.D. PE .5" O.D. | Vinyl .5" O.D Vinyl .5" O.D |
| C12 | 7 13 † | 1.8 | PVC | Ceramic Ceramic | Fluorofilm | PTFE | 4FV 4FV | PE .5 U.D. | |
| CIZ 🛄 - | 74S** | 1.8 | PVC | Ceramic | Fluorofilm™ | PIFE | 4FV 4FV | Pipe 1/4" | |
| | 743 75HV | 1.8 | Polypropylene | 316 S.S. | Fluorofilm™ | PTFE | 4F V | | /inyl .938" O.I |
| | 75NV 75S † | 1.8 | Polypropylene | Ceramic | Fluorofilm™ | PTFE | 4FV | PE .5 O.D. \\ PE .5" | |
| | 70 | 1.8 | Acrylic/PP | 316 S.S. | Fluorofilm™ | Hypalon® | 41 V | | 6.b. /ipyl938" O. |
| | 79 | 1.8 | UHMW PE | Ceramic | Hypalon® | Hypalon® | | | Vinyl .5" 6.D |
| | 77 | 1.0 | OTHVIVV I E | Cerannie | гураюн | тураюн | I | 1 L .5 O.D. | VIIIYI .J O.B |
| | 310SI † | 3.0 | Acrylic/PGC | Ceramic | Fluorofilm™ | PGC / Polyprel® | 4FV | PE .375' | ' O.D. |
| | 311SI † | 3.0 | PGC/PGC | Ceramic | Fluorofilm™ | PGC / Polyprel® | 4FV | PE .375' | |
| İ | 312SI † | 3.0 | PVDF / PVDF | Ceramic | Fluorofilm™ | PVDF/ Polyprel® | 4FV | PE .375' | |
| C93 🔲 - | 313SI † | 3.0 | PVDF / PVDF | Ceramic | Fluorofilm™ | PVDF / PTFE | 4FV | PE .375' | |
| C73 🗖 | 20HV | 3.0 | Acrylic/PP | 316 S.S. | Fluorofilm™ | Hypalon® | | | /inyl .938" O. |
| C13 🔲 - | 20S** | 3.0 | Acrylic/PVC | Ceramic | Fluorofilm™ | Hypalon® | 4FV | PE .5" O.D. | Vinyl .5" O.D |
| <u></u> | 24 | 3.0 | PVC | Coramic | Fluorofilm™ | DTEE | | Pina 1/2" | NDT M |
| | 25HV | 3.0 | Polypropylene | 316 S.S. | Fluorofilm™ | PTFE | | PE .5" O.D. \ | /inyl .938" O. |
| 4 | 25P | 3.0 | Polypropylene | Ceramic | Fiuorofilm | PTFE | | Pipe 1/2 | |
| | 25T | 3.0 | Polypropylene | Ceramic | Fluorofilm™ | PTFE | | PE .5" | O.D. |
| | 26S** | 3.0 | PVC | Ceramic | Fluorofilm™ | Viton® | 4FV | PE .5" | |
| | 27 | 3.0 | 316 S.S. | 316 S.S. | Fluorofilm™ | PTFE | | Pipe 1/2" | |
| | 29 | 3.0 | UHMW PE | Ceramic | Fluorofilm™ | Hypalon® | | PE .5" | O.D. |
| | | | | | 1 | 1 | | I | |
| | 30 | 6.0 | Acrylic/PVC | Ceramic | Fluorofilm™ | PTFE | | PE .5" O.D | Vinyl .5" O.L |
| C94 🔲 - | 32 | 6.0 | PVDF | Ceramic | Fluorofilm™ | PTFE | | PE 5" | |
| C78 🔲 - | 34 | 6.0 | PVC | Ceramic | Fluorofilm™ | PTFE | | Pipe 1/2" | |
| C74 🔲 - | 35P | 6.0 | Polypropylene | Ceramic | Fluorofilm™ | PTFE | | Pipe 1/2" | |
| C14 🔲 - | 35T | 6.0 | Polypropylene | Ceramic | Fluorofilm™ | PTFE | | PE .5" | |
| | 36 | 6.0 | PVG | Ceramic | Fluorofilm™ | PIFE | | PE .5" | |
| | 37 | 6.0 | 316 S.S. | 316 S.S. | Fluorofilm™ | PTFE | | Pipe 1/2" | NPT M |
| | 20111/ | 2.0 | A II - /DD | 21/ 6.6 | Classic Class TM | I II I ® | Τ | DE ELOD 1 | #I 020II O |
| | 20HV 20S** | 3.0 | Acrylic/PP | 316 S.S. | Fluorofilm™ | Hypalon® | 451/ | PE .5" O.D. \ | /inyl .938" O. |
| - | | 3.0 | Acrylic/PVC | Ceramic | Fluorofilm™ | Hypalon® PTFE | 4FV | | Vinyl .5" O.D |
| C77 🔲 - | 24 25HV | 3.0 | PVC Polypropylene | Ceramic 316 S.S. | Fluorofilm™ Fluorofilm™ | PTFE | 1 | Pipe 1/2" PE .5" O.D. \ | <u>NPT M</u> /inyl .938" O. |
| C// 🔲 - | | 3.0 | | | Fluorofilm™ | PTFE | | | |
| } | 25P 25T | 3.0 | Polypropylene | Ceramic | Fluorofilm™ | PTFE | | Pipe 1/2" | |
| | 26S** | 3.0 | Polypropylene PVC | Ceramic Ceramic | Fluorofilm™ | Viton® | 4FV | PE .5" PE 5" | <u>υ.υ.</u> |
| | 265 | 3.0 | 316 S.S. | 316 S.S. | Fluorofilm™ Fluorofilm™ | PTFE | 4F V | Pipe 1/2" | U.D. |
| | 29 | 3.0 | UHMW PE | Ceramic | Fluorofilm™ | Hypalon® | | Pipe 1/2 PE .5" | |
| | L 7 | ა.0 | • | | e "I' to "P' To specify blac | | I | FE.3 | υ.υ. |

See front page for voltage code specifications.

specify 3FV, change 'S' to'T'.
Fluorofilm™ is a copolymer of PTFE and PFA.
Polyprel® is an elastomeric PTFE copolymer.

Output Information

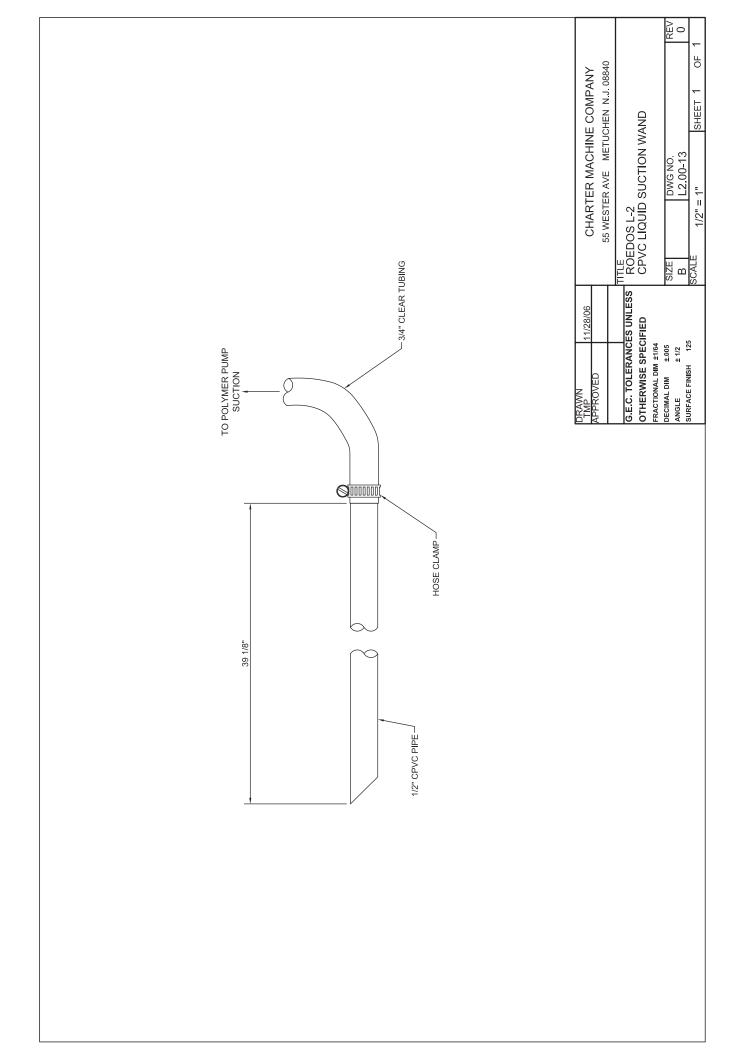
| | Gallons | oer Hour | Liters pe | er Hour | mL/cc pe | r Minute | mL/cc p | er Stroke | Maximum Injection | | |
|-----------------|---------|----------|-----------|---------|----------|----------|---------|-----------|-------------------|------------|--|
| Series | Min | Max | Min | Max | Min | Max | Min | Max | Pres | sure | |
| C10, C70*, C90* | 0.001 | 1.3 | 0.005 | 4.9 | 0.08 | 82 | 0.08 | 0.82 | 300 psi | (20.7 Bar) | |
| C11, C71*, C91* | 0.003 | 2.5 | 0.010 | 9.5 | 0.16 | 158 | 0.16 | 1.58 | 150 psi | (10.3 Bar) | |
| C12, G72*, C92* | 0.004 | 4.0 | 0.015 | 15.1 | 0.25 | 252 | 0.25 | 2.52 | 100 pci | (6.0 Par) | |
| C13, C73*, C93* | 0.008 | 8.0 | 0.030 | 30 | 0.51 | 505 | 0.51 | 5.05 | 60 psi | (4.1 Bar) | |
| C14, C74*, C94* | 0.020 | 20.0 | 0.076 | 76 | 1.20 | 1262 | 1.26 | 12.62 | 25 psi | (1.7 Dar) | |
| C77* | 0.010 | 10.0 | 0.038 | 38 | 0.63 | 631 | 0.63 | 6.31 | 80 psi | (5.5 Bar) | |
| C78* | 0.025 | 25.0 | 0.095 | 95 | 1.58 | 1577 | 1.58 | 15.77 | 30 psi | (2.07 Bar) | |

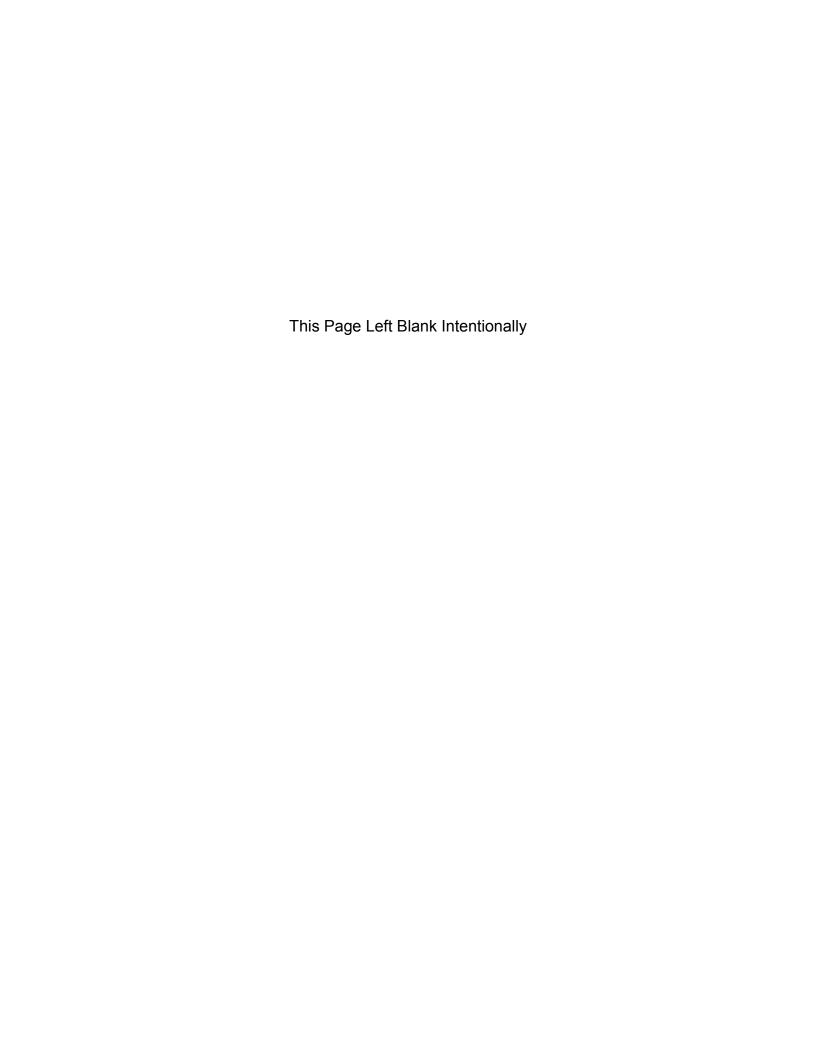
^{*}Minimum output is based on 1 stroke per minute and 10% stroke setting, minimum output can be reduced further in external mode. Series C9 pumps may be programmed for strokes per hour for lower outputs.

These Liquid Ends are available without a 4FV, simply drop the 'S' at the end of the Liquid End number to order the model without

To specify ¼" NPT male, change 'I' to 'P'. To specify black, UV resistant tubing, change 'I' to 'U'. To specify Bleed 4FV, change 'S' to 'B'. To specify 3FV, change 'S' to'T'.

4FV indicates that the pump is equipped with an LMI Four Function Valve. This diaphragm type anti-syphon/pressure relief valve is installed on the pump head. It provides anti-syphon protection and aids in priming, even under pressure.







G & L
Goulds Pumps
240 Fall Street
Seneca Falls, NY 13148

NPE 316L SS NPE Series End Suction Centrifugal Pumps

A FULL RANGE OF PRODUCT FEATURES

Superior Materials of Construction:

Complete AISI 316L stainless steel liquid handling components and mounting bracket for corrosion resistance, quality appearance, and improved strength and ductility.

High Efficiency Impeller:

Enclosed impeller with unique floating seal ring design maintains maximum efficiencies over the life of the pump without adjustments.

Casing and Adapter Features:

Stainless steel construction with NPT threaded, centerline connections, easily accessible vent,

prime and drain connections with stainless steel plugs.

Mechanical Seal:

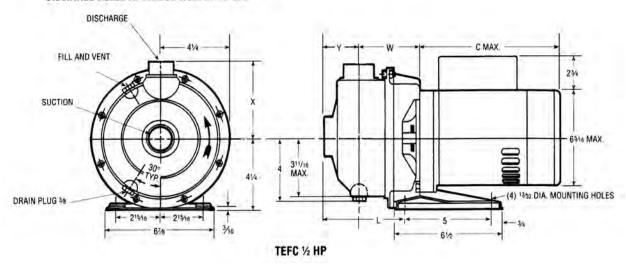
Standard John Crane Type 21 with carbon versus silicon-carbide faces, Viton elastomers, and 316 stainless metal parts.

Motors:

NEMA standard totally enclosed fan cooled (TEFC) enclosure. Rugged ball bearing design for continuous duty under all operating conditions. Built-in overload with auto-reset provided.

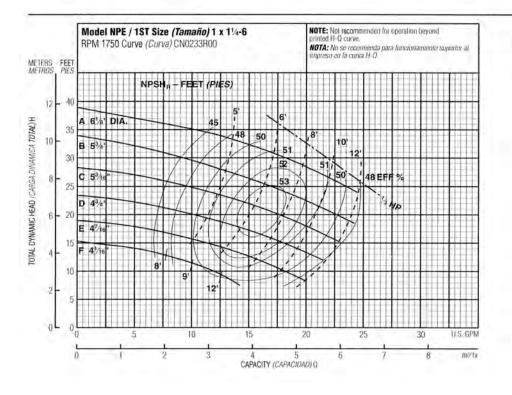


Clockwise Rotation Viewed from Drive End



| PUMP | SUCTION / DISCHARGE | НР | W | X | Y | L | M | C Max. |
|------|------------------------|-----|---------|--------|---|---------|---------|----------|
| 1ST | 1 1/4" / 1" | 1/2 | 3 5/16" | 4 3/8" | 2 | 4 9/16" | 7 5/16" | 9 15/16" |

Performance Curves - 60 Hz, 1750 RPM

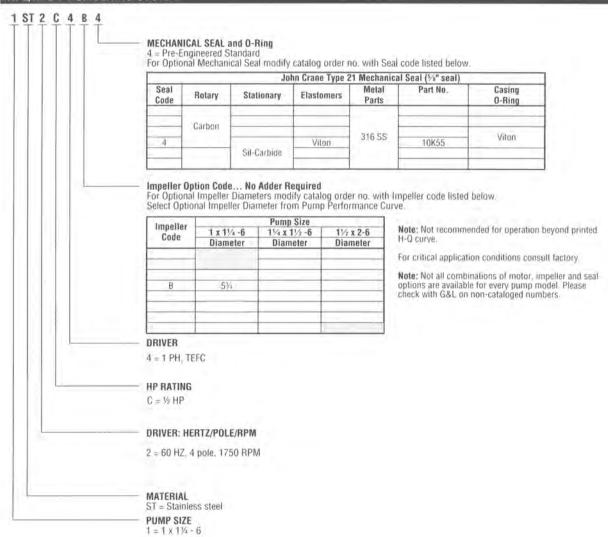


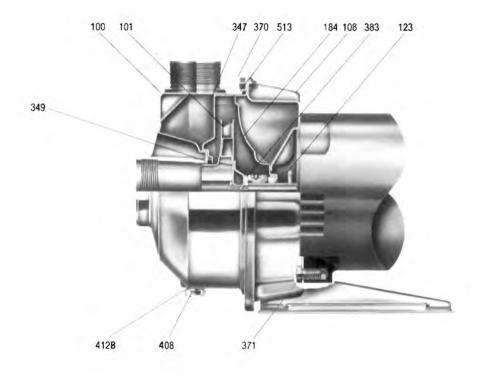
| Optional Impell Impulsor Opcio | |
|------------------------------------|------|
| Ordering Code, Código de Pedido | Dia. |
| В | 53/4 |
| | |
| | |

NOTE: Although not recommended, the pump may pass a Vie" sphere.

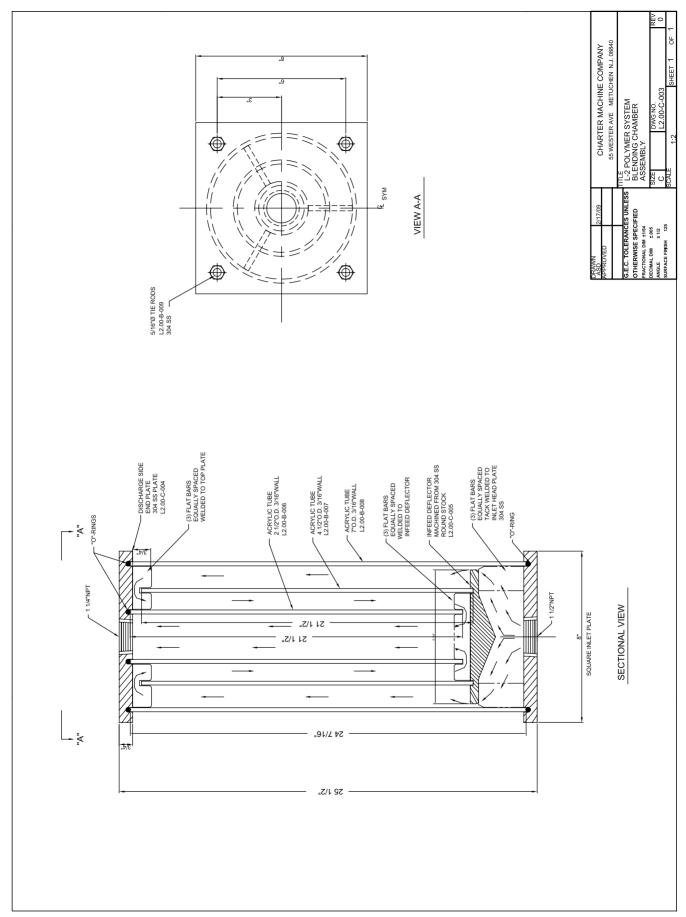
NOTA: Si bien no se recomienda, la bomba puede pasar una esfera de Vie".

NPE/NPE-F NUMBERING SYSTEM

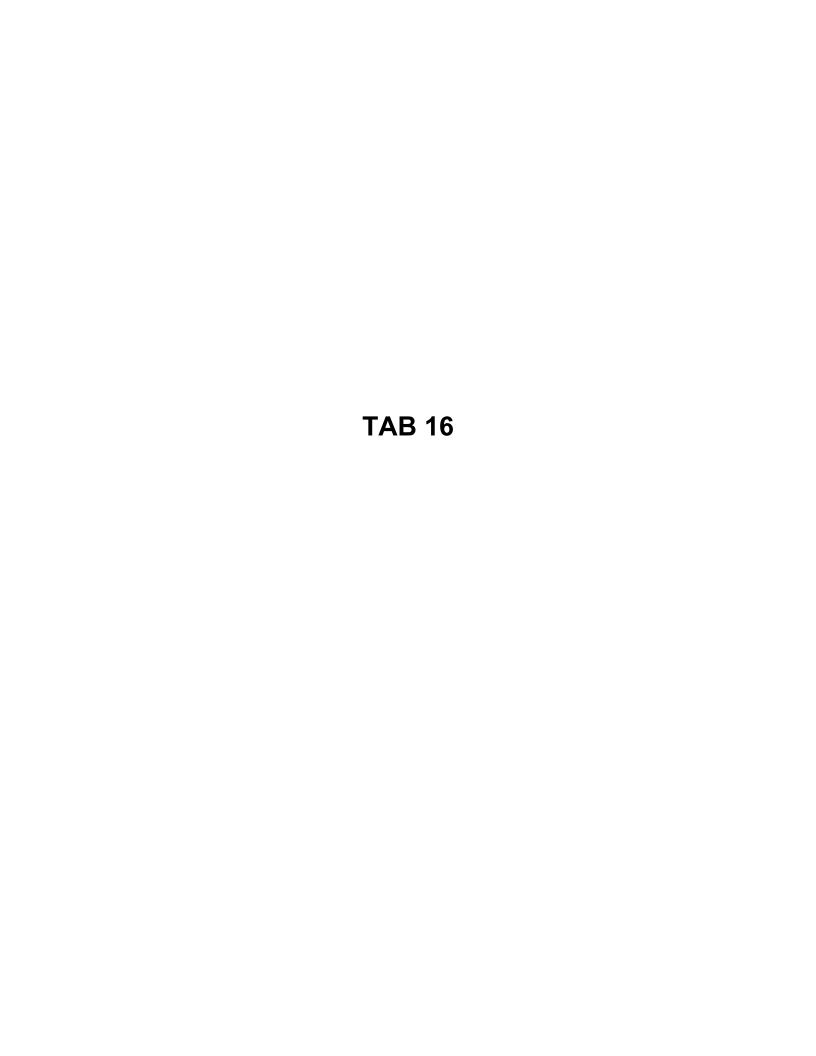




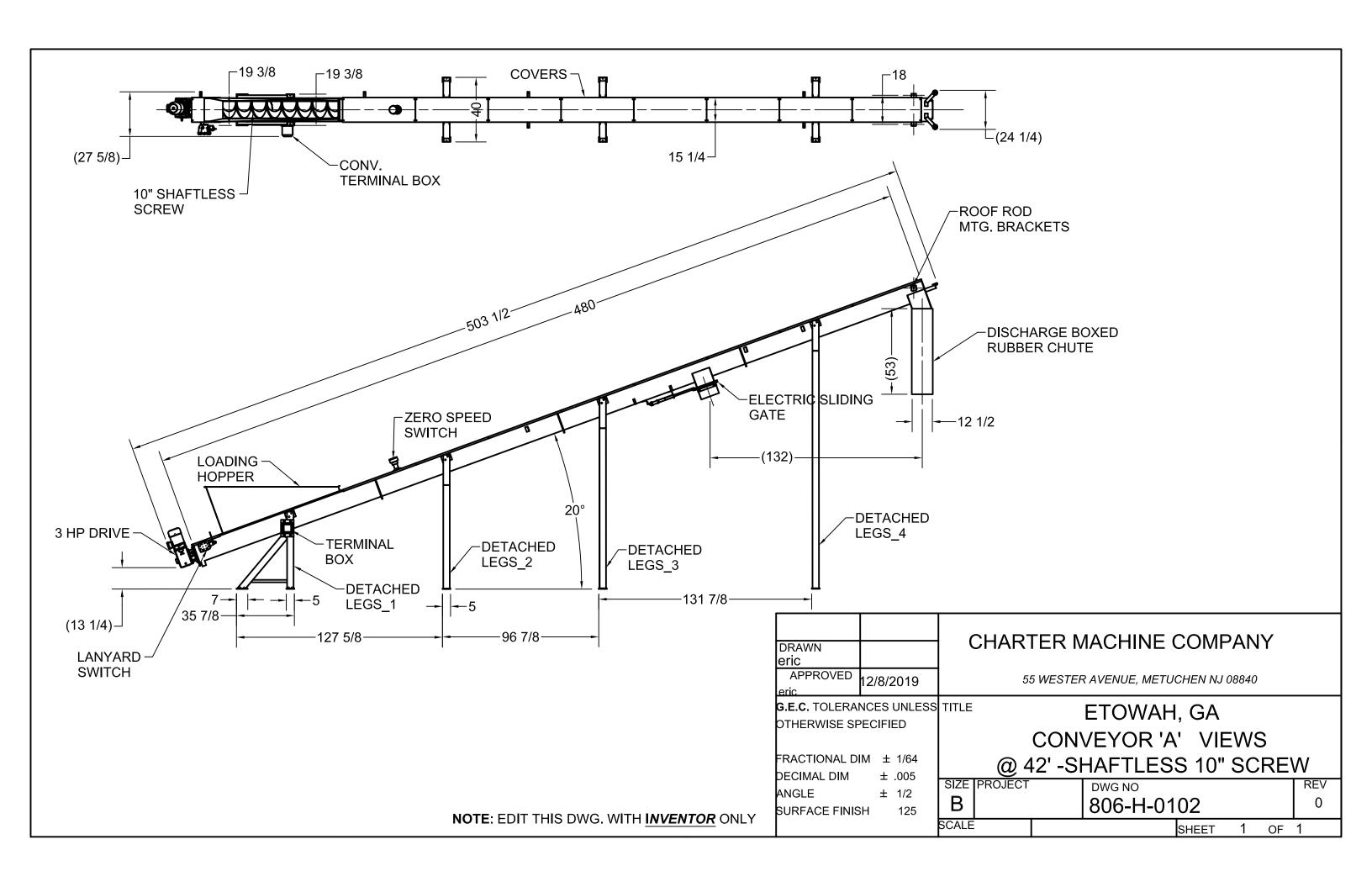
| ITEM NO. | DESCRIPTION | MATERIAL |
|----------|-----------------------------|--------------|
| 100 | Casing | AISI 316L SS |
| 101 | Impeller | AISI 316L SS |
| 108 | Motor Adapter | AISI 316L SS |
| 123 | Deflector | Buna-N |
| 184 | Seal Housing | AISI 316L SS |
| 347 | Guide vane | AISI 316L SS |
| 349 | Seal Ring, Guide vane | Viton |
| 370 | Socket Head Screws, Casing | AISI 410 SS |
| 371 | Bolts, Motor | Plated Steel |
| 383 | Mechanical Seal | |
| 408 | Drain and Vent Plug, Casing | AISI 316L SS |
| 412B | O-Ring, Drain and Vent Plug | Viton |
| 513 | NEMA 56J flange | |













DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

SPECIFICATIONS

10" SHAFTLESS SCREW CONVEYOR CHARTER MACHINE COMPANY

MODEL - 10SS CONV

Conveyor A – Inclined Shaftless Screw Conveyor

1. <u>INCLINED CONVEYOR</u>

1.01 GENERAL

- A. A sludge discharge conveyor shall be supplied as shown on the Contract Drawings. The conveyor shall receive dewatered sludge cake from the belt filter press and convey the material to the two (2) loadout conveyors.
- B. The screw conveyor system shall include; conveyor troughs with liners, spiral flighting, conveyor drive w/motor, gearbox adaptor w/packing rings, trough ends, covers, inlet hopper, outlet hopper and all hardware.
- C. The conveyor shall be a type shaftless screw conveyor approximately <u>40'-0"</u> long by 10" wide and be of the latest design and shall be fabricated of materials and in a fashion, which will fully perform the necessary functions.

1.02 TROUGHS

- A. The troughs of the conveyor shall be formed and constructed from type 304 stainless steel and conform to CEMA standards.
- B. The minimum trough thickness shall be <u>11</u> gage.
- C. A silicone gasket shall be applied at each trough connecting flange and a neoprene rubber gasket shall be applied between trough top edge and covers.
- D. Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape.
- E. 14 gage type 304 stainless steel covers in maximum 4-foot sections shall be provided over the top of the trough to enclose the unit with the exception of the inlet hopper section.
- F. A 2" drain shall be provided at least 4" from the drive end trough flange, bottom mounted and welded perpendicular to the trough.
- G. Each trough shall be equipped with filling and/or discharge spouts at the location shown on the drawings. If required, each filling and discharge spout shall be flanged and shaped suitable for interconnection to other devices.

1.03 WEAR LINER

- A. The wear liners for the conveyor shall be made from anti wear material Tivar Ceram P with incorporated micro glass beads designed for use in dewatering equipment with a high abrasive resistance filler content.
- B. The wear liner shall be furnished in 4' maximum sections with a minimum thickness of 1/4" for ease of replacement. The liner shall be held in place with welded hold down clips.

1.04 SPIRAL FLIGHTING

- A. The spiral flights shall be designed to convey material without a center shaft. The spiral flights shall be designed with the stability to prevent distortion and jumping in the trough. The torsional rating of the spiral shall be such that, at 150% of the nameplate horsepower, the drive unit cannot produce more torque than the torsional rating of the flighting.
- B. Spiral flights shall be manufactured from 8620 high strength alloy steel with a brinnel hardness of 225, and a maximum yield strength of 80,000 psi. The spiral flighting shall be painted with gray 2-part epoxy paint.
- C. The spiral flighting shall be manufactured in a two-stage process. Single stage forming is not acceptable. Sectional flighting formed from plate shall not be permitted. The first stage shall consist of tightly cold rolling at zero pitch on a mandrel which uses a device to control the plastic flow of the spiral during forming and maintain a uniform outside and inside diameter. The second stage of spiral forming shall consist of pulling the closely wound spiral in tension to the specified pitch in a device permitting free spiral rotation.
- D. Spiral flighting shall have full penetration welds at all splice connections, the flights shall be aligned to assure true alignment when assembled in the field and shall be made in accordance with supplier's requirements. The spiral flights shall be coupled to the end shaft by a flanged, bolted connection.
- E. The connection of the spiral to the drive system shall be through a flanged connection plate that is welded to the spiral forming a smooth and continuous transformation from the flange plate to the spiral. The drive shaft shall have a mating flange and shall be bolted to the spiral connection plate.
- F. A gland packing ring consisting of two Teflon coated packing rings shall seal the drive shaft at its penetration through the end plate, along with a greased labyrinth sealing system.

1.05 SUPPORTS

- A. The conveyor supports shall be capable of supporting the equipment weight when fully loaded. Support legs shall be sufficiently cross braced so as to form a rigid structure. These supports shall be used for support only and not used for access to the conveyor.
- B. Supports shall be constructed of carbon steel channel shapes and plates. Conveyor support base pads shall be pre-drilled for anchor bolt installation by the contractor.
- C. Supports shall be shop blasted and hot dipped galvanized. OPTIONAL type 304 stainless steel supports may be also provided in lieu of carbon steel support legs with hot dipped galvanized coating.
- D. All structural supporting members shall be designed such that the ratio of the unbraced length to least radius of gyration shall not exceed 120 for any compression member and shall not exceed 240 for any tension member. In addition, all structural members and connections shall be designed so that the unit stresses will not exceed the American Institute of Steel Construction allowable stresses by more than 1/3 when subject to loading of twice the maximum design operating torque of the spiral conveyor drive motors.

1.06 DRIVE SYSTEM

- A. Drive assembly shall consist of an integral gearmotor, mounted directly to the screw shaft. Gearmotor housing shall be cast iron, furnishing complete protection under all conditions of service. Gears shall be manufactured and rated for continuous duty in accordance with AGMA standards, of heat treated alloy steel. Gear reducer shall be Class II speed reducer.
- B. 3 HP, 3 phase, 60 cycle, TEFC induction motor and speed reducer shall be supplied to drive the conveyor screw at a constant speed of approximately 26 revolutions per minute. The conveyor drive shall be directly mounted to the screw drive shaft.
- C. The gear reducer and drive shall be designed to provide an applied torque adequate to start a fully loaded conveyor.
- D. The gearbox and motor shall be factory mounted on the conveyor, factory tested and shipped fully assembled.

1.07 <u>SAFETY DEVICES</u>

- A. A zero-speed switch shall be provided. The switch shall be mounted to one of the conveyor covers.
- B. All controls, interlocks, and motor starters for the conveyor shall be contained in the belt filter press control panel.
- C. A safety stop switch shall be supplied for each conveyor.

1.08 SLIDE GATE

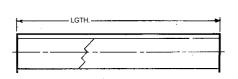
- A. Slide gates shall be provided as shown on the drawings. Each slide gate shall be specifically designed to operate as an integral part of the conveyor system, and shall be supplied by the manufacturer.
- B. The slide gate shall be electro-mechanically operated and shall be designed with a maximum vertical dimension of 10" including the operator. The slide gate shall be designed so that in the full, open position at least one rotation of the spiral is exposed to the opening in the direction of transport.
- C. The slide gates shall have an opening the full width of the conveyor trough. Minimum opening size shall be 11" x 12". The slide gates shall be fabricated from 304 stainless steel, and UHMW.

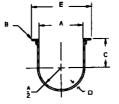


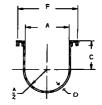
Standard Conveyor Trough



Standard conveyor troughs have a U-shaped steel body with angle iron top flanges or formed top flanges and jig drilled end flanges.







Angle Flange

Formed Flange

| | _ | Angle | | Angle Flan | ged Trough | | | Formed F | langed Trou | gh ▲ | | | | | | |
|--|---|---|--|-------------------------------------|--------------------------|--------------------------|--|--|------------------------------------|--|--------------------------|---------------|------------------|---------------|---|---|
| Conveyor Diameter | D | Flanged | Wei | • | | ight | | | ight | | ight | A | В | С | E | F |
| | Trough Thick. | Part Number | 10´* Length | 5´ Length | 12´ Length | 6´ Length | Part Number | 10´ Length | 5´ Length | 12´ Length | 6´ Length | | | | | |
| 4 4 | 10-0A: 14 12 | 40TA16 40TA14 40TA12 | 58 69 78 | 29 99 42 | 111 | 111 | 40TF16 40TF14 40TF12 | \$ \$ ₹ | 20 20 90 | | | 5 | 4 | 0% | 7% 7% 7% | 7% 7% 8 |
| •••• | 10-0A: 14 12 10 10 | 60TA16 60TA14 60TA12 60TA10 60TA7 | 87 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 | 44 49 89 79 80 | ш | 11111 | 00TF10 00TF14 00TF12 00TF10 00TF7 | 885‡\$ | 92 90 50 94 79 | | шш | 7 | 444 | 41/2 | 0% 0% 0% 0% 0% | * 7 7 * |
| ••••• | 0 | 96TA16 96TA14 96TA12 96TA10 96TA7 96TA3 | 127 156 179 200 200 | 60 70 67 402 424 452 | ппп | шшп | 90TF14 90TF14 90TF12 90TF10 90TF7 90TF7 | % | \$ \$ \$ \$ \$ \$ | шш | шш | 10 | 17/ 2 | 6% | 10% 10% 10% 10% 10% 10% | \$ |
| 10 10 10 10 | 16-GA. ■ 14 12 40 % | 10CTA12 10CTA12 10CTA12 10CTA12 10CTA13 10CTA7 | 146 199 164 179 299 900 | 92 402 401 400 | 111111 | | 100TF10 100TF14 100TF12 100TF10 100TF7 100TF0 | 8 5 1 1 1 8 | 54 62 60 94 420 450 | = | | 11 | 1½ | 6% | 14% 14% 14% 14% 14% 14% | 14% 14% 14% 14% 14% 14% |
| 12 12 12 12 | □ 12 CA. 10 % | 420TA42 420TA40 420TA7 420TA8 | 497 294 294 972 | 110 100 164 200 | 200 201 950 410 | 105 100 107 211 | 420TF12 420TF10 420TF7 420TF3 | 464 467 272 657 | 95 117 150 191 | 107 224 026 420 | 114 140 100 200 | 10 | 2 | 7% | 47% 47% 47% 47% | 17½ 17½ 17% 17% |
| 14 14 14 14 | □ 12 GA. 10 3/ ₁₆ 1/ ₄ | 14CTA12 14CTA10 14CTA7 14CTA2 | 214 258 328 418 | 121 143 180 224 | 257 309 394 501 | 145 172 216 269 | 14CTF12 14CTF10 14CTF7 14CTF3 | 183 207 304 403 | 102 127 168 215 | 219 248 365 483 | 152 152 202 258 | 15 | 2 | 91/4 | 191/4 107/16 193/8 191/2 | 19½ 19½ 19¾ 19½ |
| 16 16 16 16 | □ 12 GA. 10 ³ / ₁₆ ½ | 16CTA12 16CTA10 16CTA7 16CTA3 | 238 288 368 471 | 133 150 200 243 | 285 345 442 565 | 160 191 240 291 | 16CTF12 16CTF10 16CTF7 16CTF3 | 206 234 345 455 | 107 144 188 228 | 247 281 414 546 | 128 173 226 273 | 17 | 2 | 10% | 21½ 21½ 21¾ 21½ | 21½ 21½ 21¾ 21½ |
| 18 18 18 18 | □ 12 GA. 10 ³ / ₁₆ ¹ / ₄ | 18CTA12 18CTA10 18CTA7 18CTA3 | 252 353 444 559 | 159 170 243 298 | 302 423 533 671 | 191 204 291 358 | 18CTF12 18CTF10 18CTF7 18CTF3 | 240 269 394 520 | 133 165 217 275 | 288 323 473 624 | 160 198 260 330 | 19 | 2½ | 12% | 241/4 245/16 243/8 241/2 | 24½ 24½ 24¾ 24½ |
| 20 20 20 | □ 10 GA. ¾ ₆ ¼ | 20CTA10 20CTA7 20CTA3 | 383 484 612 | 228 271 334 | 460 581 734 | 274 325 401 | 20CTF10 20CTF7 20CTF3 | 296 434 573 | 190 247 315 | 355 521 687 | 228 296 378 | 21 | 2½ | 13½ | 26 ⁵ / ₁₆ 26 ³ / ₈ 26 ¹ / ₂ | 26½ 26¾ 26½ |
| 24 24 24 | □ 10 GA ^{3/6} ^{1/4} | 24CTA10 24CTA7 24CTA3 | 443 563 717 | 255 319 363 | 531 676 860 | 306 383 435 | 24CTF10 24CTF7 24CTF3 | 384 514 678 | 227 293 339 | 461 617 813 | 272 352 406 | 25 | 2½ | 16½ | 30 ⁵ / ₁₆ 20 ₃ / ₈ 30½ | 30½ 30¾ 30½ |

□ Standard Gauge Bolt Patterns Page H-40

All troughs available in other materials such as stainless, aluminum, abrasion resistant, etc.

▲ Double formed flange standard on all sizes through 10 ga.



Size and Capacity

| | CONFIGURATIO | ONS / OPTIONS |
|-----------------------------|----------------|---|
| | Type of Steel | Carbon SteelHigh Brinell Carbon SteelStainless Steel |
| | Capacity | • Up to 17,000 CFH |
| | Diameter | 6" to 30" (and larger) |
| | Pitches | • Full, 2/3, 1/2 |
| | Trough | CEMA Standards |
| | Options | Liners - UHMW - Xylethon - Tivar - AR Rider Bars Inspection and Overflow Hatches Various Drive Configurations Available Housings: CEMA Standard U-Trough or Split Tubular Housing |
| Shaftless Screw Live Bottom | Configurations | Single or Inner/Outer Flight Design Twin Screw Multiple Live Bottom Feeders Inclined Screw Conveyors Grit Washers Vertical |

^{*}Conveyors shown without cover for illustration purposes only. Please follow manufacturing safety guidelines when operating conveyors.

| | | 50% Troug | h Loading* | | |
|--------------|-----------|-------------|----------------|------------|----|
| Nom. Dia. | A Dia. | B Inside | CFH @ 1 RPM | Max RPM | |
| 6 | 6 | 7 | 6 | 2.5 | 25 |
| g | g | 10 | g | 9.1 | 25 |
| 10 | 10 | 11 | 10 | 12.7 | 25 |
| 12 | 12 | 13 | 12 | 21.0 | 25 |
| 14 | 14 | 15 | 14 | 34.7 | 25 |
| 16 | 16 | 17 | 16 | 51.9 | 25 |
| 18 | 18 | 19 | 18 | 75.1 | 25 |
| 20 | 20 | 21 | 20 | 104 | 25 |
| 24 | 24 | 25 | 24 | 182 | 25 |
| 30 | 30 | 31 | 30 | 359 | 25 |

^{*} Based on horizontal application only.



TIVAR® Ceram P®

TIVAR® Ceram P® HANDLES INTENSE SLIDING ABRASION APPLICATIONS

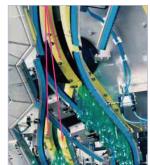
Reduce maintenance downtime, extend equipment service life and reduce replacement part costs with TIVAR® Ceram P® from Quadrant Engineering Plastic Products.

Developed for severe service conditions, TIVAR® Ceram P® outwears and out-performs other materials in highly abrasive industrial environments such as:

- agriculture
- chemical handling/processing
- filter manufacturing
- paper production (lumber mills)



TIVAR® Ceram P® combines abrasion resistance and long wear-life in one easy-to-machine material.



TIVAR® Ceram P® is the answer for extremely high wear conveyor components.

A shatter-resistant alternative to sintered ceramics, TIVAR® Ceram P® maintains its key properties - abrasion-, corrosion-, moisture-, chemical-resistance, low coefficient of friction - in a variety of intense sliding wear abrasion applications such as:

- bearing pads
- grain strippers
- guide boards/guide rails
- regulating discs
- slide elements in telescoping booms
- split rings in centrifugal pumps
- wear plates
- wear rings
- wearstrips



TIVAR® Ceram P® performs well as a slide panel in telescoping booms. Outstanding abrasion resistance adds to the wear-life of the pad.

When your application calls for a material with extreme wear-resistance in a severe, abrasive environment, choose TIVAR® Ceram P®.

Important: Most plastics will ignite and sustain flame under certain conditions. Caution is urged where any material may be exposed to open flame or heat generating equipment. Use Material Safety Data Sheets to determine auto-ignition and flashpoint temperatures of material or consult Quadrant. TIVAR® and Ceram P® are registered trademarks of the Quadrant group of companies.

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QUADRANT

You inspire ... we materialize®

QUADRANT ENGINEERING PLASTIC PRODUCTS

TIVAR Ceram P is a wear improved PE-UHMW material with incorporated micro glass beads, specifically developed for use in the dewatering zone of paper machinery equipped with plastic wires and manufacturing paper with high abrasive filler content.

Physical properties (indicative values *)

| PROPERTIES | Test methods | Unite | Charles and the second |
|---|---------------------------------------|--|---|
| Colour | - | - | yellow-green |
| Average molar mass (average molecular weight) - (1) | - | 10 ⁶ g/mol | 9 |
| Density | ISO 1183-1 | g/cm³ | 0.96 |
| Water absorption at saturation in water of 23 °C | - | % | < 0.1 |
| Thermal Properties (2) | | | |
| Melting temperature (DSC, 10 °C/min) | ISO 11357-1/-3 | °C | 135 |
| Thermal conductivity at 23 °C | - | W/(K.m) | 0.40 |
| Average coefficient of linear thermal expansion between 23 and 10 | 10 °C - | m/(m.K) | 200 x 10 ⁻⁶ |
| Temperature of deflection under load: | | **** | |
| - method A: 1.8 MPa | ISO 75-1/-2 | °C | 42 |
| Vicat softening temperature - VST/B50 | ISO 306 | °C | 80 |
| Max. allowable service temperature in air: | | | |
| - for short periods (3) | - | °C | 120 |
| - continuously : for 20,000 h (4) | - | °C | 80 |
| Min. service temperature (5) | • | °C | -150 |
| Flammability (6): | | ······································ | 24.24.7 |
| - "Oxygen Index" | ISO 4589-1/-2 | % | < 20 |
| - according to UL 94 (6 mm thickness) | - | (<u>*</u> | HB |
| Mechanical Properties at 23 °C (7) | | | |
| Tension test (8): | | N.E | |
| - tensile stress at yield (9) | ISO 527-1/-2 | MPa | 18 🤄 |
| - tensile strain at yield (9) | ISO 527-1/-2 | % | ∕15 िः |
| - tensile strain at break (9) | ISO 527-1/-2 | % % | > 50 |
| - tensile modulus of elasticity (10) | ISO 527-1/-2 | MPa | 750 |
| Compression test (11): | · · · · · · · · · · · · · · · · · · · | 7 / | 6 107 BY |
| - compressive stress at 1 / 2 / 5 % nominal strain (10) | ISO 604 | MPa | 7 / 11 / 17.5 |
| Charpy impact strength - unnotched (12) | ISO 179-1/1eU | kJ/m² | no break |
| Charpy impact strength - notched | ISO 179-1/1eA | kJ/m² | 105P |
| Charpy impact strength - notched (double 14° notch) - (13) | ISO 11542-2 | kJ/m² | 125 |
| Ball indentation hardness (14) | ISO 2039-1 | N/mm² | 33 |
| Shore hardness D (14) | ISO 868 | | 60 |
| Relative volume loss during a wear test in "sand/water-slurry"; | 3 8 7 30 5 | | |
| TIVAR 1000 = 100 | ISO 15527 | • | 75 |
| Electrical Properties at 23 °C | | | |
| Electric strength (15) | IEC 60243-1 | kV/mm | 45 |
| Volume resistivity | IEC 60093 | Ohm.cm | > 10 14 |
| Surface resistivity 4 | IEC 60093 | Ohm | > 10 12 |
| Relative permittivity ε _r : - at 100 Hz | IEC 60250 | | - 10 |
| - at 1 MHz | IEC 60250 | - | _ |
| Dielectric dissipation factor tan δ: - at 100 Hz | IEC 60250 | - | |
| - at 1 MHz | IEC 60250 | _ | _ |
| Comparative tracking index (CTI) | IEC 60112 | | |

Legend:

- This is the average molar mass of the PE-UHMW resins (irrespective of any additives) used for the manufacture of this material. It is calculated by means of the Margolies-equation M = 5.37 x 10⁴ x [η]. with [η] being the intrinsic viscosity (Staudinger index) derived from a viscosity measurement according to ISO 1628-3:2001, using decahydronaphtalene as a solvent (concentration of 0.0002 g/cm²).
- (2) The figures given for these properties are for the most part derived from raw material supplier data and other publications.
- (3) Only for short time exposure (a few hours) in applications where no or only a very low load is applied to the material.
- Temperature resistance over a period of 20,000 hours. After this period of time, there is a decrease in tensile strength measured at 23 °C of about 50 % as compared with the original value. The temperature value given here is thus based on the thermal-oxidative degradation which takes place and causes a reduction in properties. Note, however, that the maximum allowable service temperature depends in many cases essentially on the duration and the magnitude of the mechanical stresses to which the material is subjected.
- (5) Impact strength decreasing with decreasing temperature, the minimum allowable service temperature is practically mainly determined by the extent to which the material is subjected to impact. The value given here is based on unfavourable impact conditions and may consequently not be considered as being the absolute practical limit.
- (6) These estimated ratings, derived from raw material supplier data and other publications, are not intended to reflect hazards presented by the material under actual fire conditions. There is no 'UL File Number' available for TIVAR Ceram P stock shapes.
- The figures given for these properties are average values of tests run on test specimens machined out of 20 - 30 mm thick plates.
- Test specimens: Type 1 B
- (9) Test speed: 50 mm/min
 -)) Test speed: 1 mm/min.
- 1) Test specimens: cylinders Ø 8 mm x 16 mm
- Pendulum used: 15 J
- (13) Pendulum used: 25 J
- (14) Measured on 10 mm thick test specimens.
- (15) Electrode configuration: Ø 25 / Ø 75 mm coaxial cylinders; in transformer oil according to IEC 60296; 1 mm thick test specimens.
- This table, mainly to be used for comparison purposes, is a valuable help in the choice of a material. The data listed here fall within the normal range of product properties. However, they are not guaranteed and they should not be used to establish material specification limits nor used alone as the basis of design.

TIVAR® is a registered trademark of the Quadrant Group.

This product data sheet and any data and specifications presented on our website shall provide promotional and general information about the Engineering Plastic Products (the "Products") manufactured and offered by Quadrant Engineering Plastic Products ("Quadrant") and shall serve as a preliminary guide. All data and descriptions relating to the Products are of an indicative nature only. Neither this data sheet nor any data and specifications presented on our website shall create or be implied to create any legal or contractual obligation.

Any illustration of the possible fields of application of the Products shall merely demonstrate the potential of these Products, but any such description does not constitute any kind of covenant whatsoever. Irrespective of any tests that Quadrant may have carried out with respect to any Product, Quadrant does not possess expertise in evaluating the suitability of its materials or Products for use in specific applications or products manufactured or offered by the customer respectively. The choice of the most suitable plastics material depends on available chemical resistance data and practical experience, but often preliminary testing of the finished plastics part under actual service conditions (right chemical, concentration, temperature and contact time, as well as other conditions) is required to assess its final suitability for the given application.

It thus remains the customer's sole responsibility to test and assess the suitability and compatibility of Quadrant's Products for its intended applications, processes and uses, and to choose those Products which according to its assessment meet the requirements applicable to the specific use of the finished product. The customer undertakes all liability in respect of the application, processing or use of the aforementioned information or product, or any consequence thereof, and shall verify its quality and other properties.









UNICASE™ Construction



UNICASE™ Construction refers to an overall design concept that allows proper alignment of the gear meshes and the bearings. All of the main drive train components are contained in a one-piece housing. All bearing bores, pilots, and registers of the housing are machined in one set-up. First, the foot or inspection cover is machined. The housing is then positioned from this first cut to machine all remaining features. Specially designed, dedicated fixtures are used to hold the castings rigidly and accurately for machining. This assures positive bearing and gear alignment.

Covers or openings are minimized, reducing the number of potential leak paths, and subsequently the probability of a leak occurring. A standard Failure Effects and Modes Analysis (FEMA) shows that this is the best design. Although this type of design tends to make assembly more difficult, it results in a superior product. Fortunately, NORD has specially designed tools to assure proper, efficient assembly.

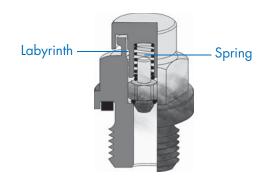
All covers and openings are un-stressed access panels, or are positioned with a large pilot diameter. An un-stressed access panel is the best, because there are no forces trying to break the seal between the components.

In no case is a bearing bore split even if it is internal to the reducer. Designs with split bearing bores require bolts to hold the bore together. It is common for bearings to fail due the outer face being improperly supported, causing a stress riser at seams in bearing bores.

AUTOVENT ™ Breather

When a gear reducer is operated intermittently, it warms up while operating and cools down after being shut off. The oil expands when it heats up and compresses the air inside the housing, resulting in a positive pressure that could cause the oil seals to rupture if left unregulated. Conversely, when the oil is cooling, it will reduce in volume, and outside air, and potentially humidity and dirt, will enter the reducer. A small concentration of water in mineral oil will cause foaming, will reduce the lubricating properties of the oil, and will promote a rapid degradation of the lubricant's chemistry. Internal components, such as bearings and gears, may quickly be damaged by a small quantity of these contaminants alone or in combination with caustic or corrosive fluids.

The Autovent™ operates like a check-valve to allow the reducer to dissipate internal pressure during warm-up, while preventing lubricant contamination during cooling. A spring presses a ball against a machined orifice until the heating of the oil and air inside the reducer exceeds 2 psi. Between 2 and 3 psi, the spring compresses and the ball is displaced, allowing pressure to escape. The internal pressure then drops below 2 psi, the spring elongates, and the ball returns to its initial position, sealing the unit. As the reducer continues to cool, the unit will temporarily develop a slight vacuum.



NORD Gear supplies all reducers, except those that are "lubricated for life", with an Autovent™ as a standard feature. In addition, the Autovent™ gives NORD Gear the ability to ship reducers and gear motors with factory-filled lubricant. Since the spring keeps the valve tightly closed regardless of the reducer's orientation, the unit can be inverted during shipment and not develop an oil leak. A metal canopy protects the ball and spring from damage. During operation, oil splash and mist are generated. In contrast to the Autovent™ breather, an open breather can allow these to migrate out, resulting in an undesirable brownish stain around the vent plug.







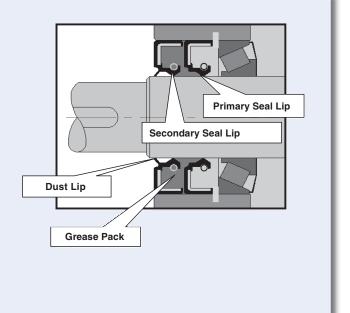


Quadrilip™ Seals

Quadrilip[™] seals are standard for most UNICASE[™] gear frame sizes. The smaller gear units do not have dual seals, but the quality of shaft preparation and seal installation is universal.

The Quadrilip™ system is a sign of quality. The seal system consists of two sealing lips, a dust lip, and a grease chamber between the seals. The grease chamber functions as an additional barrier: it helps protect the inner seal lip from damage, and helps prevent external contamination from working its way in. The grease also lubricates the seal lips and keeps them soft and flexible, and prevents them from wearing quickly by reducing friction between the seal lip and shaft surface.

All shaft seal surfaces are either roller burnished or plunge ground, and are an important part of the seal system. With these processes a smooth surface finish of 12-24 pinch rms can be achieved without machine lead that causes the seal surface to act as a pump to force oil out from the reducer or gearmotor.



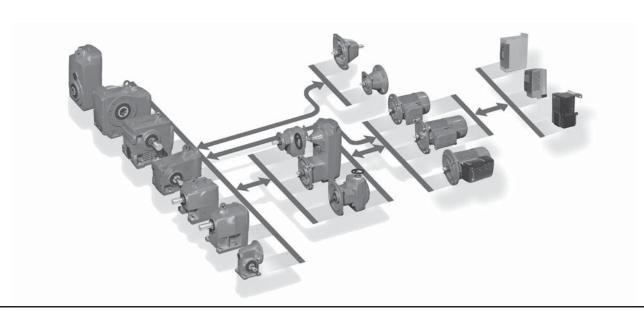
Modular Design

NORD's modular design philosophy provides you with a competitive edge by allowing you to configure drive systems to exactly fit to your applications. More than 20,000,000 combinations of totally unique gearmotors and speed reducers are possible - assembled in-line or right-angle, mounted by foot or flange, featuring solid or hollow shafts with either metric or inch extensions - to give you complete freedom to specify a drive solution that's perfect for you.

Benefits

- More output speeds
- More mounting arrangements/Greater flexibility
- Fewer gear stages/Lower costs
- Metric and inch products

NORD engineers stand ready to assist you with your custom applications. Most standard drives can be modified to your purposes, and custom designs can be developed for special applications.





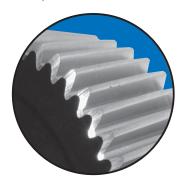






Gearing

The gears are made from high strength steel forgings. The teeth are case-hardened then precision finished using either grinding or skive-hobbing methods. As a result, high tooth-to-tooth accuracy is ensured which delivers steady output motion. Tooth stresses are controlled to assure very long durability with infinite life of the gear teeth. Gear torque ratings are thus optimized for a high degree of reliability.



Gear Quality Level: AGMA Class 11-13.

Gear Hardness: Case hardened to 58-62 Rockwell-C.

Gear Finish: All high-speed gears are ground; low-speed gears are skive finished after hardening.

Edge Deburred Gearing. Designed for infinite life

High-Strength Gearcases

Standard housing material is Class 35 Cast Iron. Some units utilize a corrosion resistant aluminum alloy or diecast aluminum alloy housing material.

NORD's robust housings maintain heavy wall sections. Some competitors have reduced material used in their housings for cost savings. Material has been reduced to the point that the walls are too thin and can flex under load. This will misalign the gears and bearings. In addition, bearing outer races need to be supported with a stiff backing to achieve their rating. Thin housings may not properly support the outer bearing races. Housings are internally painted with a primer to seal casting process residue and fill any surface imperfections.

Lubrication

NORD Gear supplies most all gear units factory-filled with the appropriate oil lubrication type and fill-level per the specified reducer mounting position. The current exceptions include Clincher™ Series parallel-shaft gear units: SK10282, SK10382, SK11282, SK11382, SK12382, and SK9096.1 which are supplied without oil.

It is important that proper oils are used in a gear reducer. By supplying the appropriate lubricant type and amount, NORD Gear eliminates the "guess work" for the consumer.

Properly selected oil will have the required additives to prevent the unwanted formation of foam, oxidation, and rust. As well, the proper extreme pressure additive may be used for hardened alloy steels, or more importantly, not used when it will be a detriment to the bronze gearing in worm reducers. For additional technical information please reference the Lubrication section of this catalog beginning on page 36.

Please see the lubrication table on page 42 for the standard and optional reducer lubrication types, and their service temperature ranges.

High-Performance Motors & Brakemotors

NORD motors are designed to run cool for longer service life. Low rotor inertia and high starting torque allow peak performance in the most difficult applications for inverter and vector duty per NEMA MG 1-2006 Section 31.4.4.2 voltage spikes. Our motors are internationally accepted, conforming to North American NEMA MG 1 and international IEC electrical specifications. High performance options include brakes, encoders, and forced cooling fans.











Compact Coupled (NEMA C-face Input)

NORD Gear supplies reducers with special couplings that eliminate the need for quill-type input with NEMA and IEC frame motors. This allows for superior input shaft alignment and smooth torque transfer, reducing incidents of bearing, shaft, and key failures. Smaller reducers use a proprietary one piece nylon, curved tooth gear coupling with a bronze insert. These materials were selected for their ability to accommodate misalignment, as well as corrosion protection. The bronze insert eliminates steelto-steel contact allowing ease of motor disassembly even after years of service. Quill-type inputs have steel-to-steel contact between the motor shaft and the quill-input shaft of the reducer. This metal-to-metal contact will undergo fretting corrosion, especially in corrosive or moist environments. Each reducer is shipped from the factory with a sticker on the coupling that shows the proper coupling placement from the motor mounting surface.





Energy Efficient

Combining the UNICASE™ close dimension control and torsionally stiff, stable housings with high quality gearing results in higher operating efficiencies. Our industry leading 98.5% efficiency per gear stage results in significant power savings over the long haul.

Lowering your operating costs is one of our greatest goals! NORD research and development focuses on energy efficiency, with gearboxes, motors, and frequency inverters designed for lower energy consumption. Our fully diverse line of in-line or right-angle units and motors has been developed to suit your needs.

Stainless Steel Paint

NORD stainless steel paint is a plural component, aliphatic polyurethane paint with 316 stainless steel flakes with outstanding physical properties and excellent appearance. This paint has excellent adhesion to cast iron, steel, aluminum and most plastics and can be used as a topcoat or as a primer. The NORD stainless steel paint also has outstanding exterior durability and corrosion resistance, and superior chemical resistance when exposed to most industrial solvents, lubricants and cutting oils. The NORD stainless steel paint is excellent for both indoor and outdoor duty and is non-flammable.

It is designed as a USDA incidental contact coating acceptable for use in food, drug and cosmetic industries. Incidental contact means that the paint may not contain antimony: arsenic, cadmium, lead, mercury, selenium or other materials such as carcinogens, mutagens, or teratogens classified as hazardous substances.

Recapping NORD Stainless Steel Paint Features:

- Solvent based polyurethane paint for increased durability
- Outstanding exterior durability and corrosion resistance
- Superior chemical resistance when exposed to industrial solvents (laquer thinner, acetone, gasoline, Xylol), lubricants, and cutting oils
- Cured coating develops 2H hardness, yet exhibits excellent high impact resistance
- Heat and humidity resistant (tested for 500 hours at 100%) humidity and 100°F)
- USDA/H1 compliant incidental contact
- Colors Stainless steel gray, white, blue, red, black, and orange

2.0 hp, 3.0 hp Gearmotors







| Motor Power | | Output Torque | | AGMA Class | Gear Ratio | | ndard rings | Heav Bearir | y Duty igs (VL) | Model Type | Weight | Dim. Page |
|----------------|----------------|-----------------------|----------------|---------------|------------------|-----------------|-----------------|-------------------|--------------------|---------------------------------------|--------|--------------|
| P _n | n ₂ | T ₂ | f _B | | i _{tot} | F _{RN} | F _{AN} | F _{R VL} | F _{A VL} | | ı | |
| | | | | | | OHL | Thrust | OHL | Thrust | | ĪЬ | |
| [hp] | [rpm] | [lb-in] | | | | [lb] | [lb] | [lb] | [lb] | | [lb] | |
| 2.0 | 7.0 | 13281 | 1.9 | II | 236.58 | 5963 | 4669 | 5963 | 6300 | SK 43125 - 90L/4 | 280 | 662 |
| 2.0 | 6.2 | 14939 | 1.7 | l li | 269.76 | 5963 | 4669 | 5963 | 6300 | SK 43125 - 90L/4 SK 43125 - 90LH/4 | 200 | 002 |
| | 5.1 | 17670 | 1.2 | I | 323.51 | 5963 | 4669 | 5963 | 6300 | | | |
| | 4.4 | 20489 | 1.1 | - 1 | 380.39 | 5805 | 4669 | 5963 | 6300 | | | |
| | 3.7 | 23598 | 1.1 | 1 | 444.38 | 5459 | 4669 | 5963 | 6300 | | | |
| | 3.0 | 28657 | 1.0 | * | 547.47 | 4718 | 4669 | 5963 | 6300 | | | |
| | 2.1 | 32550 | 0.8 | , | 794.58 | 3935 | 4669 | 5963 | 6300 | | | |
| 3.0 | 229 | 742 | 1.9 | II | 7.43 | 837 | 1089 | 1971 | 2036 | SK 12063 - 100L/4 | 84 | 634 |
| | 201 | 846 | 1.7 | II | 8.47 | 857 | 1103 | 2036 | 2070 | SK 12063 - 100LH/4 | | |
| | 171 | 984 | 1.5 1.4 | II II | 9.96 | 884 | 1123 | 2115 | 2111 | | | |
| | 152 134 | 1109 1261 | 1.4 | ll I | 11.22 12.76 | 900 916 | 1127 1127 | 2174 2237 | 2133 2156 | | | |
| | 110 | 1521 | 1.1 | i | 15.57 | 938 | 1112 | 2331 | 2169 | | | |
| | 90 | 1792 | 1.1 | - 1 | 18.99 | 1064 | 1618 | 2401 | 2250 | | | |
| | 76 | 2082 | 1.0 | - 1 | 22.32 | 1094 | 1652 | 2376 | 2250 | | | |
| | 68 | 2346 | 0.9 | * | 25.15 | 1105 | 1670 | 2347 | 2250 | | | |
| | 60 | 2637 | 0.8 | * | 28.61 | 1121 | 1688 | 2311 | 2250 | | | |
| | 226 | 763 | 3.3 | III | 7.55 | 1078 | 1382 | 2518 | 2486 | SK 12080 - 100L/4 | 106 | 642 |
| | 178 | 966 | 3.0 | III | 9.56 | 1141 | 1465 | 2678 | 2599 | SK 12080 - 100LH/4 | | |
| | 159 | 1086 | 2.8 | III | 10.75 | 1170 | 1492 | 2759 | 2651 | | | |
| | 136 122 | 1250 1400 | 2.4 | III III | 12.51 14.01 | 1213 1240 | 1539 1555 | 2867 2925 | 2700 2700 | | | |
| | 107 | 1579 | 1.8 | II II | 15.98 | 1269 | 1586 | 2925 | 2700 | | | |
| | 89 | 1846 | 2.2 | III | 19.11 | 1400 | 2025 | 2925 | 2700 | | | |
| | 79 | 2076 | 2.0 | III | 21.49 | 1433 | 2025 | 2925 | 2700 | | | |
| | 68 | 2387 | 1.8 | II II | 25.00 | 1478 | 2025 | 2925 | 2700 | | | |
| | 61 53 | 2642 3013 | 1.7 1.5 | II II | 27.99 31.92 | 1517 1541 | 2025 2025 | 2925 2925 | 2700 2700 | | | |
| | 45 | 3536 | 1.4 | II II | 37.91 | 1584 | 2025 | 2925 | 2700 | | | |
| | 38 | 3972 | 1.2 | İ | 44.72 | 1667 | 2025 | 2925 | 2700 | | | |
| | 33 | 4564 | 1.1 | - 1 | 52.03 | 1699 | 2025 | 2925 | 2700 | | | |
| | 29 | 5047 | 1.1 | l I | 58.27 | 1721 | 2025 | 2905 | 2700 | | | |
| | 26 22 | 5681 6659 | 1.0 0.9 | * | 66.44 78.91 | 1715 1404 | 2025 2025 | 2810 2630 | 2700 2700 | | | |
| | | 0033 | 0.5 | | 70.31 | 1404 | 2025 | 2030 | 2700 | | | |
| | 128 | 1348 | 3.1 | III | 13.34 | 1539 | 1922 | 3632 | 3600 | SK 32100 100L/4 | 163 | 654 |
| | 105 | 1621 | 3.7 | III | 16.22 | 1674 | 2322 | 3645 | 3600 | SK 32100 - 100LH/4 | | |
| | 100 90 | 1729 1896 | 2.7 2.5 | III III | 17.11 18.97 | 1634 1672 | 2032 2075 | 3645 3645 | 3600 3600 | | | |
| | 83 | 2030 | 3.6 | III | 20.54 | 1787 | 2502 | 3645 | 3600 | | | |
| | 70 | 2371 | 3.4 | III | 24.27 | 1859 | 2630 | 3645 | 3600 | | | |
| | 57 | 2909 | 3.1 | III | 30.11 | 1953 | 2700 | 3645 | 3600 | | | |
| | 50 | 3201 | 3.0 | III | 34.32 | 2030 | 2700 | 3645 | 3600 | | | |
| | 44 | 3689 | 2.6 | III | 38.63 | 2061 | 2700 | 3645 | 3600 | | | |
| | 40 34 | 4090 4581 | 2.4 2.1 | III | 42.83 50.31 | 2102 2201 | 2700 2700 | 3645 3645 | 3600 3600 | | | |
| | 26 | 5734 | 1.0 | | 64.55 | 2309 | 2700 2700 | 3645 | 3600 | | | |
| | 24 | 6278 | 1.7 | II | 71.57 | 2354 | 2700 | 3645 | 3600 | | | |
| | 18 | 8053 | 1.4 | H | 94.19 | 2435 | 2700 | 3645 | 3600 | | | |

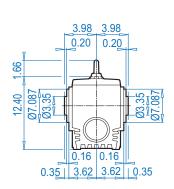
(AGMA Class $I = f_B 1.0 - 1.39$ $II = f_B 1.4 - 1.99$ $III = f_B \ge 2.0$ * = $f_B < 1.0$) (Model Type in blue is an Energy Efficient motor)

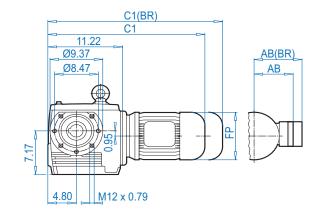




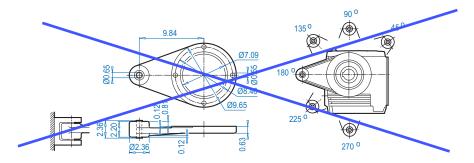


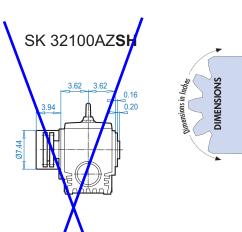
SK 32100AZ



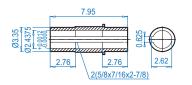


SK 32100AZ**D**

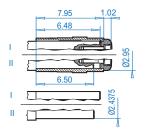


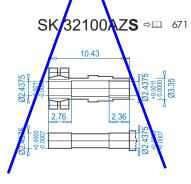


SK 32100AZ



SK 32100AZ**B** ⇒ □ 672





Motor dimensions

| Standard efficiency | 71S/L | 80S/L | 90S/L | 100L | | 132S/M | For Other Connection Possibilities please see | | |
|---------------------|-------|-------|---------|-------|-------|----------|---|--|--|
| Energy efficiency | | 80LH | 90SH/LH | 100LH | 112MH | 132SH/MH | ⇒ □ 666 & 667 | | |
| AB | 4.88 | 5.59 | 5.79 | 6.65 | 7.05 | 8.03 | | | |
| AB (BR) | 5.24 | 5.63 | 5.83 | 6.26 | 6.69 | 7.72 | | | |
| C1 | 20.28 | 21.26 | 22.87 | 24.06 | 24.96 | 28.35 | | | |
| C1 (BR) | 22.56 | 23.78 | 25.83 | 27.64 | 28.62 | 32.56 | | | |
| FP | 5.71 | 6.50 | 7.20 | 7.91 | 8.98 | 10.47 | | | |

(BR) denotes Brakemotor

ALTERNATE SHAFTS SEE PAGES 669 - 671





Performance Data

Energy Efficient (EPAct)

230/460V - 60Hz / EE

Inverter duty • TEFC

Synchronous speed 1800rpm @ 60Hz • 4-pole • Three-phase

Voltages: 230/460V - 60Hz • 1.15 Service Factor

Continuous Duty • 40°C Ambient • up to 3300ft Elevation

Class B temperature rise • Class F insulation











| Motor Type | | wer ^o n | Nn Full-load | Full-Load | | la/In | Code Letter | Torque Tn | Ta/Tn | Tk/Tn | pf | Eff. | Jm Inertia |
|----------------|------|-----------------------|-----------------|--------------------|--------|-------|----------------|--------------|-------|-------|------|------|---------------|
| | | | | 230V ^{a)} | 460V°) | | | | | | | | |
| | [hp] | [kW] | [rpm] | [A] | [A] | [%] | | [lb-in] | | | | [%] | [lb-ft²] |
| 80LH/4 | 1 | 0.75 | 1750 | 3.88 | 1.94 | 600 | L | 36.0 | 4.6 | 4.3 | 0.59 | 82.5 | 0.051 |
| 90SH/4 | 1.5 | 1.1 | 1740 | 4.3 | 2.15 | 630 | J | 53.1 | 3.5 | 3.8 | 0.76 | 84.0 | 0.085 |
| <u>901H</u> /4 | 2 | 1.5 | 1745 | 6.3 | 3.15 | 670 | K | 72.1 | 4.3 | 4.5 | 0.71 | 84.0 | 0.092 |
| 100LH/4 | 3 | 2.2 | 1765 | 8.6 | 4.3 | 790 | L | 105 | 3.6 | 4.7 | 0.73 | 87.5 | 0.178 |
| 112MH/4 | 5 | 3.7 | 1770 | 14.4 | 7.2 | 810 | L | 176 | 4.0 | 4.8 | 0.76 | 87.5 | 0.304 |
| 132SH/4 | 7.5 | 5.5 | 1780 | 20.9 | 10.5 | 820 | L | 259 | 4.3 | 4.6 | 0.74 | 89.5 | 0.75 |
| 132MH/4 | 10 | 7.5 | 1770 | 27.0 | 13.5 | 735 | J | 356 | 3.2 | 4.0 | 0.78 | 89.5 | 0.84 |
| 160MH/4 | 15 | 11 | 1765 | 35.8 | 17.9 | 810 | J | 527 | 2.6 | 3.2 | 0.85 | 91.0 | 1.23 |
| 160LH/4 | 20 | 15 | 1765 | 49 | 24.5 | 850 | K | 712 | 2.8 | 3.5 | 0.85 | 91.0 | 1.35 |
| 180MH/4 | 25 | 18.5 | 1770 | 61 | 30.5 | 840 | K | 879 | 2.8 | 3.6 | 0.83 | 92.4 | 3.56 |
| 180LH/4 | 30 | 22 | 1770 | 72 | 36 | 880 | K | 1046 | 3.1 | 3.9 | 0.83 | 92.4 | 4.51 |
| 200LH/4 | 40 | 30 | 1770 | 94 | 47 | 830 | J | 1424 | 3.0 | 3.6 | 0.86 | 93.0 | 7.60 |
| 225SH/4 | 50 | 37 | 1782 | - | 59 | 810 | J | 1758 | 3.0 | 3.4 | 0.84 | 94.1 | 9.5 |
| 225MH/4 | 60 | 45 | 1782 | - | 70 | 820 | J | 2109 | 3.0 | 3.5 | 0.85 | 94.3 | 11.6 |
| 250MH/4 | 75 | 55 | 1790 | - | 86 | 820 | J | 2619 | 2.9 | 3.4 | 0.86 | 95.1 | 20.4 |
| 280SH/4 | 100 | 75 | 1786 | - | 116 | 830 | J | 3506 | 2.9 | 3.5 | 0.85 | 94.5 | 36.3 |
| 280MH/4 | 125 | 90 | 1786 | - | 146 | 800 | J | 4385 | 2.8 | 3.3 | 0.85 | 94.9 | 43.4 |
| 315SH/4 | 150 | 110 | 1791 | - | 174 | 760 | Н | 5246 | 2.8 | 3.1 | 0.85 | 95.5 | 58.8 |
| 315MaH/4 | 200 | 150 | 1791 | - | 225 | 890 | J | 6995 | 3.3 | 3.5 | 0.86 | 95.9 | 86.9 |

a) Motors frame 225 and larger are standardly provided as single-voltage 460V and not as dual voltage

Full load power Full load speed Pn Nn ln Full load current Locked-rotor current la

Locked-rotor current ratio (%) la/In

Full-load torque Tn Locked-rotor torque Ta

Ta/Tn Locked-rotor torque ratio Break-down torque Τk Tk/Tn Break-down torque ratio

pf Eff **Power factor** Normal efficiency Jm Motor inertia



Circuit Safe JIC Enclosures



Manufactured from structural foam thermoplastic, Carlon® Circuit Safe® JIC enclosures provide high impact strength to eliminate dents and deformations along with high dielectric strength, excellent weathering capabilities, and excellent resistance to a wide range of corrosive agents, acids, alkalines, and salts. These UL approved and CSA recognized enclosures also withstand wet and dirty environments, while their thick wall construction make them a particularly good choice wherever condensation is a concern. Rated for use in Type 1, 3, 3S, 3X, 3SX, 4, 4X, 12, and 13 environments, Carlon Circuit Safe JIC enclosures are suited for virtually all indoor/outdoor industrial, MRO, and OEM applications. They are available in 10 sizes from 6 x 6 x 5 through 30 x 24 x 12 with a choice of screw or hinged design, opaque covers, or clear polycarbonate covers which protect devices from hostile environments while allowing monitoring of instrumentation and/or electrical functions.

Features

- Hinge caps make covers captive.
- Nonmetallic molded-in hinges on hinged models.
- No rough corners, sharp edges, or burrs.
- Nonconductive eliminates danger of electrical shock.
- Lid design provides greater usable internal volume.
- Ample interior space for ease of wiring.
- Fully gasketed.
- Ultraviolet stabilized for outdoor use.

Applications

- Instrument case.
- Junction and terminal boxes.
- Control and switching enclosures.
- Splice and pull boxes.
- Starter, pushbutton, and transformer housings.
- Meter and transformer cabinets.

Standards

- Meets NEMA Types 1, 3, 3S, 3X, 3SX, 4, 4X, 12, 13 as indicated.
- UL Listed per UL 50, enclosures for electrical equipment.
- CSA certified.
- JIC compliance.

122 www.carlon.com

Hinged Cover

Meets NEMA 1, 3, 3S, 3X, 3SX, 4, 4X, 12, 13







Features

- Nonmetallic mounting feet and all mounting hardware included.
- White painted 14 gauge steel or 1/4" PVC back panel (order separately).
- 304 (18-8) stainless steel screws (10-32 / 11/8").
- Lid design provides greater usable internal volume.
- Completely nonmetallic hinges.
- Brass screw inserts.
- Temperature Range: -30° to 230°F
- Material: polycarbonate molded base and cover.

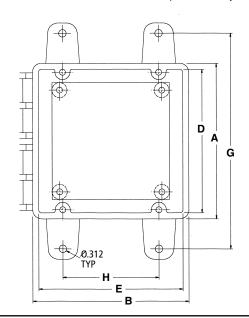
Factory Assembled

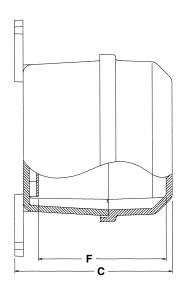
| | Opaque Cover | Clear Cover | | Externa | al | Dimens | ions Internal | l | Mour | nting | Std. Ctn. Qty. (lbs.) | Back Panel* Part Nos. | Panel | Std. Ctn. Qty. (lbs.) |
|---|-----------------|----------------|-------|---------|-----------------|--------|------------------|-----------------|------------------|-------|-----------------------------|--------------------------|---------------|--------------------------|
| | Part Nos. | Part Nos. | Α | В | С | D | E | F | G | Н | Opaque/Clear | Steel/PVC | Size | Steel/PVC |
| (| CJ665 | CC665 | 6.50 | 6.50 | 6.69 | 6.00 | 6.00 | 5.45 | 9.00 | 4.00 | 1 (Opa 3.5) / 1 (Clr 3.1) | JP66/JP66P | 4.88 x 4.88 | 1 (1.0) / 1 (0.3) |
| | CJ863 | CC863 | 8.50 | 6.50 | 4.49 | 8.00 | 6.00 | 3.25 | 11.00 | 4.00 | 1 (Opa 2.8) / 1 (Clr 3.1) | JP86/JP86P | 6.75 x 4.88 | 1 (1.0) / 1 (0.78) |
| | CJ1085 | CC1085 | 10.50 | 8.50 | 6.69 | 10.00 | 8.00 | 5.45 | 13.00 | 6.00 | 1 (Opa 5.2) / 1 (Clr 5.2) | JP108/JP108P | 8.75 x 6.88 | 1 (1.5) / 1 (0.7) |
| | CJ12106 | CC12106 | 12.50 | 10.50 | 7.69 | 12.00 | 10.00 | 6.45 | 15.00 | 8.00 | 1 (Opa 7.1) / 1 (Clr 8.4) | JP1210/JP1210P | 10.75 x 8.88 | 1 (2.0) / 1 (1.2) |
| | CJ14126 | CC14126 | 14.50 | 12.50 | 7.72 | 14.00 | 12.00 | 6.48 | 17.00 | 10.00 | 1 (Opa 9.0) / 1 (Clr 8.6) | JP1412/JP1412P | 12.75 x 10.88 | 1 (3.2) / 1 (1.7) |
| | CJ16147 | CC16147 | 16.50 | 14.50 | 8.46 | 16.00 | 14.00 | 7.22 | 19.00 | 12.00 | 1 (Opa 10.6) / 1 (Clr 11.9) | JP1614/JP1614P | 14.75 x 12.88 | 1 (4.7) / 1 (2.3) |

^{*}Order back panels separately.

Enclosures shipped with mounting feet, hinge caps and screws.

For factory installed pad lockable latch, consult Customer Service for price and delivery.





For emergency or normal shutdown of conveyor systems, elevator equipment, bulk handling systems, cranes, production and assembly lines, or any other equipment which may require immediate, positive shutdown.

Switch

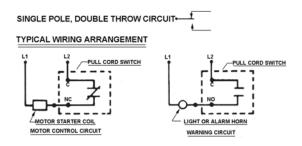
| Part # | Catalog # | SP/ST Switch |
|--------------|-----------|--------------------------|
| 035-225-0247 | PCL2S | Single end left – 2 sw. |
| 035-225-0347 | PCR2S | Single end right – 2 sw. |

Installation Instructions

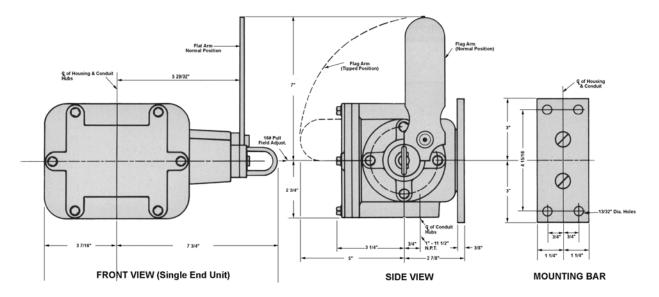
- Switch should be mounted on a flat surface by using two or more of the four 13/32" dia. mounting holes provided. One fastener in each end of the mounting bar will be sufficient.
- Distances between switches should not exceed 200 ft. We suggest you do not use more than 100 ft. of cable per switch end. This suggestion is for maximum safety purposes. Too much cable can result in a "long pull" situation due to slackness in the cable.
- Recommended spacing of cable support eye bolts is 10 ft. Care should be taken to keep the cable from becoming too slack. Care must also be taken that the cable is

- not so "tight" as to be pulling out the cable end connection clevis.
- Wiring should be through the motor control circuit.
- After supply power, actuate by pulling cable to check switch. This will insure that there is not too much slack in the cable and that there are no obstructions to the cable or flag arm.

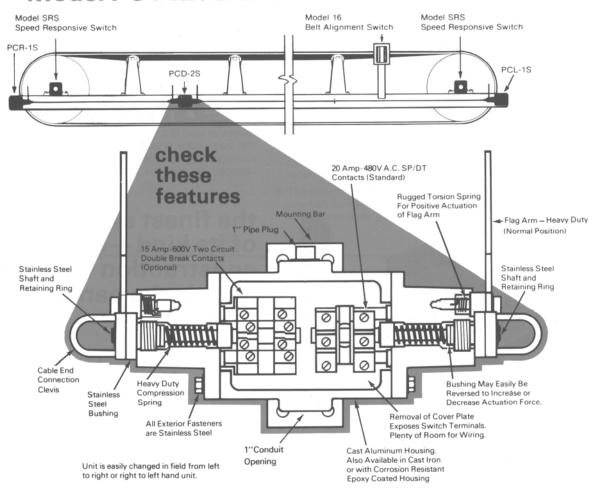
Typical Wiring



MODEL PC Dimensions



Model PC CABLE OPERATED SAFETY STOP SWITCH



OPERATIONS

A cable is connected from a fixed point to the cable end connecting clevis on the end of the unit. A pull on the cable (16 lb. force standard –25 lb. optional) with a movement of less than ½" will actuate the switch and trip the flag arm down, into the walkway, and lock the switch (and flag arm) in the actuated position. Unit is reset by returning the flag arm to the normal position.

TECHNICAL INFORMATION

Enclosure sealed for outside applications.
Standard unit meets NEMA 1, 3, 4X, and 12 requirements.

Conduit opening – 1 inch hole.

Housing – Cast aluminum (Std.) Flag arm – Steel with red epoxy paint coating

STANDARD SWITCH

Two SP.DT switch per side.

20 amps, 125, 250, or 480 vac;

10 amps, 125 vac "L" (tungsten lamp load);

1 hp, 125 vac; 1/4 amp, 250 vdc

Use two SP/DT switches per end when separate light or audible alarm is required.

Process Protection

Motion sensors

SITRANS WM100

Overview



SITRANS WM100 is a heavy-duty zero-speed alarm switch. This non-contacting unit provides cost-effective equipment protection even in the harshest conditions.

Benefits

- Up to 100 mm (4 inch) gap between SITRANS WM100 and targets
- Rugged, low maintenance suitable for tough environments
- · 1 SPDT Form C relay contact
- Provides cost-effective protection
- · Visual indication of target triggered pulse

Application

This rugged unit is impervious to dust, dirt, build-up and moisture and is ideal for such primary industries as mining, aggregate, and cement. Operating where other systems are prone to failure, the non-contacting design eliminates the need for lubricating, cleaning and part replacement. Downtime and clean-up expenses associated with conveying equipment failure are reduced by the SITRANS WM100. It alarms to minimize spillage, prevent extensive damage or even fire caused by belt slippage at the head pulley and warn against conveyor malfunction.

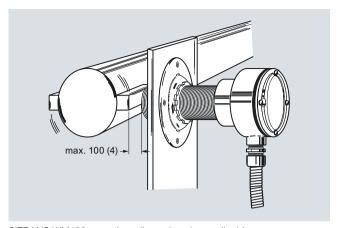
The SITRANS WM100 has built-in selectable start delays and 1 Form C relay contact. With an aluminum body, it operates from -40 to +60 $^{\circ}$ C (-40 to +140 $^{\circ}$ F).

Key Applications: tail pulleys, driven pulleys, motor shaft sensing, screw conveyor flights, bucket elevators

Design

Mounting

The WM100 probe should be mounted, using the supplied mounting flange, onto a vibration-free structure. The gap between the probe and the target should be sufficient such that there is no danger of the target damaging the probe. The maximum allowable gap is 100 mm (4") from the face of the target to the face of the probe for $4.5 \times 4.5 \, \text{mm}$ (3/16 × 3/16") keyway. The WM100 is sensitive to lateral disturbances to its magnetic field. If the WM100 is responding to motion from an interfering target, move the WM100 or install a ferrous plate (steel) as a shield between the WM100 and the interfering target. Where possible, the probe should be mounted such that the cable inlet is pointing downward to avoid accumulation of condensation in the casing. Connection of the probe should be made via flexible conduit for easier removal or adjustment of the probe.



SITRANS WM100 mounting, dimensions in mm (inch)

Technical specifications

| Mode of operation | | |
|---|--|--|
| Measuring principle | Disruption of magnetic field by ferrous target | |
| Typical application | Monitors absence or presence of motion in harsh conditions | |
| Output | | |
| Contact | 1 SPDT Form C dry relay contact, rated 5 A at 250 V AC, fail-safe operation | |
| Time delay | Start up: 10 14 seconds (5 7 seconds with 12 ppm jumper installed) | |
| Zero Speed (selected via a common jumper) | • 5 seconds ± 1 (minimum speed 10 15 ppm) or | |
| | • 10 seconds ± 2 (minimum speed 5 7.5 ppm) | |
| Rated operating conditions | | |
| Operating temperature | -40 +60 °C (-40 +140 °F) | |
| Design | | |
| Probe body | Aluminum | |
| Process mounting | 2" NPSL | |
| Connection box | Aluminum, ¾" NPT conduit entrance, 5 screw terminals plus grounding terminal for electrical connection, max. 12 AWG (3.30 mm²) wire size | |
| Gasketing | Neoprene | |
| Display | Red LED for verification of pulses | |
| Enclosure rating | Type NEMA 4x, 6, IP67 | |
| Dynamic range | Minimum 6 or 12 pulses per minute Maximum 3000 pulses per minute | |
| Shipping weight | 2 kg (4.4 lbs) | |
| Power supply | • 115 V AC/50 60 Hz, 7 VA • 230 V AC/50 60 Hz, 7 VA | |
| | • ± 10 % of rated voltage | |
| Certificates and approvals | CSA _{US/C} , CE, C-TICK | |

Process Protection Motion sensors

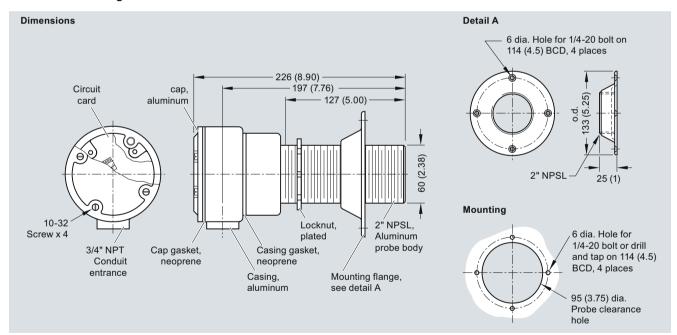
SITRANS WM100

| Selection and Ordering data | Order No. |
|--|----------------|
| SITRANS WM100 | 7MH7158 - |
| A heavy-duty zero-speed alarm switch that does not require a controller. | 0 A 0 0 |
| Model | |
| 115 V AC | Α |
| 230 V AC | В |

| Selection and Ordering data | Order code |
|--|---------------|
| Further designs | |
| Please add "-Z" to Order No. and specify Order code(s). | |
| Manufacturer's test certificate M to DIN 55 350, Part 18 and to ISO 9000 | C11 |
| Acrylic coated, stainless steel tag [13 x 45 mm $(0.5 \times 1.75")$]: Measuring-point number/identification (max. 16 characters), specify in plain text | Y17 |
| Operating Instructions | Order No. |
| SITRANS WM100, English C) | 7ML1998-5MW01 |
| SITRANS WM100, German C) | 7ML1998-5MW31 |
| Note: The operating instructions should be ordered as a separate item on the order. This device is shipped with the Siemens Milltronics manual CD containing the complete operating instructions library. | |
| Locknut, for WM100 and Millpulse 600 C) | 7MH7723-1CR |
| Mounting flange, for WM100 and Millpulse 600 | 7MH7723-1CS |
| Motion cable gland adaptor kit | 7MH7723-1JN |

C) Subject to export regulations AL: N, ECCN: EAR99.

Dimensional drawings



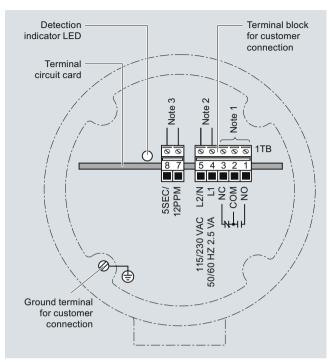
SITRANS WM100 dimensions in mm (inch) and mounting

Process Protection

Motion sensors

SITRANS WM100

Schematics



SITRANS WM100 wiring

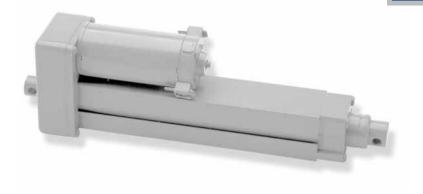
Notes:

- 1. Dry contacts shown in de-energized (alarm or shelf) state.
- SITRANS WM100 is manufactured for either 115 or 230 V AC operation. Check WM100 nameplate for applicable voltage. Correct voltage must be supplied. Voltages lower than specified will result in an inoperative condition. Voltages higher than specified will severely damage unit.
- 3. For 5 second time delay and a minimum 12 ppm range, connect jumper across terminals 7 and 8. Without a jumper, the default is a 10 second time delay and a minimum 6 ppm range





100 Pound Capacity
Series TMD100



Compact and economical. Corrosion resistant materials throughout. Timing belt drive for quiet, smooth operation. Low current draw and keyed translating tube simplify installation requirements.

Model Number

TMD01-1406-stroke
12 VDC without Limit Switches

TMD01-2406-stroke
24 VDC without Limit Switches

TMD01-1906-stroke

12 VDC with Limit Switches

TMD01-2906-stroke
24 VDC with Limit Switches

Note: Model number prefix for pulse generator models is PTD01.

Specifications

Capacity 100 lbs (45.4 Kgf, 445 N) tension or compression loads.

Static Load 300 lbs (136 Kgf, 1334 N) maximum.

AC Power Options See power supplies, part no. PS1260 and part no. 4824.

Stroke Lengths 2, 4, 6, 8, 10, and 12 inch 50, 102, 152, 203, 254, and 304 mm).

Duty Cycle 25% at full load and 77°F ambient

Construction Aluminum housings, stainless steel translating tube.

Mounting Double clevis ends. Translating tube clevis threaded 10-32UNF to accept rod end.

Load Screw Acme thread.

Limit Switches Independently adjustable. Includes control enclosure with relay, fuse and terminal

blocks for power and switch connections. Enclosure may be mounted on actuator tube

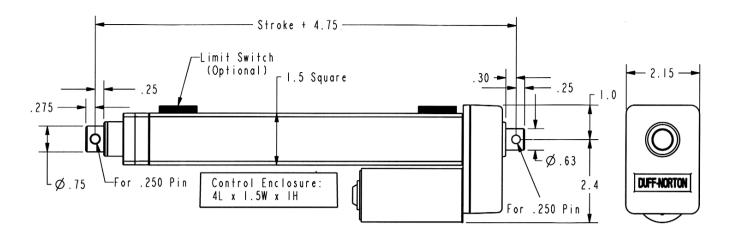
or mounted separately.

Extend/Retract Control . . Optional. See part no. EM1010-58.

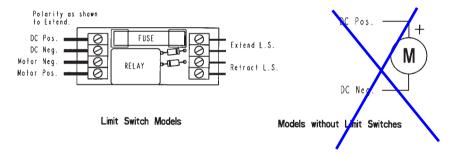
Temperature Range -20°F to 120° F (-29°C to 50°C).

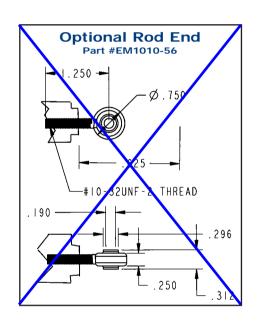
Restraining Torque Keyed translating tube resists rotation.

Pulse Generator Optional feedback device. Contact Application Engineering for specifications.

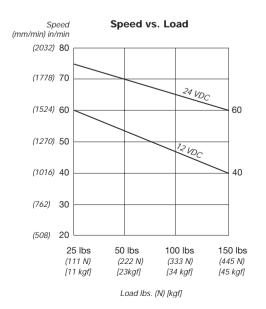


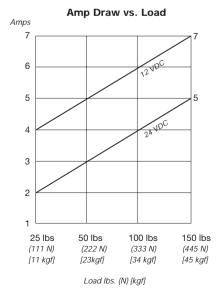
Wiring Connections

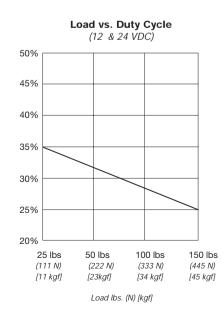




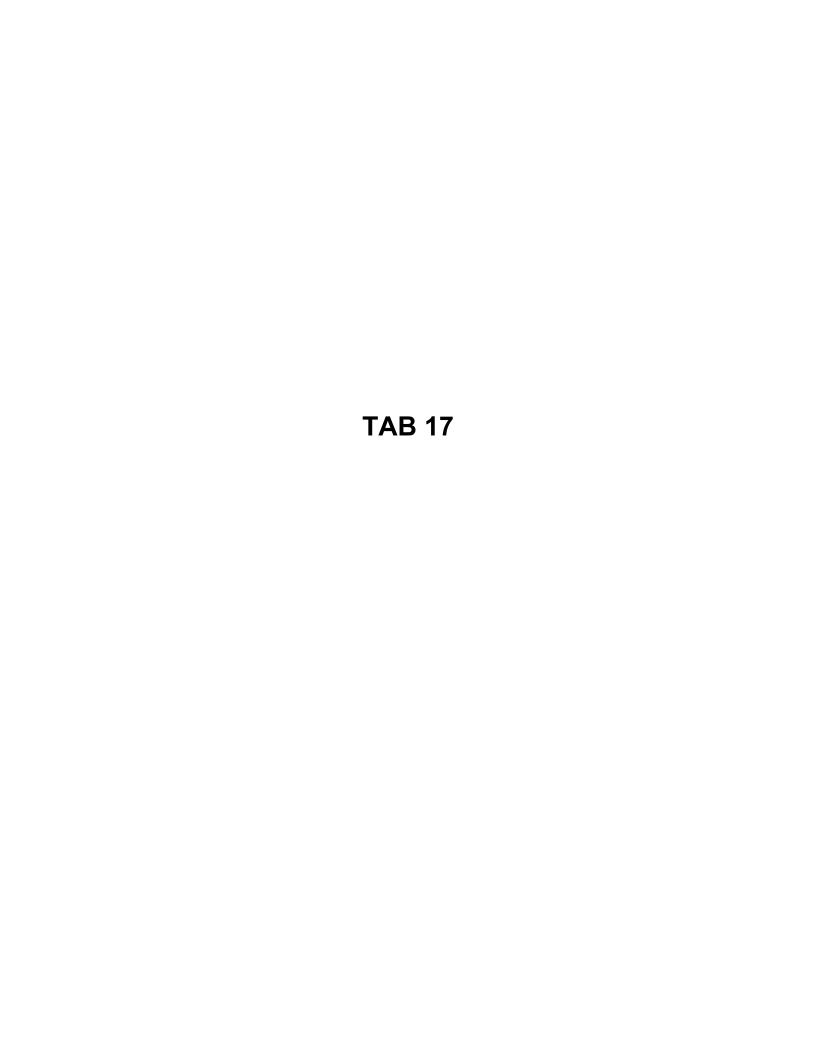
Performance Characteristics



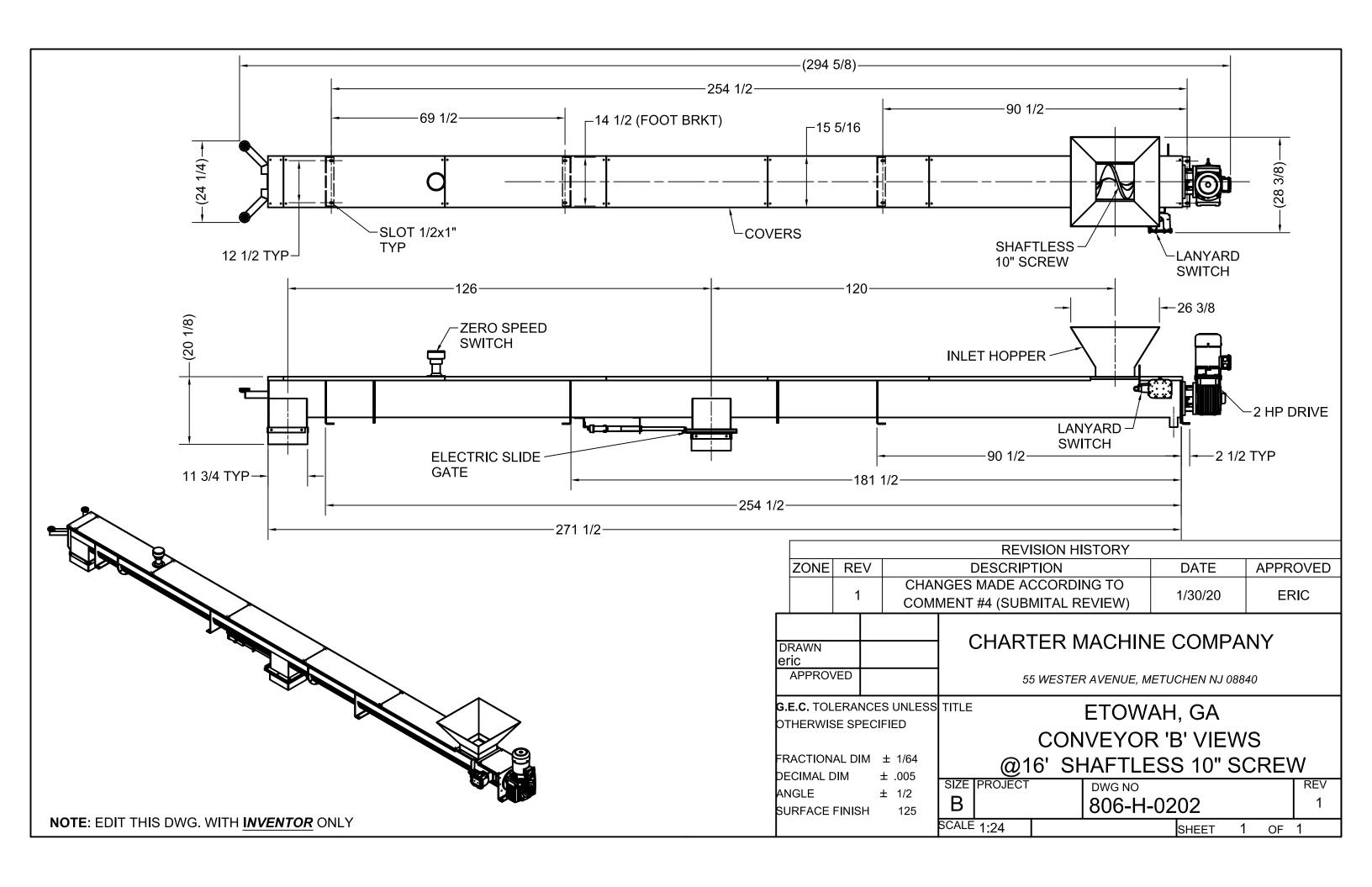




TMD100









DAWSON FOREST WRF ETOWAH WATER AND SEWER AUTHORITY

SPECIFICATIONS

10" SHAFTLESS SCREW CONVEYOR CHARTER MACHINE COMPANY

MODEL - 10SS CONV

Conveyor B – (2) Loadout Shaftless Screw Conveyors

1. <u>DISCHARGE CONVEYOR</u>

1.01 GENERAL

- A. Two (2) sludge loadout conveyors shall be supplied as shown on the Contract Drawings. The conveyors shall receive dewatered sludge cake from the inclined conveyor and distribute the material to the dumpsters..
- B. The screw conveyor system shall include; conveyor troughs with liners, spiral flighting, conveyor drive w/motor, gearbox adaptor w/packing rings, trough ends, covers, inlet hopper, outlet hopper and all hardware.
- C. The conveyor shall be a type shaftless screw conveyor approximately <u>16'-1"</u> long by 10" wide and be of the latest design and shall be fabricated of materials and in a fashion, which will fully perform the necessary functions.

1.02 TROUGHS

- A. The troughs of the conveyor shall be formed and constructed from type 304 stainless steel and conform to CEMA standards.
- B. The minimum trough thickness shall be <u>11</u> gage.
- C. A silicone gasket shall be applied at each trough connecting flange and a neoprene rubber gasket shall be applied between trough top edge and covers.
- D. Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape.
- E. 14 gage type 304 stainless steel covers in maximum 4 foot sections shall be provided over the top of the trough to enclose the unit with the exception of the inlet hopper section.
- F. A 2" drain shall be provided at least 4" from the drive end trough flange, bottom mounted and welded perpendicular to the trough.
- G. Each trough shall be equipped with filling and/or discharge spouts at the location shown on the drawings. If required, each filling and discharge spout shall be flanged and shaped suitable for interconnection to other devices.

1.03 WEAR LINER

- A. The wear liners for the conveyor shall be made from anti wear material Tivar Ceram P with incorporated micro glass beads designed for use in dewatering equipment with a high abrasive resistance filler content.
- B. The wear liner shall be furnished in 4' maximum sections with a minimum thickness of 1/4" for ease of replacement. The liner shall be held in place with welded hold down clips.

1.04 SPIRAL FLIGHTING

- A. The spiral flights shall be designed to convey material without a center shaft. The spiral flights shall be designed with the stability to prevent distortion and jumping in the trough. The torsional rating of the spiral shall be such that, at 150% of the nameplate horsepower, the drive unit cannot produce more torque than the torsional rating of the flighting.
- B. Spiral flights shall be manufactured from 8620 high strength alloy steel with a brinnel hardness of 225, and a maximum yield strength of 80,000 psi. The spiral flighting shall be painted with gray 2-part epoxy paint.
- C. The spiral flighting shall be manufactured in a two-stage process. Single stage forming is not acceptable. Sectional flighting formed from plate shall not be permitted. The first stage shall consist of tightly cold rolling at zero pitch on a mandrel which uses a device to control the plastic flow of the spiral during forming and maintain a uniform outside and inside diameter. The second stage of spiral forming shall consist of pulling the closely wound spiral in tension to the specified pitch in a device permitting free spiral rotation.
- D. Spiral flighting shall have full penetration welds at all splice connections, the flights shall be aligned to assure true alignment when assembled in the field and shall be made in accordance with supplier's requirements. The spiral flights shall be coupled to the end shaft by a flanged, bolted connection.
- E. The connection of the spiral to the drive system shall be through a flanged connection plate that is welded to the spiral forming a smooth and continuous transformation from the flange plate to the spiral. The drive shaft shall have a mating flange and shall be bolted to the spiral connection plate.
- F. A gland packing ring consisting of two Teflon coated packing rings shall seal the drive shaft at its penetration through the end plate, along with a greased labyrinth sealing system.

1.05 SUPPORTS

- A. The contractor shall be responsible for supporting the conveyors.
- B. Mounting feet shall be supplied on the conveyors as shown on the drawings.

1.06 DRIVE SYSTEM

- A. 2 HP drive assembly shall consist of an integral gearmotor, mounted directly to the screw shaft. Gearmotor housing shall be cast iron, furnishing complete protection under all conditions of service. Gears shall be manufactured and rated for continuous duty in accordance with AGMA standards, of heat-treated alloy steel. Gear reducer shall be Class II speed reducer.
- B. 2 HP, 3 phase, 60 cycle, TEFC induction motor and speed reducer shall be supplied to drive the conveyor screw at a constant speed of approximately 25 rpms. The conveyor drive shall be directly mounted to the screw drive shaft.
- C. The gear reducer and drive shall be designed to provide an applied torque adequate to start a fully loaded conveyor.
- D. The gearbox and motor shall be factory mounted on the conveyor, factory tested and shipped fully assembled.

1.07 SAFETY DEVICES

- A. A zero-speed switch shall be provided. The switch shall be mounted to one of the conveyors covers.
- B. All controls, interlocks, and motor starters for the conveyor shall be contained in the belt filter press control panel.
- C. A safety stop switch shall be supplied for each conveyor.

1.08 SLIDE GATE

- A. Slide gates shall be provided as shown on the drawings. Each slide gate shall be specifically designed to operate as an integral part of the conveyor system, and shall be supplied by the manufacturer.
- B. The slide gate shall be electro-mechanically operated and shall be designed with a maximum vertical dimension of 10" including the operator. The slide gate shall be

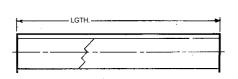
- designed so that in the full, open position at least one rotation of the spiral is exposed to the opening in the direction of transport.
- C. The slide gates shall have an opening the full width of the conveyor trough. Minimum opening size shall be 11" x 12". The slide gates shall be fabricated from 304 stainless steel, and UHMW.

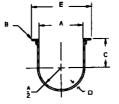


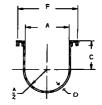
Standard Conveyor Trough



Standard conveyor troughs have a U-shaped steel body with angle iron top flanges or formed top flanges and jig drilled end flanges.







Angle Flange

Formed Flange

| | _ | Angle | | Angle Flan | ged Trough | | | Formed F | langed Trou | gh ▲ | | | | | | |
|--|---|---|--|-------------------------------------|--------------------------|--------------------------|--|--|------------------------------------|--|--------------------------|---------------|------------------|---------------|---|---|
| Conveyor Diameter | D | Flanged | Wei | • | | ight | | | ight | | ight | A | В | С | E | F |
| | Trough Thick. | Part Number | 10´* Length | 5´ Length | 12´ Length | 6´ Length | Part Number | 10´ Length | 5´ Length | 12´ Length | 6´ Length | | | | | |
| 4 4 | 10-0A: 14 12 | 40TA16 40TA14 40TA12 | 58 69 78 | 29 99 42 | 111 | 111 | 40TF16 40TF14 40TF12 | \$ \$ ₹ | 20 20 90 | | | 5 | 4 | 0% | 7% 7% 7% | 7% 7% 8 |
| •••• | 10-0A: 14 12 10 10 | 60TA16 60TA14 60TA12 60TA10 60TA7 | 87 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 | 44 49 89 79 80 | ш | 11111 | 00TF10 00TF14 00TF12 00TF10 00TF7 | 885‡\$ | 92 90 50 94 79 | | шш | 7 | 4+4 | 41/2 | 0% 0% 0% 0% 0% | * 7 7 * |
| ••••• | 0 | 96TA16 96TA14 96TA12 96TA10 96TA7 96TA3 | 127 156 179 200 200 | 60 70 67 402 424 452 | ппп | шш | 90TF14 90TF14 90TF12 90TF10 90TF7 90TF7 | % | \$ \$ \$ \$ \$ \$ | шш | шш | 10 | 17/ 2 | 6% | 10% 10% 10% 10% 10% 10% | \$ |
| 10 10 10 10 | 16-GA. ■ 14 12 40 % | 10CTA12 10CTA12 10CTA12 10CTA12 10CTA13 10CTA7 | 146 199 164 179 299 900 | 92 402 401 400 | 111111 | | 100TF10 100TF14 100TF12 100TF10 100TF7 100TF0 | 8 5 1 1 1 8 | 54 62 60 94 420 450 | = | | 11 | 1½ | 6% | 14% 14% 14% 14% 14% 14% | 14% 14% 14% 14% 14% 14% |
| 12 12 12 12 | □ 12 CA. 10 % | 420TA42 420TA40 420TA7 420TA8 | 497 294 294 972 | 110 100 164 200 | 200 201 950 410 | 105 100 107 211 | 420TF12 420TF10 420TF7 420TF3 | 464 467 272 657 | 95 117 150 191 | 107 224 026 420 | 114 140 100 200 | 10 | 2 | 7% | 47% 47% 47% 47% | 17½ 17½ 17% 17% |
| 14 14 14 14 | □ 12 GA. 10 3/ ₁₆ 1/ ₄ | 14CTA12 14CTA10 14CTA7 14CTA2 | 214 258 328 418 | 121 143 180 224 | 257 309 394 501 | 145 172 216 269 | 14CTF12 14CTF10 14CTF7 14CTF3 | 183 207 304 403 | 102 127 168 215 | 219 248 365 483 | 122 152 202 258 | 15 | 2 | 91/4 | 191/4 107/16 193/8 191/2 | 19½ 19½ 19¾ 19½ |
| 16 16 16 16 | □ 12 GA. 10 ³ / ₁₆ ½ | 16CTA12 16CTA10 16CTA7 16CTA3 | 238 288 368 471 | 133 150 200 243 | 285 345 442 565 | 160 191 240 291 | 16CTF12 16CTF10 16CTF7 16CTF3 | 206 234 345 455 | 107 144 188 228 | 247 281 414 546 | 128 173 226 273 | 17 | 2 | 10% | 21½ 21½ 21¾ 21½ | 21½ 21½ 21¾ 21½ |
| 18 18 18 18 | □ 12 GA. 10 ³ / ₁₆ ¹ / ₄ | 18CTA12 18CTA10 18CTA7 18CTA3 | 252 353 444 559 | 159 170 243 298 | 302 423 533 671 | 191 204 291 358 | 18CTF12 18CTF10 18CTF7 18CTF3 | 240 269 394 520 | 133 165 217 275 | 288 323 473 624 | 160 198 260 330 | 19 | 2½ | 12% | 241/4 245/16 243/8 241/2 | 24½ 24½ 24¾ 24½ |
| 20 20 20 | □ 10 GA. ¾ ₆ ¼ | 20CTA10 20CTA7 20CTA3 | 383 484 612 | 228 271 334 | 460 581 734 | 274 325 401 | 20CTF10 20CTF7 20CTF3 | 296 434 573 | 190 247 315 | 355 521 687 | 228 296 378 | 21 | 2½ | 13½ | 26 ⁵ / ₁₆ 26 ³ / ₈ 26 ¹ / ₂ | 26½ 26¾ 26½ |
| 24 24 24 | □ 10 GA ^{3/16} ^{1/4} | 24CTA10 24CTA7 24CTA3 | 443 563 717 | 255 319 363 | 531 676 860 | 306 383 435 | 24CTF10 24CTF7 24CTF3 | 384 514 678 | 227 293 339 | 461 617 813 | 272 352 406 | 25 | 2½ | 16½ | 30 ⁵ / ₁₆ 20 ₃ / ₈ 30½ | 30½ 30¾ 30½ |

□ Standard Gauge Bolt Patterns Page H-40

All troughs available in other materials such as stainless, aluminum, abrasion resistant, etc.

▲ Double formed flange standard on all sizes through 10 ga.



Size and Capacity

| CONFIGURATIONS / OPTIONS | | | | | | | | | |
|-----------------------------|----------------|---|--|--|--|--|--|--|--|
| | Type of Steel | Carbon SteelHigh Brinell Carbon SteelStainless Steel | | | | | | | |
| | Capacity | • Up to 17,000 CFH | | | | | | | |
| | Diameter | 6" to 30" (and larger) | | | | | | | |
| | Pitches | • Full, 2/3, 1/2 | | | | | | | |
| | Trough | CEMA Standards | | | | | | | |
| | Options | Liners - UHMW - Xylethon - Tivar - AR Rider Bars Inspection and Overflow Hatches Various Drive Configurations Available Housings: CEMA Standard U-Trough or Split Tubular Housing | | | | | | | |
| Shaftless Screw Live Bottom | Configurations | Single or Inner/Outer Flight Design Twin Screw Multiple Live Bottom Feeders Inclined Screw Conveyors Grit Washers Vertical | | | | | | | |

^{*}Conveyors shown without cover for illustration purposes only. Please follow manufacturing safety guidelines when operating conveyors.

| | 50% Trough Loading* | | | | | | | | | | |
|--------------|---------------------|-------------|------------|----------------|------------|--|--|--|--|--|--|
| Nom. Dia. | A Dia. | B Inside | C Pitch | CFH @ 1 RPM | Max RPM | | | | | | |
| 6 | 6 | 7 | 6 | 2.5 | 25 | | | | | | |
| g | g | 10 | g | 9.1 | 25 | | | | | | |
| 10 | 10 | 11 | 10 | 12.7 | 25 | | | | | | |
| 12 | 12 | 13 | 12 | 21.0 | 25 | | | | | | |
| 14 | 14 | 15 | 14 | 34.7 | 25 | | | | | | |
| 16 | 16 | 17 | 16 | 51.9 | 25 | | | | | | |
| 18 | 18 | 19 | 18 | 75.1 | 25 | | | | | | |
| 20 | 20 | 21 | 20 | 104 | 25 | | | | | | |
| 24 | 24 | 25 | 24 | 182 | 25 | | | | | | |
| 30 | 30 | 31 | 30 | 359 | 25 | | | | | | |

^{*} Based on horizontal application only.



TIVAR® Ceram P®

TIVAR® Ceram P® HANDLES INTENSE SLIDING ABRASION APPLICATIONS

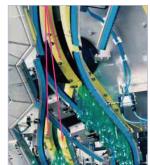
Reduce maintenance downtime, extend equipment service life and reduce replacement part costs with TIVAR® Ceram P® from Quadrant Engineering Plastic Products.

Developed for severe service conditions, TIVAR® Ceram P® outwears and out-performs other materials in highly abrasive industrial environments such as:

- agriculture
- chemical handling/processing
- filter manufacturing
- paper production (lumber mills)



TIVAR® Ceram P® combines abrasion resistance and long wear-life in one easy-to-machine material.



TIVAR® Ceram P® is the answer for extremely high wear conveyor components.

A shatter-resistant alternative to sintered ceramics, TIVAR® Ceram P® maintains its key properties - abrasion-, corrosion-, moisture-, chemical-resistance, low coefficient of friction - in a variety of intense sliding wear abrasion applications such as:

- bearing pads
- grain strippers
- guide boards/guide rails
- regulating discs
- slide elements in telescoping booms
- split rings in centrifugal pumps
- wear plates
- wear rings
- wearstrips



TIVAR® Ceram P® performs well as a slide panel in telescoping booms. Outstanding abrasion resistance adds to the wear-life of the pad.

When your application calls for a material with extreme wear-resistance in a severe, abrasive environment, choose TIVAR® Ceram P®.

Important: Most plastics will ignite and sustain flame under certain conditions. Caution is urged where any material may be exposed to open flame or heat generating equipment. Use Material Safety Data Sheets to determine auto-ignition and flashpoint temperatures of material or consult Quadrant. TIVAR® and Ceram P® are registered trademarks of the Quadrant group of companies.

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QUADRANT

You inspire ... we materialize®

QUADRANT ENGINEERING PLASTIC PRODUCTS

TIVAR Ceram P is a wear improved PE-UHMW material with incorporated micro glass beads, specifically developed for use in the dewatering zone of paper machinery equipped with plastic wires and manufacturing paper with high abrasive filler content.

Physical properties (indicative values *)

| PROPERTIES | Test methods | Unite | Charles and the second |
|---|---------------------------------------|--|---|
| Colour | - | - | yellow-green |
| Average molar mass (average molecular weight) - (1) | - | 10 ⁶ g/mol | 9 |
| Density | ISO 1183-1 | g/cm³ | 0.96 |
| Water absorption at saturation in water of 23 °C | - | % | < 0.1 |
| Thermal Properties (2) | | | |
| Melting temperature (DSC, 10 °C/min) | ISO 11357-1/-3 | °C | 135 |
| Thermal conductivity at 23 °C | - | W/(K.m) | 0.40 |
| Average coefficient of linear thermal expansion between 23 and 10 | 10 °C - | m/(m.K) | 200 x 10 ⁻⁶ |
| Temperature of deflection under load: | | **** | |
| - method A: 1.8 MPa | ISO 75-1/-2 | °C | 42 |
| Vicat softening temperature - VST/B50 | ISO 306 | °C | 80 |
| Max. allowable service temperature in air: | | | |
| - for short periods (3) | - | °C | 120 |
| - continuously : for 20,000 h (4) | - | °C | 80 |
| Min. service temperature (5) | • | °C | -150 |
| Flammability (6): | | ······································ | 24.24.7 |
| - "Oxygen Index" | ISO 4589-1/-2 | % | < 20 |
| - according to UL 94 (6 mm thickness) | - | (<u>*</u> | HB |
| Mechanical Properties at 23 °C (7) | | | |
| Tension test (8): | | N.E | |
| - tensile stress at yield (9) | ISO 527-1/-2 | MPa | 18 🤄 |
| - tensile strain at yield (9) | ISO 527-1/-2 | % | ∕15 िः |
| - tensile strain at break (9) | ISO 527-1/-2 | % % | > 50 |
| - tensile modulus of elasticity (10) | ISO 527-1/-2 | MPa | 750 |
| Compression test (11): | · · · · · · · · · · · · · · · · · · · | 7 / | 6 107 BY |
| - compressive stress at 1 / 2 / 5 % nominal strain (10) | ISO 604 | MPa | 7 / 11 / 17.5 |
| Charpy impact strength - unnotched (12) | ISO 179-1/1eU | kJ/m² | no break |
| Charpy impact strength - notched | ISO 179-1/1eA | kJ/m² | 105P |
| Charpy impact strength - notched (double 14° notch) - (13) | ISO 11542-2 | kJ/m² | 125 |
| Ball indentation hardness (14) | ISO 2039-1 | N/mm² | 33 |
| Shore hardness D (14) | ISO 868 | | 60 |
| Relative volume loss during a wear test in "sand/water-slurry"; | 3 8 7 30 5 | | |
| TIVAR 1000 = 100 | ISO 15527 | • | 75 |
| Electrical Properties at 23 °C | | | |
| Electric strength (15) | IEC 60243-1 | kV/mm | 45 |
| Volume resistivity | IEC 60093 | Ohm.cm | > 10 14 |
| Surface resistivity 4 | IEC 60093 | Ohm | > 10 12 |
| Relative permittivity ε _r : - at 100 Hz | IEC 60250 | | - 10 |
| - at 1 MHz | IEC 60250 | - | _ |
| Dielectric dissipation factor tan δ: - at 100 Hz | IEC 60250 | - | |
| - at 1 MHz | IEC 60250 | _ | _ |
| Comparative tracking index (CTI) | IEC 60112 | | |

Legend:

- This is the average molar mass of the PE-UHMW resins (irrespective of any additives) used for the manufacture of this material. It is calculated by means of the Margolies-equation M = 5.37 x 10⁴ x [η]. with [η] being the intrinsic viscosity (Staudinger index) derived from a viscosity measurement according to ISO 1628-3:2001, using decahydronaphtalene as a solvent (concentration of 0.0002 g/cm²).
- (2) The figures given for these properties are for the most part derived from raw material supplier data and other publications.
- (3) Only for short time exposure (a few hours) in applications where no or only a very low load is applied to the material.
- Temperature resistance over a period of 20,000 hours. After this period of time, there is a decrease in tensile strength measured at 23 °C of about 50 % as compared with the original value. The temperature value given here is thus based on the thermal-oxidative degradation which takes place and causes a reduction in properties. Note, however, that the maximum allowable service temperature depends in many cases essentially on the duration and the magnitude of the mechanical stresses to which the material is subjected.
- (5) Impact strength decreasing with decreasing temperature, the minimum allowable service temperature is practically mainly determined by the extent to which the material is subjected to impact. The value given here is based on unfavourable impact conditions and may consequently not be considered as being the absolute practical limit.
- (6) These estimated ratings, derived from raw material supplier data and other publications, are not intended to reflect hazards presented by the material under actual fire conditions. There is no 'UL File Number' available for TIVAR Ceram P stock shapes.
- The figures given for these properties are average values of tests run on test specimens machined out of 20 - 30 mm thick plates.
- Test specimens: Type 1 B
- (9) Test speed: 50 mm/min
 -)) Test speed: 1 mm/min.
- 1) Test specimens: cylinders Ø 8 mm x 16 mm
- Pendulum used: 15 J
- (13) Pendulum used: 25 J
- (14) Measured on 10 mm thick test specimens.
- (15) Electrode configuration: Ø 25 / Ø 75 mm coaxial cylinders; in transformer oil according to IEC 60296; 1 mm thick test specimens.
- This table, mainly to be used for comparison purposes, is a valuable help in the choice of a material. The data listed here fall within the normal range of product properties. However, they are not guaranteed and they should not be used to establish material specification limits nor used alone as the basis of design.

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It thus remains the customer's sole responsibility to test and assess the suitability and compatibility of Quadrant's Products for its intended applications, processes and uses, and to choose those Products which according to its assessment meet the requirements applicable to the specific use of the finished product. The customer undertakes all liability in respect of the application, processing or use of the aforementioned information or product, or any consequence thereof, and shall verify its quality and other properties.









UNICASE™ Construction



UNICASE™ Construction refers to an overall design concept that allows proper alignment of the gear meshes and the bearings. All of the main drive train components are contained in a one-piece housing. All bearing bores, pilots, and registers of the housing are machined in one set-up. First, the foot or inspection cover is machined. The housing is then positioned from this first cut to machine all remaining features. Specially designed, dedicated fixtures are used to hold the castings rigidly and accurately for machining. This assures positive bearing and gear alignment.

Covers or openings are minimized, reducing the number of potential leak paths, and subsequently the probability of a leak occurring. A standard Failure Effects and Modes Analysis (FEMA) shows that this is the best design. Although this type of design tends to make assembly more difficult, it results in a superior product. Fortunately, NORD has specially designed tools to assure proper, efficient assembly.

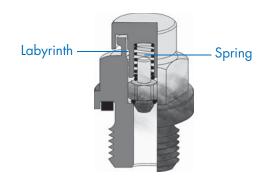
All covers and openings are un-stressed access panels, or are positioned with a large pilot diameter. An un-stressed access panel is the best, because there are no forces trying to break the seal between the components.

In no case is a bearing bore split even if it is internal to the reducer. Designs with split bearing bores require bolts to hold the bore together. It is common for bearings to fail due the outer face being improperly supported, causing a stress riser at seams in bearing bores.

AUTOVENT ™ Breather

When a gear reducer is operated intermittently, it warms up while operating and cools down after being shut off. The oil expands when it heats up and compresses the air inside the housing, resulting in a positive pressure that could cause the oil seals to rupture if left unregulated. Conversely, when the oil is cooling, it will reduce in volume, and outside air, and potentially humidity and dirt, will enter the reducer. A small concentration of water in mineral oil will cause foaming, will reduce the lubricating properties of the oil, and will promote a rapid degradation of the lubricant's chemistry. Internal components, such as bearings and gears, may quickly be damaged by a small quantity of these contaminants alone or in combination with caustic or corrosive fluids.

The Autovent™ operates like a check-valve to allow the reducer to dissipate internal pressure during warm-up, while preventing lubricant contamination during cooling. A spring presses a ball against a machined orifice until the heating of the oil and air inside the reducer exceeds 2 psi. Between 2 and 3 psi, the spring compresses and the ball is displaced, allowing pressure to escape. The internal pressure then drops below 2 psi, the spring elongates, and the ball returns to its initial position, sealing the unit. As the reducer continues to cool, the unit will temporarily develop a slight vacuum.



NORD Gear supplies all reducers, except those that are "lubricated for life", with an Autovent™ as a standard feature. In addition, the Autovent™ gives NORD Gear the ability to ship reducers and gear motors with factory-filled lubricant. Since the spring keeps the valve tightly closed regardless of the reducer's orientation, the unit can be inverted during shipment and not develop an oil leak. A metal canopy protects the ball and spring from damage. During operation, oil splash and mist are generated. In contrast to the Autovent™ breather, an open breather can allow these to migrate out, resulting in an undesirable brownish stain around the vent plug.







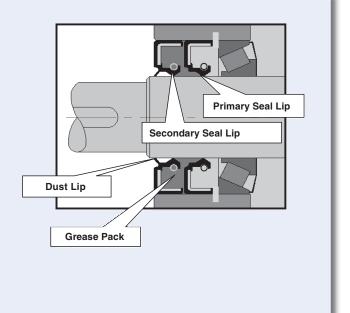


Quadrilip™ Seals

Quadrilip[™] seals are standard for most UNICASE[™] gear frame sizes. The smaller gear units do not have dual seals, but the quality of shaft preparation and seal installation is universal.

The Quadrilip™ system is a sign of quality. The seal system consists of two sealing lips, a dust lip, and a grease chamber between the seals. The grease chamber functions as an additional barrier: it helps protect the inner seal lip from damage, and helps prevent external contamination from working its way in. The grease also lubricates the seal lips and keeps them soft and flexible, and prevents them from wearing quickly by reducing friction between the seal lip and shaft surface.

All shaft seal surfaces are either roller burnished or plunge ground, and are an important part of the seal system. With these processes a smooth surface finish of 12-24 pinch rms can be achieved without machine lead that causes the seal surface to act as a pump to force oil out from the reducer or gearmotor.



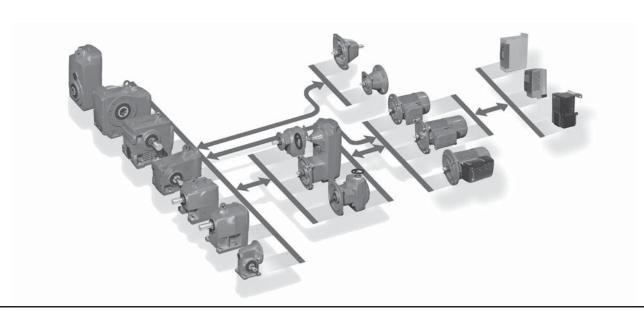
Modular Design

NORD's modular design philosophy provides you with a competitive edge by allowing you to configure drive systems to exactly fit to your applications. More than 20,000,000 combinations of totally unique gearmotors and speed reducers are possible - assembled in-line or right-angle, mounted by foot or flange, featuring solid or hollow shafts with either metric or inch extensions - to give you complete freedom to specify a drive solution that's perfect for you.

Benefits

- More output speeds
- More mounting arrangements/Greater flexibility
- Fewer gear stages/Lower costs
- Metric and inch products

NORD engineers stand ready to assist you with your custom applications. Most standard drives can be modified to your purposes, and custom designs can be developed for special applications.





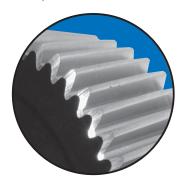






Gearing

The gears are made from high strength steel forgings. The teeth are case-hardened then precision finished using either grinding or skive-hobbing methods. As a result, high tooth-to-tooth accuracy is ensured which delivers steady output motion. Tooth stresses are controlled to assure very long durability with infinite life of the gear teeth. Gear torque ratings are thus optimized for a high degree of reliability.



Gear Quality Level: AGMA Class 11-13.

Gear Hardness: Case hardened to 58-62 Rockwell-C.

Gear Finish: All high-speed gears are ground; low-speed gears are skive finished after hardening.

Edge Deburred Gearing. Designed for infinite life

High-Strength Gearcases

Standard housing material is Class 35 Cast Iron. Some units utilize a corrosion resistant aluminum alloy or diecast aluminum alloy housing material.

NORD's robust housings maintain heavy wall sections. Some competitors have reduced material used in their housings for cost savings. Material has been reduced to the point that the walls are too thin and can flex under load. This will misalign the gears and bearings. In addition, bearing outer races need to be supported with a stiff backing to achieve their rating. Thin housings may not properly support the outer bearing races. Housings are internally painted with a primer to seal casting process residue and fill any surface imperfections.

Lubrication

NORD Gear supplies most all gear units factory-filled with the appropriate oil lubrication type and fill-level per the specified reducer mounting position. The current exceptions include Clincher™ Series parallel-shaft gear units: SK10282, SK10382, SK11282, SK11382, SK12382, and SK9096.1 which are supplied without oil.

It is important that proper oils are used in a gear reducer. By supplying the appropriate lubricant type and amount, NORD Gear eliminates the "guess work" for the consumer.

Properly selected oil will have the required additives to prevent the unwanted formation of foam, oxidation, and rust. As well, the proper extreme pressure additive may be used for hardened alloy steels, or more importantly, not used when it will be a detriment to the bronze gearing in worm reducers. For additional technical information please reference the Lubrication section of this catalog beginning on page 36.

Please see the lubrication table on page 42 for the standard and optional reducer lubrication types, and their service temperature ranges.

High-Performance Motors & Brakemotors

NORD motors are designed to run cool for longer service life. Low rotor inertia and high starting torque allow peak performance in the most difficult applications for inverter and vector duty per NEMA MG 1-2006 Section 31.4.4.2 voltage spikes. Our motors are internationally accepted, conforming to North American NEMA MG 1 and international IEC electrical specifications. High performance options include brakes, encoders, and forced cooling fans.











Compact Coupled (NEMA C-face Input)

NORD Gear supplies reducers with special couplings that eliminate the need for quill-type input with NEMA and IEC frame motors. This allows for superior input shaft alignment and smooth torque transfer, reducing incidents of bearing, shaft, and key failures. Smaller reducers use a proprietary one piece nylon, curved tooth gear coupling with a bronze insert. These materials were selected for their ability to accommodate misalignment, as well as corrosion protection. The bronze insert eliminates steelto-steel contact allowing ease of motor disassembly even after years of service. Quill-type inputs have steel-to-steel contact between the motor shaft and the quill-input shaft of the reducer. This metal-to-metal contact will undergo fretting corrosion, especially in corrosive or moist environments. Each reducer is shipped from the factory with a sticker on the coupling that shows the proper coupling placement from the motor mounting surface.





Energy Efficient

Combining the UNICASE™ close dimension control and torsionally stiff, stable housings with high quality gearing results in higher operating efficiencies. Our industry leading 98.5% efficiency per gear stage results in significant power savings over the long haul.

Lowering your operating costs is one of our greatest goals! NORD research and development focuses on energy efficiency, with gearboxes, motors, and frequency inverters designed for lower energy consumption. Our fully diverse line of in-line or right-angle units and motors has been developed to suit your needs.

Stainless Steel Paint

NORD stainless steel paint is a plural component, aliphatic polyurethane paint with 316 stainless steel flakes with outstanding physical properties and excellent appearance. This paint has excellent adhesion to cast iron, steel, aluminum and most plastics and can be used as a topcoat or as a primer. The NORD stainless steel paint also has outstanding exterior durability and corrosion resistance, and superior chemical resistance when exposed to most industrial solvents, lubricants and cutting oils. The NORD stainless steel paint is excellent for both indoor and outdoor duty and is non-flammable.

It is designed as a USDA incidental contact coating acceptable for use in food, drug and cosmetic industries. Incidental contact means that the paint may not contain antimony: arsenic, cadmium, lead, mercury, selenium or other materials such as carcinogens, mutagens, or teratogens classified as hazardous substances.

Recapping NORD Stainless Steel Paint Features:

- Solvent based polyurethane paint for increased durability
- Outstanding exterior durability and corrosion resistance
- Superior chemical resistance when exposed to industrial solvents (laquer thinner, acetone, gasoline, Xylol), lubricants, and cutting oils
- Cured coating develops 2H hardness, yet exhibits excellent high impact resistance
- Heat and humidity resistant (tested for 500 hours at 100%) humidity and 100°F)
- USDA/H1 compliant incidental contact
- Colors Stainless steel gray, white, blue, red, black, and orange









2.0 hp Gearmotors

| | Output | | | | Gear | Star | ndard rings | Heav | y Duty ngs (VL) | Model Type | Weight | |
|----------------|----------------|-----------------------|----------------|------------|------------------|------------------|-----------------|-------------------|--------------------|-------------------|--------|------|
| Power | Speed | Torque | | Class | Ratio | | | | | Type | | Page |
| P _n | n ₂ | T ₂ | f _B | | i _{tot} | F _{R N} | F _{AN} | F _{R VL} | F _{A VL} | | Ī | |
| | | | | | | OHL | Thrust | OHL | Thrust | | 110 | |
| [hp] | [rpm] | [lb-in] | | | | [lb] | [lb] | [lb] | [lb] | | [lb] | |
| 2.0 | 220 | 521 | 3.4 | III | 7.55 | 1132 | 1539 | 2588 | 2633 | SK 12080 - 90L/4 | 97 | 642 |
| | 174 | 660 | 3.2 | III | 9.56 | 1211 | 1654 | 2752 | 2700 | SK 12080 - 90LH/4 | | |
| | 154 | 742 | 3.1 | III | 10.75 | 1249 | 1706 | 2842 | 2700 | | | |
| | 133 118 | 854 957 | 3.0 2.8 | III | 12.51 14.01 | 1298 1337 | 1782 1836 | 2925 2925 | 2700 2700 | | | |
| | 104 | 1079 | 2.7 | III | 15.98 | 1379 | 1904 | 2925 | 2700 | | | |
| | 87 | 1261 | 3.2 | III | 19.11 | 1501 | 2025 | 2925 | 2700 | | | |
| | 77 | 1418 | 2.9 | III | 21.49 | 1544 | 2025 | 2925 | 2700 | | | |
| | 66 | 1631 | 2.7 | III | 25.00 | 1604 | 2025 | 2925 | 2700 | | | |
| | 59 | 1805 | 2.5 | III | 27.99 | 1647 | 2025 | 2925 | 2700 | | | |
| | 52 44 | 2058 2416 | 2.3 2.0 | III III | 31.92 | 1697 1764 | 2025 2025 | 2925 2925 | 2700 2700 | | | |
| | 37 | 2714 | 1.8 | II | 37.91 44.72 | 1859 | 2025 | 2925 | 2700 | | | |
| | 32 | 3118 | 1.6 | ii | 52.03 | 1919 | 2025 | 2925 | 2700 | | | |
| | 28 | 3448 | 1.5 | ll l | 58.27 | 1962 | 2025 | 2925 | 2700 | | | |
| | 25 | 3881 | 1.4 | II | 66.44 | 2014 | 2025 | 2925 | 2700 | | | |
| | 21 | 4550 | 1.3 | I | 78.91 | 1967 | 2025 | 2925 | 2700 | | | |
| | 18 | 4652 | 1.1 | I | 94.35 | 1946 | 2025 | 2925 | 2700 | | | |
| | 16 13 | 5150 5899 | 1.0 0.9 | * | 106.08 123.42 | 1843 1654 | 2025 2025 | 2889 2772 | 2700 2700 | | | |
| | 12 | 6396 | 0.9 | * | 138.21 | 1499 | 2025 | 2684 | 2700 | | | |
| | 11 | 7173 | 0.8 | * | 157.59 | 1184 | 2025 | 2520 | 2700 | | | |
| | 55 | 1987 | 3.3 | III | 30.11 | 2081 | 2700 | 3645 | 3600 | SK 32100 - 90L/4 | 154 | 654 |
| | 48 | 2187 | 3.6 | III | 34.32 | 2167 | 2700 | 3645 | 3600 | SK 32100 - 90LH/4 | | |
| | 43 | 2520 | 3.0 | III | 38.63 | 2221 | 2700 | 3645 | 3600 | | | |
| | 39 | 2794 | 2.9 3.1 | | 42.83 50.21 | 2277 | 2700 | 3645 3645 | 3600 3600 | | | |
| | 26 | 3918 | 2.7 | III | 64.55 | 2536 | 2700 | 3645 | 3600 | | | |
| | 23 | 4269 | 2.5 | iii | 71.57 | 2599 | 2700 | 3645 | 3600 | | | |
| | 18 | 5502 | 2.1 | III | 94.19 | 2759 | 2700 | 3645 | 3600 | | | |
| | 16 | 5444 | 1.9 | II | 104.0 | 2891 | 2700 | 3645 | 3600 | | | |
| | 13 | 6557 | 1.7 | II | 129.0 | 3031 | 2700 | 3645 | 3600 | | | |
| | 10 9.0 | 8035 8770 | 1.5 1.4 | II II | 165.5 183.5 | 3204 3256 | 2700 2700 | 3645 3645 | 3600 3600 | | | |
| | 6.9 | 10992 | 1.1 | I | 241.5 | 3220 | 2700 | 3645 | 3600 | | | |
| | 5.5 | 13837 | 0.9 | * | 304.0 | 2576 | 2700 | 3645 | 3600 | | | |
| | 6.4 | 13876 | 1.0 | I | 257.63 | 2565 | 2700 | 3645 | 3600 | SK 33100 - 90L/4 | 172 | 654 |
| | 5.5 | 13168 | 1.0 | 1 | 299.28 | 2756 | 2700 | 3645 | 3600 | SK 33100 - 90L/4 | | |
| | 4.5 | 15509 | 0.9 | * | 365.07 | 2012 | 2700 | 3645 | 3600 | | | |
| | 22 | 4787 | 3.3 | III | 76.95 | 4815 | 4669 | 5963 | 6300 | SK 42125 - 90L/4 | 243 | 658 |
| | 19 | 5364 | 3.2 | Ш | 87.30 | 4993 | 4669 | 5963 | 6300 | SK 42125 - 90LH/4 | | |
| | 17 | 5646 | 3.3 | III | 100.58 | 5243 | 4669 | 5963 | 6300 | | | |
| | 14 | 6418 | 3.1 | III | 117.50 | 5468 | 4669 | 5963 | 6300 | | | |
| | 11 10 | 7687 8414 | 2.8 2.6 | III III | 144.76 160.74 | 5796 5963 | 4669 4669 | 5963 5963 | 6300 6300 | | | |
| | 9.1 | 9407 | 2.4 | III | 182.36 | 5963 | 4669 | 5963 | 6300 | | | |
| | 8.2 | 10248 | 2.3 | III | 201.63 | 5963 | 4669 | 5963 | 6300 | | | |
| | 3.3 | 21441 | 1.2 | I | 495.85 | 5706 | 4669 | 5963 | 6300 | | | |
| | 2.4 | 29023 | 0.9 | * | 695.60 | 4655 | 4669 | 5963 | 6300 | | | |

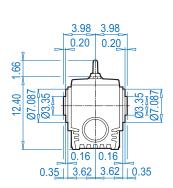
(AGMA Class $I = f_B 1.0 - 1.39$ $II = f_B 1.4 - 1.99$ $III = f_B \ge 2.0$ * = $f_B < 1.0$) (Model Type in blue is an Energy Efficient motor)

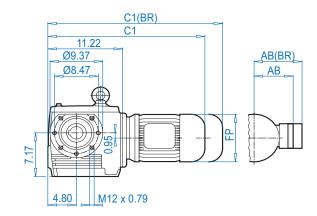




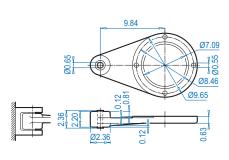


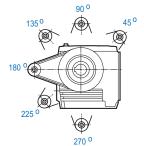
SK 32100AZ



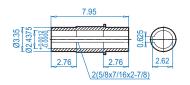


SK 32100AZ**D**



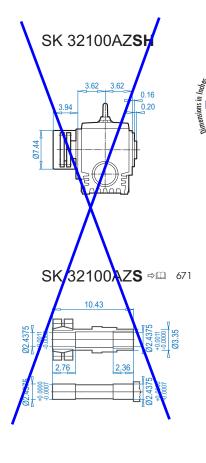


SK 32100AZ



SK 32100AZ**B** ⇒ □ 672





Motor dimensions

| Standard efficiency | 71S/L | 80S/L | 90S/L | 100L | | 132S/M | For Other Connection |
|---------------------|-------|-------|---------|-------|-------|----------|---|
| Energy efficiency | | 80LH | 90SH/LH | 100LH | 112MH | 132SH/MH | Possibilities please see ⇒ ☐ 666 & 667 |
| AB | 4.88 | 5.59 | 5.79 | 6.65 | 7.05 | 8.03 | |
| AB (BR) | 5.24 | 5.63 | 5.83 | 6.26 | 6.69 | 7.72 | |
| C1 | 20.28 | 21.26 | 22.87 | 24.06 | 24.96 | 28.35 | 2 |
| C1 (BR) | 22.56 | 23.78 | 25.83 | 27.64 | 28.62 | 32.56 | |
| FP | 5.71 | 6.50 | 7.20 | 7.91 | 8.98 | 10.47 | |

(BR) denotes Brakemotor

ALTERNATE SHAFTS SEE PAGES 669 - 671

Ta

Performance Data





Standard Efficiency

230/460V - 60Hz

Inverter duty • TEFC

Synchronous speed 1800rpm @ 60Hz • 4-pole • Three-phase

Voltages: 230/460V – 60Hz • 1.15 Service Factor

Continuous Duty • 40°C Ambient • up to 3300ft Elevation

Class B temperature rise • Class F insulation







| Motor Type | Pov P | wer n | Nn Full- load | In Full-Load Cur- rent 230V ^{a)} 460V ^a | | la/ln | Code Letter | Torque Tn | Ta/Tn | Tk/Tn | pf | Eff. | Jm Inertia |
|---------------|----------|----------|---------------------|--|------|-------|----------------|--------------|-------|-------|------|------|---------------|
| | [hp] | [kW] | [rpm] | [A] | [A] | [%] | | [lb-in] | | | | [%] | [lb-ft² |
| 63\$/4 | 0.16 | 0.12 | 1700 | 0.88 | 0.44 | 245 | F | 5.92 | 2.1 | 2.2 | 0.66 | 52 | 0.005 |
| 63L/4 | 0.25 | 0.18 | 1680 | 1.12 | 0.56 | 275 | Е | 8.99 | 2.1 | 2.2 | 0.71 | 57 | 0.0067 |
| 71S/4 | 0.33 | 0.25 | 1710 | 1.56 | 0.78 | 310 | G | 12.3 | 2.5 | 2.4 | 0.64 | 63 | 0.017 |
| 71L/4 | 0.5 | 0.37 | 1720 | 1.90 | 0.95 | 355 | F | 18.0 | 2.45 | 2.6 | 0.69 | 71 | 0.0204 |
| 805/4 | 0.75 | 0.55 | 1710 | 2.70 | 1.35 | 355 | F | 27.0 | 2.2 | 2.2 | 0.71 | 72 | 0.0259 |
| 80L/4 | 1 | 0.75 | 1650 | 3.66 | 1.83 | 390 | G | 38.1 | 2.2 | 2.3 | 0.74 | 70 | 0.0345 |
| 905/4 | 1.5 | 1.1 | 1660 | 4.84 | 2.42 | 445 | G | 55.6 | 2.7 | 2.6 | 0.78 | 73 | 0.055 |
| 90L/4 | 2 | 1.5 | 1660 | 6.34 | 3.17 | 465 | G | 75.8 | 2.55 | 2.5 | 0.80 | 74 | 0.074 |
| 100L/4 | 3 | 2.2 | 1705 | 9.0 | 4.50 | 490 | G | 108 | 2.3 | 2.0 | 0.61 | 82 | 0.107 |
| 100LA/4 | 5 | 3.7 | 1725 | 15.2 | 7.62 | 510 | G | 180 | 2.7 | 3.1 | 0.75 | 81 | 0.141 |
| 1325/4 | 7.5 | 5.5 | 1735 | 19.8 | 9.9 | 545 | G | 267 | 2.45 | 2.75 | 0.82 | 86 | 0.55 |
| 132M/4 | 10 | 7.5 | 1735 | 25.8 | 12.9 | 645 | Н | 363 | 2.9 | 3.2 | 0.84 | 87 | 0.752 |
| 160M/4 | 15 | 11 | 1770 | 38.4 | 19.2 | 665 | Н | 522 | 2.45 | 3.0 | 0.82 | 88 | 0.95 |
| 160L/4 | 20 | 15 | 1765 | 49 | 24.5 | 725 | Н | 713 | 2.9 | 3.3 | 0.86 | 89.4 | 1.23 |
| 180MX/4 | 25 | 18.5 | 1750 | 60 | 30 | 860 | K | 887 | 2.95 | 3.4 | 0.87 | 89 | 1.35 |
| 180LX/4 | 30 | 22 | 1755 | 71 | 35.5 | 980 | L | 1052 | 3.4 | 3.7 | 0.87 | 89.4 | 1.35 |
| 200L/4 | 40 | 30 | 1780 | 96 | 48 | 770 | J | 1414 | 2.9 | 3.6 | 0.85 | 92 | 5.70 |
| 225S/4 | 50 | 37 | 1765 | - | 58 | 760 | Н | 1759 | 3.1 | 3.5 | 0.86 | 93.1 | 7.60 |

a) Motors frame 225 and larger are standardly provided as single-voltage 460V and not as dual voltage

Pn **Full load power** Ta/Tn Locked-rotor torque ratio Full load speed Break-down torque Nn Tk In Full load current Tk/Tn Break-down torque ratio Locked-rotor current pf Power factor la Eff la/In Locked-rotor current ratio (%) Normal efficiency Full-load torque Jm **Motor inertia** Tn Locked-rotor torque



Circuit Safe JIC Enclosures



Manufactured from structural foam thermoplastic, Carlon® Circuit Safe® JIC enclosures provide high impact strength to eliminate dents and deformations along with high dielectric strength, excellent weathering capabilities, and excellent resistance to a wide range of corrosive agents, acids, alkalines, and salts. These UL approved and CSA recognized enclosures also withstand wet and dirty environments, while their thick wall construction make them a particularly good choice wherever condensation is a concern. Rated for use in Type 1, 3, 3S, 3X, 3SX, 4, 4X, 12, and 13 environments, Carlon Circuit Safe JIC enclosures are suited for virtually all indoor/outdoor industrial, MRO, and OEM applications. They are available in 10 sizes from 6 x 6 x 5 through 30 x 24 x 12 with a choice of screw or hinged design, opaque covers, or clear polycarbonate covers which protect devices from hostile environments while allowing monitoring of instrumentation and/or electrical functions.

Features

- Hinge caps make covers captive.
- Nonmetallic molded-in hinges on hinged models.
- No rough corners, sharp edges, or burrs.
- Nonconductive eliminates danger of electrical shock.
- Lid design provides greater usable internal volume.
- Ample interior space for ease of wiring.
- Fully gasketed.
- Ultraviolet stabilized for outdoor use.

Applications

- Instrument case.
- Junction and terminal boxes.
- Control and switching enclosures.
- Splice and pull boxes.
- Starter, pushbutton, and transformer housings.
- Meter and transformer cabinets.

Standards

- Meets NEMA Types 1, 3, 3S, 3X, 3SX, 4, 4X, 12, 13 as indicated.
- UL Listed per UL 50, enclosures for electrical equipment.
- CSA certified.
- JIC compliance.

122 www.carlon.com

Hinged Cover

Meets NEMA 1, 3, 3S, 3X, 3SX, 4, 4X, 12, 13







Features

- Nonmetallic mounting feet and all mounting hardware included.
- White painted 14 gauge steel or 1/4" PVC back panel (order separately).
- 304 (18-8) stainless steel screws (10-32 / 11/8").
- Lid design provides greater usable internal volume.
- Completely nonmetallic hinges.
- Brass screw inserts.
- Temperature Range: -30° to 230°F
- Material: polycarbonate molded base and cover.

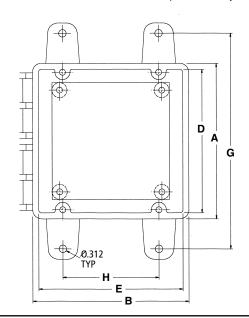
Factory Assembled

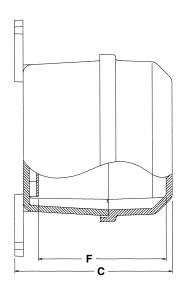
| | Opaque Cover | Clear Cover | External | | | Dimensions Mounting | | | nting | Std. Ctn. Qty. (lbs.) | Back Panel* Part Nos. | Panel | Std. Ctn. Qty. (lbs.) | |
|---|-----------------|----------------|------------------|-------|-----------------|-----------------------|-------|-----------------|------------------|--------------------------|-----------------------------|----------------|--------------------------|------------------------------|
| | Part Nos. | Part Nos. | Α | В | С | D | E | F | G | Н | Opaque/Clear | Steel/PVC | Size | Steel/PVC |
| (| CJ665 | CC665 | 6.50 | 6.50 | 6.69 | 6.00 | 6.00 | 5.45 | 9.00 | 4.00 | 1 (Opa 3.5) / 1 (Clr 3.1) | JP66/JP66P | 4.88 x 4.88 | 1 (1.0) / 1 (0.3) |
| | CJ863 | CC863 | 8.50 | 6.50 | 4.49 | 8.00 | 6.00 | 3.25 | 11.00 | 4.00 | 1 (Opa 2.8) / 1 (Clr 3.1) | JP86/JP86P | 6.75 x 4.88 | 1 (1.0) / 1 (0.78) |
| | CJ1085 | CC1085 | 10.50 | 8.50 | 6.69 | 10.00 | 8.00 | 5.45 | 13.00 | 6.00 | 1 (Opa 5.2) / 1 (Clr 5.2) | JP108/JP108P | 8.75 x 6.88 | 1 (1.5) / 1 (0.7) |
| | CJ12106 | CC12106 | 12.50 | 10.50 | 7.69 | 12.00 | 10.00 | 6.45 | 15.00 | 8.00 | 1 (Opa 7.1) / 1 (Clr 8.4) | JP1210/JP1210P | 10.75 x 8.88 | 1 (2.0) / 1 (1.2) |
| | CJ14126 | CC14126 | 14.50 | 12.50 | 7.72 | 14.00 | 12.00 | 6.48 | 17.00 | 10.00 | 1 (Opa 9.0) / 1 (Clr 8.6) | JP1412/JP1412P | 12.75 x 10.88 | 1 (3.2) / 1 (1.7) |
| | CJ16147 | CC16147 | 16.50 | 14.50 | 8.46 | 16.00 | 14.00 | 7.22 | 19.00 | 12.00 | 1 (Opa 10.6) / 1 (Clr 11.9) | JP1614/JP1614P | 14.75 x 12.88 | 1 (4.7) / 1 (2.3) |

^{*}Order back panels separately.

Enclosures shipped with mounting feet, hinge caps and screws.

For factory installed pad lockable latch, consult Customer Service for price and delivery.





For emergency or normal shutdown of conveyor systems, elevator equipment, bulk handling systems, cranes, production and assembly lines, or any other equipment which may require immediate, positive shutdown.

Switch

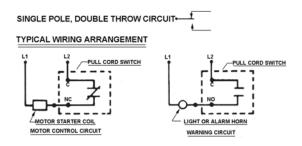
| Part # | Catalog # | SP/ST Switch | | | |
|--------------|-----------|--------------------------|--|--|--|
| 035-225-0247 | PCL2S | Single end left – 2 sw. | | | |
| 035-225-0347 | PCR2S | Single end right – 2 sw. | | | |

Installation Instructions

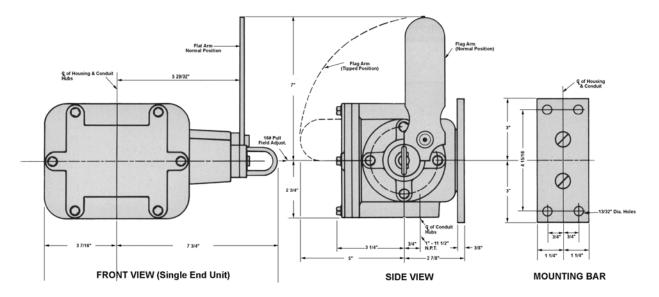
- Switch should be mounted on a flat surface by using two or more of the four 13/32" dia. mounting holes provided. One fastener in each end of the mounting bar will be sufficient.
- Distances between switches should not exceed 200 ft. We suggest you do not use more than 100 ft. of cable per switch end. This suggestion is for maximum safety purposes. Too much cable can result in a "long pull" situation due to slackness in the cable.
- Recommended spacing of cable support eye bolts is 10 ft. Care should be taken to keep the cable from becoming too slack. Care must also be taken that the cable is

- not so "tight" as to be pulling out the cable end connection clevis.
- 4. Wiring should be through the motor control circuit.
- After supply power, actuate by pulling cable to check switch. This will insure that there is not too much slack in the cable and that there are no obstructions to the cable or flag arm.

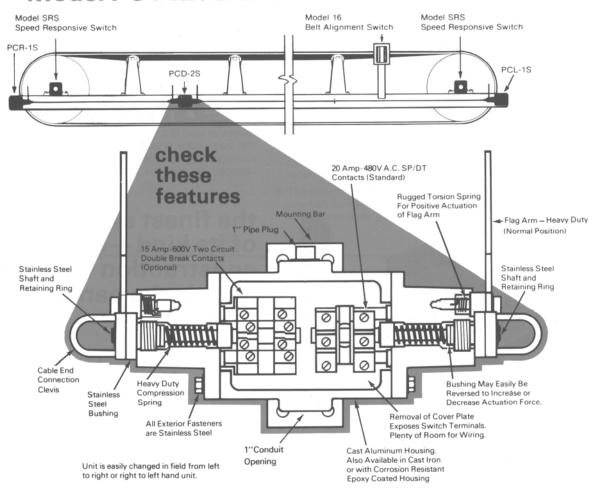
Typical Wiring



MODEL PC Dimensions



Model PC CABLE OPERATED SAFETY STOP SWITCH



OPERATIONS

A cable is connected from a fixed point to the cable end connecting clevis on the end of the unit. A pull on the cable (16 lb. force standard –25 lb. optional) with a movement of less than ½" will actuate the switch and trip the flag arm down, into the walkway, and lock the switch (and flag arm) in the actuated position. Unit is reset by returning the flag arm to the normal position.

TECHNICAL INFORMATION

Enclosure sealed for outside applications.
Standard unit meets NEMA 1, 3, 4X, and 12 requirements.

Conduit opening – 1 inch hole.

Housing – Cast aluminum (Std.) Flag arm – Steel with red epoxy paint coating

STANDARD SWITCH

Two SP.DT switch per side.

20 amps, 125, 250, or 480 vac;

10 amps, 125 vac "L" (tungsten lamp load);

1 hp, 125 vac; 1/4 amp, 250 vdc

Use two SP/DT switches per end when separate light or audible alarm is required.

Process Protection

Motion sensors

SITRANS WM100

Overview



SITRANS WM100 is a heavy-duty zero-speed alarm switch. This non-contacting unit provides cost-effective equipment protection even in the harshest conditions.

Benefits

- Up to 100 mm (4 inch) gap between SITRANS WM100 and targets
- Rugged, low maintenance suitable for tough environments
- · 1 SPDT Form C relay contact
- Provides cost-effective protection
- · Visual indication of target triggered pulse

Application

This rugged unit is impervious to dust, dirt, build-up and moisture and is ideal for such primary industries as mining, aggregate, and cement. Operating where other systems are prone to failure, the non-contacting design eliminates the need for lubricating, cleaning and part replacement. Downtime and clean-up expenses associated with conveying equipment failure are reduced by the SITRANS WM100. It alarms to minimize spillage, prevent extensive damage or even fire caused by belt slippage at the head pulley and warn against conveyor malfunction.

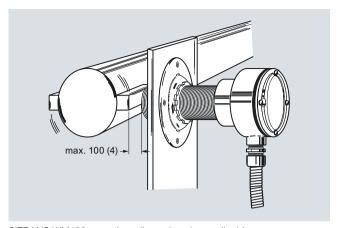
The SITRANS WM100 has built-in selectable start delays and 1 Form C relay contact. With an aluminum body, it operates from -40 to +60 °C (-40 to +140 °F).

Key Applications: tail pulleys, driven pulleys, motor shaft sensing, screw conveyor flights, bucket elevators

Design

Mounting

The WM100 probe should be mounted, using the supplied mounting flange, onto a vibration-free structure. The gap between the probe and the target should be sufficient such that there is no danger of the target damaging the probe. The maximum allowable gap is 100 mm (4") from the face of the target to the face of the probe for $4.5 \times 4.5 \, \text{mm}$ (3/16 × 3/16") keyway. The WM100 is sensitive to lateral disturbances to its magnetic field. If the WM100 is responding to motion from an interfering target, move the WM100 or install a ferrous plate (steel) as a shield between the WM100 and the interfering target. Where possible, the probe should be mounted such that the cable inlet is pointing downward to avoid accumulation of condensation in the casing. Connection of the probe should be made via flexible conduit for easier removal or adjustment of the probe.



SITRANS WM100 mounting, dimensions in mm (inch)

Technical specifications

| Mode of operation | |
|---|--|
| Measuring principle | Disruption of magnetic field by ferrous target |
| Typical application | Monitors absence or presence of motion in harsh conditions |
| Output | |
| Contact | 1 SPDT Form C dry relay contact, rated 5 A at 250 V AC, fail-safe operation |
| Time delay | Start up: 10 14 seconds (5 7 seconds with 12 ppm jumper installed) |
| Zero Speed (selected via a common jumper) | • 5 seconds ± 1 (minimum speed 10 15 ppm) or |
| | • 10 seconds ± 2 (minimum speed 5 7.5 ppm) |
| Rated operating conditions | |
| Operating temperature | -40 +60 °C (-40 +140 °F) |
| Design | |
| Probe body | Aluminum |
| Process mounting | 2" NPSL |
| Connection box | Aluminum, ¾" NPT conduit entrance, 5 screw terminals plus grounding terminal for electrical connection, max. 12 AWG (3.30 mm²) wire size |
| Gasketing | Neoprene |
| Display | Red LED for verification of pulses |
| Enclosure rating | Type NEMA 4x, 6, IP67 |
| Dynamic range | Minimum 6 or 12 pulses per minute Maximum 3000 pulses per minute |
| Shipping weight | 2 kg (4.4 lbs) |
| Power supply | • 115 V AC/50 60 Hz, 7 VA • 230 V AC/50 60 Hz, 7 VA |
| | • ± 10 % of rated voltage |
| Certificates and approvals | CSA _{US/C} , CE, C-TICK |

Process Protection Motion sensors

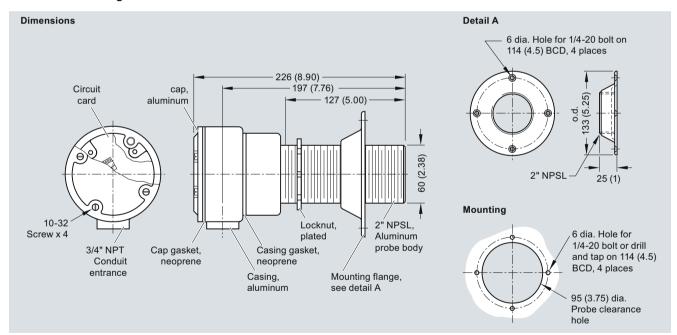
SITRANS WM100

| Selection and Ordering data | Order No. |
|--|----------------|
| SITRANS WM100 | 7MH7158 - |
| A heavy-duty zero-speed alarm switch that does not require a controller. | 0 A 0 0 |
| Model | |
| 115 V AC | A |
| 230 V AC | В |

| Selection and Ordering data | Order code |
|--|---------------|
| Further designs | |
| Please add "-Z" to Order No. and specify Order code(s). | |
| Manufacturer's test certificate M to DIN 55 350, Part 18 and to ISO 9000 | C11 |
| Acrylic coated, stainless steel tag [13 x 45 mm $(0.5 \times 1.75")$]: Measuring-point number/identification (max. 16 characters), specify in plain text | Y17 |
| Operating Instructions | Order No. |
| SITRANS WM100, English C) | 7ML1998-5MW01 |
| SITRANS WM100, German C) | 7ML1998-5MW31 |
| Note: The operating instructions should be ordered as a separate item on the order. This device is shipped with the Siemens Milltronics manual CD containing the complete operating instructions library. | |
| Locknut, for WM100 and Millpulse 600 C) | 7MH7723-1CR |
| Mounting flange, for WM100 and Millpulse 600 | 7MH7723-1CS |
| Motion cable gland adaptor kit | 7MH7723-1JN |

C) Subject to export regulations AL: N, ECCN: EAR99.

Dimensional drawings



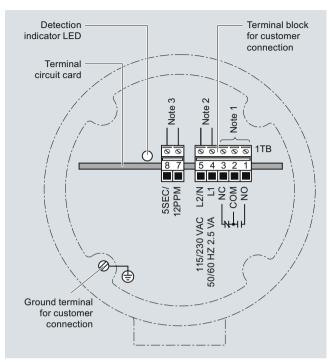
SITRANS WM100 dimensions in mm (inch) and mounting

Process Protection

Motion sensors

SITRANS WM100

Schematics



SITRANS WM100 wiring

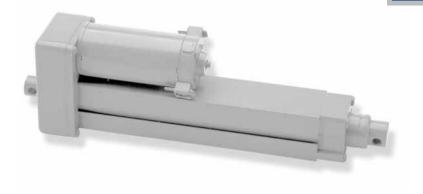
Notes:

- 1. Dry contacts shown in de-energized (alarm or shelf) state.
- SITRANS WM100 is manufactured for either 115 or 230 V AC operation. Check WM100 nameplate for applicable voltage. Correct voltage must be supplied. Voltages lower than specified will result in an inoperative condition. Voltages higher than specified will severely damage unit.
- 3. For 5 second time delay and a minimum 12 ppm range, connect jumper across terminals 7 and 8. Without a jumper, the default is a 10 second time delay and a minimum 6 ppm range





100 Pound Capacity
Series TMD100



Compact and economical. Corrosion resistant materials throughout. Timing belt drive for quiet, smooth operation. Low current draw and keyed translating tube simplify installation requirements.

Model Number

TMD01-1406-stroke
12 VDC without Limit Switches

TMD01-2406-stroke
24 VDC without Limit Switches

TMD01-1906-stroke

12 VDC with Limit Switches

TMD01-2906-stroke
24 VDC with Limit Switches

Note: Model number prefix for pulse generator models is PTD01.

Specifications

Capacity 100 lbs (45.4 Kgf, 445 N) tension or compression loads.

Static Load 300 lbs (136 Kgf, 1334 N) maximum.

AC Power Options See power supplies, part no. PS1260 and part no. 4824.

Stroke Lengths 2, 4, 6, 8, 10, and 12 inch 50, 102, 152, 203, 254, and 304 mm).

Duty Cycle 25% at full load and 77°F ambient

Construction Aluminum housings, stainless steel translating tube.

Mounting Double clevis ends. Translating tube clevis threaded 10-32UNF to accept rod end.

Load Screw Acme thread.

Limit Switches Independently adjustable. Includes control enclosure with relay, fuse and terminal

blocks for power and switch connections. Enclosure may be mounted on actuator tube

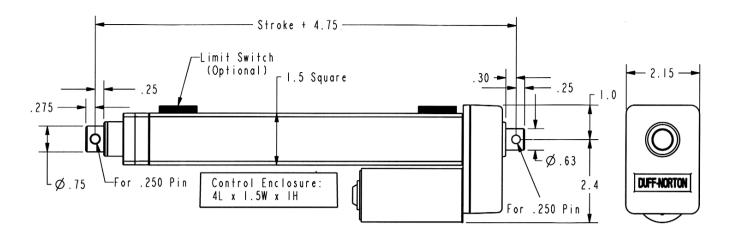
or mounted separately.

Extend/Retract Control . . Optional. See part no. EM1010-58.

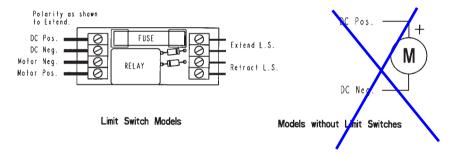
Temperature Range -20°F to 120° F (-29°C to 50°C).

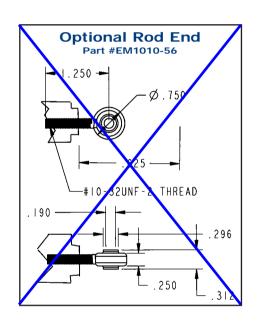
Restraining Torque Keyed translating tube resists rotation.

Pulse Generator Optional feedback device. Contact Application Engineering for specifications.

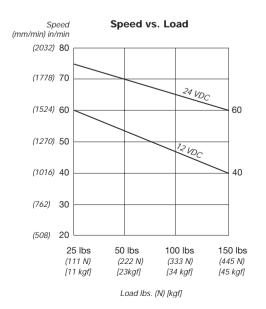


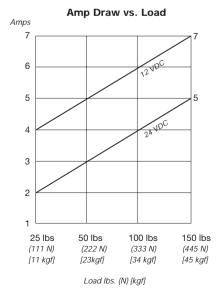
Wiring Connections

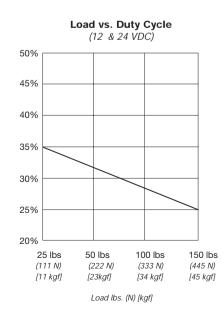




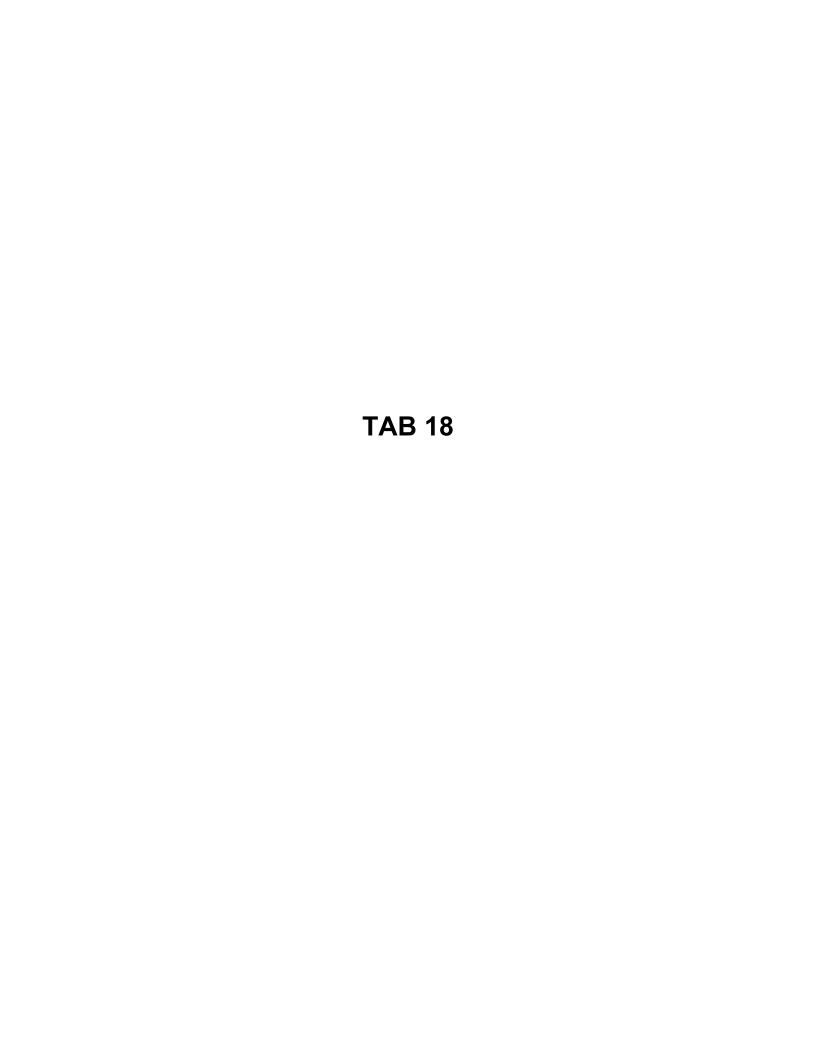
Performance Characteristics







TMD100







Technical Pump Quotation



NM076BY01L07V

| Quote: | HK-B000377033 |
|----------|---------------|
| Date: | 12/20/2019 |
| Project: | 0 |

| Product: | | Content | nominal | minimum | maximum |
|----------------------|---------|----------------------------------|---------|-----------|---------|
| Name / Composition | | 1-2% aerobically digested sludge | | ed sludge | |
| Product temperature | assumed | °F | | | |
| Specific gravity | assumed | | | | |
| Particle size | assumed | mm | | | 5 |
| pH value | assumed | | | | |
| Solids content (w/w) | assumed | %TS | | 1 | 2 |
| Dynamic viscosity | assumed | CPS | | | |
| Abrasiveness | assumed | | | Low | |

[&]quot;Materials of construction are only recommended based on the information provided. Customer needs to verify materials will be compatible with the process fluid or application."

| Application details: | | Content | nominal | at 60Hz |
|-------------------------------|---------|----------|---------|---------|
| Flow rate (Q) | approx. | GPM | 200 | 227 |
| Differential pressure | | PSI | 30 | 30 |
| Suction pressure | assumed | PSI | Flooded | Flooded |
| Discharge pressure | approx. | PSI | 30 | 30 |
| Pump operating speed | approx. | RPM | 235 | 266 |
| Sliding velocity | approx. | ft./s | 4.7 | 5.3 |
| Frequency | approx. | Hz | 54 | 60 |
| Power required at drive shaft | approx. | HP | 6 | 6.8 |
| Running torque | approx. | ft./lbs. | 133.3 | 133.3 |
| Starting torque | approx. | ft./lbs. | 223.5 | 223.5 |

| Assembly specification | Installation: | Horizontal |
|------------------------|---------------|------------|
| | | |

General operating conditions

Installation area Inside
Ambient Temperature Approx. 20°C / 70 F
Humidity up to 75%
Application type Continuous operation
Operating hours per day 8
Service voltage 3ph, 60hz, 230/460V

| Painting | Coating system | NIL System I RAL 7031 NETZSCH gray |
|----------|----------------|------------------------------------|
| | | NCS 355B60G teal (stator only) |

Operating and Maintenance Instructions

Standard documentation in accordance with the 98/37/EG Machinery Directive.

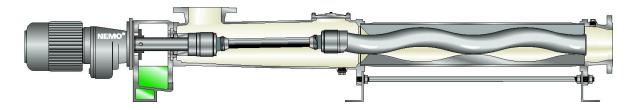
The Operational Manual is provided in English and additional Safety instructions in Spanish

Request the Operating and Maintenance at https://www.netzschusa.com/distributors/OM.html

Page 1 of 3



Pump: NM076BY01L07V



Picture is for reference only and may not be exact model specified

Characteristics and benefits of the NEMO® BY Block pump:

Reliable and sophisticated construction

Space-saving construction

Modular construction system

4 different stator – rotor geometries available for most sizes

Low investment and operating costs

Low maintenance expenses

| General cha | aracteristics |
|-------------|---------------|
|-------------|---------------|

name plate on the pump in English (Stainless steel)

direction of rotation To the left, counter clockwise(as viewed from drive end)

Pump Pedestal Cast Iron

Pump housing / End connection

Housing material Cast Iron

Housing Connection position Vertically Upwards (as viewed from drive end)

Function of housing connection Suction Connection
Function of end connection Discharge Connection

Suction Connection design Standard

Nom. dia. & pressure for pump housing 6" 125# ANSI Flange

Discharge Connection design standard

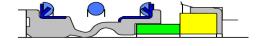
Nom. dia. & pressure of discharge flange 6" 125# ANSI Flange

Housing seals FKM

Shaft seal

Design Single Mechanical Seal Shaft seal type Netzsch uNS-100

Shaft seal materials SiC v SiC faces, Viton Elastomers, 316SS hardware - Q1Q1VGG



Rotating parts

Extension shaft Material AISI 420 - Steel Coupling Rod Material AISI 420 - Steel Coupling Rod Design Standard

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NETZSCH Pumps North America, LLC Exton, PA. 19341



| Joints | |
|------------------------|--------------------------------|
| Joint type | SM Pin Joint with Wear Bushing |
| Joint sealing material | Buna/316 Stainless Steel |
| Joint lubrication | Mineral Oil |
| | |

Rotor
Rotor material
SAE 4140 VCP - Chrome Plated Steel

Rotor Size Standard
Temperature range 32-84°F

Stator

Stator material NEMOLAST® S61L / S62L / S61M (Buna)

Drive

| Premium Efficient Gearmotor | |
|---|------------------|
| Manufacturer | Nord |
| Туре | SK772.1F-132MP/4 |
| Flange diameter (mm) | 300 |
| Shaft diameter (mm) | 50 |
| Cross drill diameter (mm) | 16 |
| Cross drill position—measured from IEC face according to WN0146 | 33 |
| Output speed n2 @60Hz (RPM) | 266 |
| Output speed min/max (RPM) | 54/266 |
| Gear Ratio | 6.63 |
| Mounting position | M1 |
| Power (HP) | 10 |
| Voltage range (V) | 230/460 |
| Frequency (Hz) | 60 |
| Number of poles / phases | 4/3 |
| Motor speed n1 @60Hz (RPM) | 1765 |
| Protection type / insulation class | IP55/F |

| Baseplate: | Carbon steel (top-hat profile) | | |
|-------------|--------------------------------|--------------|---------------------------------------|
| Arrangement | Inline | | |
| Options | 4" Grout Holes | Anchor bolts | Casters and handle bar |
| | Motor mount shims | Lifting lugs | 0.75" Drip Rim w/0.75" NPT drain plug |

| Approximate Weights – (lbs.) | |
|------------------------------|-----|
| Bareshaft Pump | 460 |
| Complete Assembly | 748 |

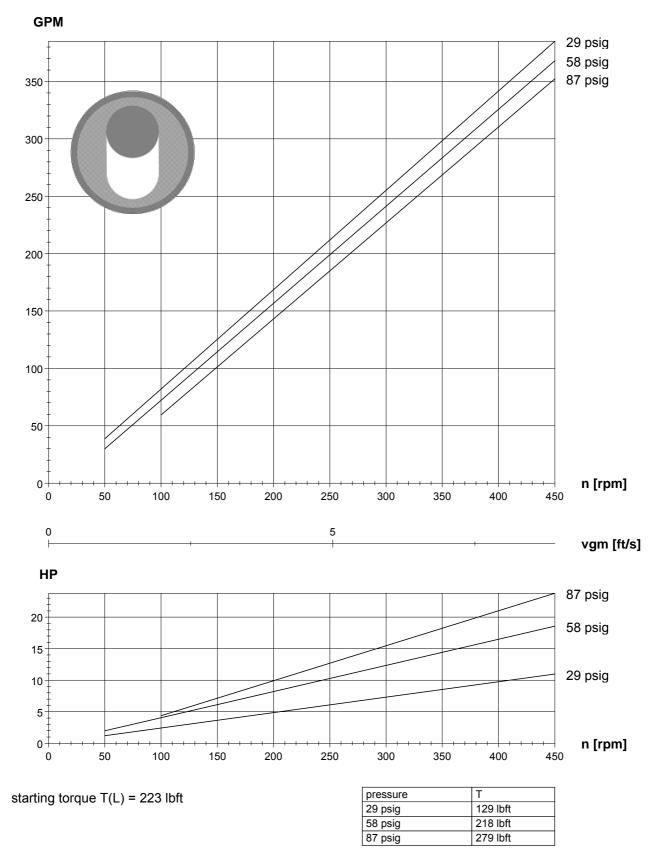
OEM NM TPS Template Rev Date 9/4/2019

Page 3 of 3 Rev - 5/4/2018

[&]quot;Materials of construction are only recommended based on the information provided. Customer needs to verify materials will be compatible with the process fluid or application."

elastomer quality: standard

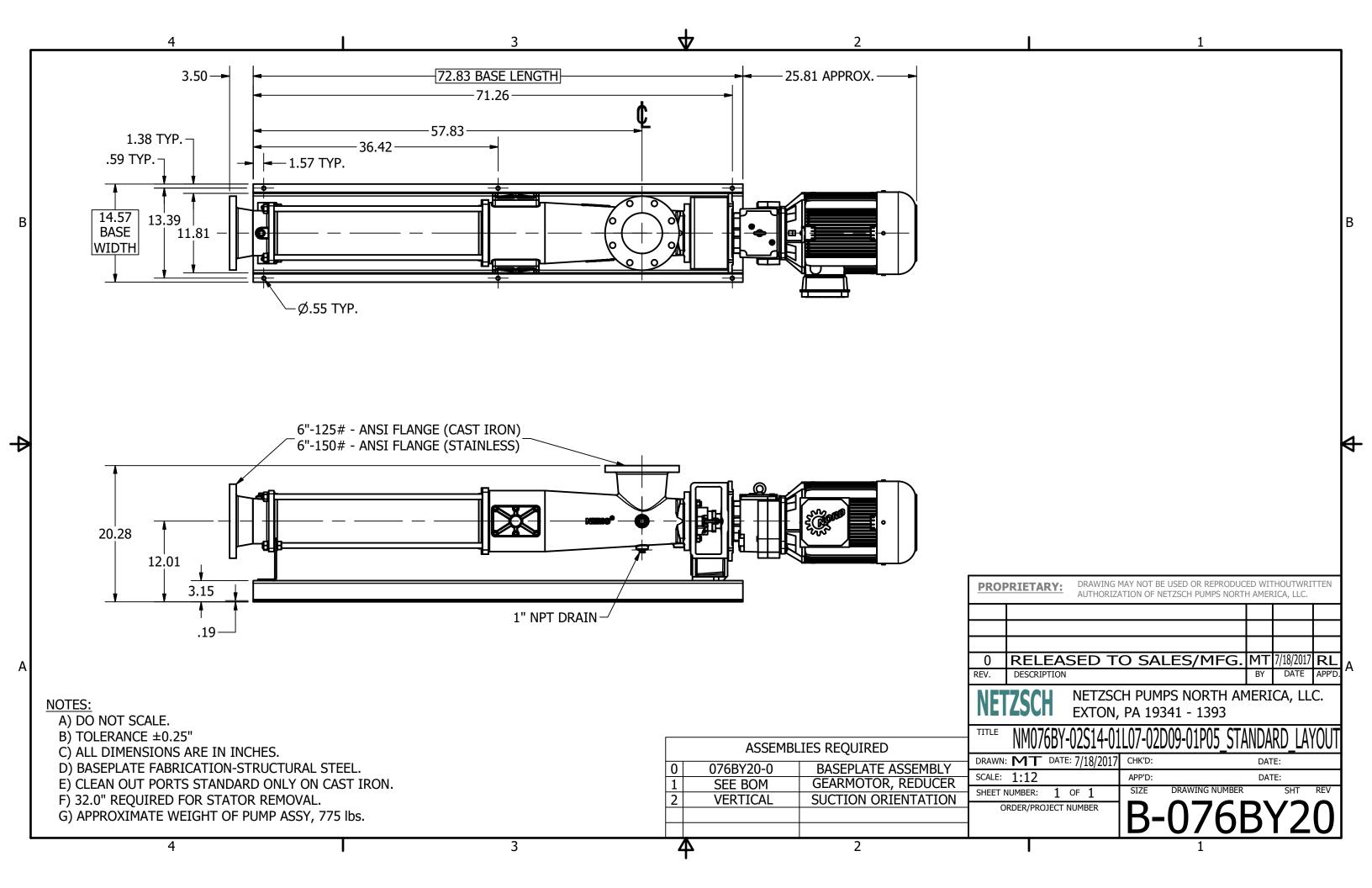




Valid for water (1 cP) at 20 °C (70 °F). Tolerances are in accordance with VDMA 24284 tolerance group II.

Rev.: 03/2007 Technical changes reserved.

www.netzsch-pumpen.de









| REQ QTY 1 | PARENT ITEM# DESCRIPTION 806.22.593S ETOWAH, GA(DAWSON FOREST) 3BTP22.593S | PANEL BU | JILT B |
|---------------------|--|----------|--------|
| | WT # | | |
| COMPONENT | COMPONENT | QTY | |
| ITEM NUMBER | DESCRIPTION/COMMENT | REQUIRED | UM |
| 1766-L32AWAA | MICROLOGIX 1400 | 1 | EA |
| 1700 LOZ/WYW | PROGRAMMABLE LOGIC CONTROLLER | <u>'</u> | |
| 1762-IA8 | MICROLOGIX 1200 8 POINT AC INPUT MODULE | 3 | EA |
| 1762-OW16 | RELAY OUTPUT MODULE | 1 | |
| 1762-OF4 | ANALOG OUTPUT MODULE | 1 | EA |
| 2711P-T10C21D8S | PANELVIEW PLUS 7 STANDARDTERMINAL | 1 | EA |
| 1784-SD1 | TOUCH SCREEN, 10.4 INCHES 1 GB SECURE DIGITAL (SD) CARD | 1 | EA |
| 1704-301 | T GB SECORE DIGITAL (SD) CARD | ' | |
| 1492-HMI | TERMINAL BLOCK ALLEN-BRADLEY | 177 | EA |
| 1492-N23 | TERMINAL BLOCK END BARRIER | 2 | EA |
| 1492-EAHJ35 | TERMINAL BLOCK END ANCHOR | 16 | EA |
| B075BTZ13JK | MICRON TRANSFORMER 75VA | 1 | EA |
| | | | |
| B750BTZ13JKF | MICRON TRANSFORMER 750VA | 1 | EA |
| XT2NU30100BFF400XXX | ABB 100 AMP 3 POLE CIRCUIT | 1 | EA |
| KXT2N4XFLHDL4 | BREAKER 480 VAC W/UV TRIP ABB DISC MECHANISM | 1 | EA |
| KATZNAALLIDLA | ADD DIGC WILCHAMOW | ' | |
| M200-03400056A | CONTROL TECHNIQUES 3HP DRIVE | 1 | EA |
| M200-04400135A | CONTROL TECHNIQUES 7.5HP DRIVE | 1 | EA |
| M200-04400170A | CONTROL TECHNIQUES 10HP DRIVE | 1 | EA |
| 3RT2015-1AK61 | SIEMENS POWER CONTACTOR AC-3 7 A, | 4 | EA |
| 2DL12446 4 CD2 | 3 KW / 400 V 1 NO 110 V AC 50 HZ 120 V, 60 HZ, 3-POLE | 3 | |
| 3RU2116-1GB0 | SIEMENS IEC OVERLOAD "4.5-6.3A" | 3 | EA |
| 3RU2116-1EB0 | SIEMENS IEC OVERLOAD "2.8-4A" | 3 | EA |
| 3RT2027-1AK60 | CONTACTOR, AC-3, 15 KW / 400 V, 1 NO + 1 NC | 1 | EA |
| 01(1202) 1/4(00 | 120VAC COIL | | |
| 3RU21264CB0 | OVERLOAD RELAY 1722 A | 1 | EA |
| 3RU29163AA01 | OVERLOAD STABD ALONE ASSEMBLY | 2 | |
| CS8-40E-120 | SPECHER & SCHUH RELAY | 1 | EA |
| RH3B-UL120AC | IDEC 3DPDT PLUG IN RELAY 120VAC | 17 | EA |
| SH3B-05C | IDEC 3DPDT RELAY SOCKET | 17 | EA |

| REQ QTY 1 | PARENT ITEM# DESCRIPTION 806.22.593S ETOWAH, GA(DAWSON FOREST) 3BTP22.593S WT # | PANEL BU | JILT B |
|---|--|---|--------|
| COMPONENT | COMPONENT | QTY | |
| ITEM NUMBER | DESCRIPTION/COMMENT | REQUIRED | UM |
| TIEW NOWBER | DESCRIPTION/COMMENT | REQUIRED | OW |
| PLT-SEC-T3-120-FM | PROTECTIVE PLUG PT WITH SURGE VOTLAGE | 1 | EA |
| FL1-3LC-13-120-1 W | EQUIPMENT PROTECTION | | LA |
| S8VK-G48024 | OMRON 24VDC POWER 20A SUPPLY | 1 | EA |
| 36 V N-G46024 | OWNOW 24VDC FOWER 20A SUPPLY | - ' | LA |
| IES-150B | INDUSTRIAL ETHERNET SWITCH | 1 | EA |
| IES-150B | INDUSTRIAL ETHERINET SWITCH | - ' | EA |
| | | | ГΛ |
| | | 1 | EA |
| | | | |
| 876-N5 | EDWARDS ALARM HORN | 1 | EA |
| | WEATHERPROOF 120VAC | | |
| #1597 | LEGRAND 115VAC 15A GFCT | 1 | EA |
| | | | |
| E980DFN | CARLSON PVC FSE BOX 1 HOLE 1/2' | 1 | EA |
| | | | |
| MPDB67563 | MERSEN 1(2/0-14GA)IN 6(2-14GA)OUT | 1 | EA |
| | 3 POLE DIST. BLOCK 175AMP | | |
| MPDBC6667 | MERSEN MEDIUM PDB COVER | 3 | EA |
| | | | |
| SCE-60XEL4912SSLP | SAGINAW 60 X 49 X 12 NEMA 4X | 1 | EA |
| | 304 STAINLESS STEEL ENCLOSURE | | |
| SCE-60P48 | SAGINAW 57X44 SUBPANEL | 1 | EA |
| | | | |
| 62003J | MERSEN CLASS J FUSE HOLDER 200A RATING | 1 | ΕA |
| | | | |
| DFC-12I | FUSE HOLDER COVER | 1 | EA |
| | | | |
| LPSC001ID | LITTLE FUSE 1 POLE | 39 | EA |
| | | | |
| 1PH9P18MM | LITTLE FUSE 1 PHASE BUS BAR 18MM | 1 | EA |
| | | | |
| 3PH12P18MM | LITTLE FUSE 3 PHASE BUS BAR 18MM | 1 | EA |
| | | | |
| 3PH9P18MM | LITTLE FUSE 3 PHASE BUS BAR 18MM | 1 | |
| | | | |
| 3PH6P18MM | LITTLE FUSE 3 PHASE BUS BAR 18MM | 1 | EA |
| | | | |
| AJT110 | MERSEN 110 AMP J FUSE TYPE | 3 | EA |
| | | | |
| | | | EA |
| | | | |
| ATDR20 | MERSEN 20 AMP CC FUSE TYPE | 6 | EA |
| | | | |
| ATDR10 | MERSEN 10 AMP CC FUSE TYPE | 7 | ΕA |
| | | | |
| ATDR5 | MERSEN 5 AMP CC FUSE TYPE | 11 | EA |
| 7.1.51.0 | MERCERO / WIN OUT OUE THE | | |
| ATDR3 | MERSEN 3 AMP CC FUSE TYPE | 3 | |
| ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | INCINCTION OF THE | - | |
| | | | |

| REQ QTY 1 | PARENT ITEM# DESCRIPTION 806.22.593S ETOWAH, GA(DAWSON FOREST) 3BTP22.593S WT# | PANEL BU | JILT B |
|---------------------|---|----------|--------|
| COMPONENT | COMPONENT | QTY | |
| ITEM NUMBER | DESCRIPTION/COMMENT | REQUIRED | UM |
| | | 1.2.5 | EA |
| | | | |
| ATDR1 | MERSEN 1 AMP CC FUSE TYPE | 4 | EA |
| | | | |
| ATDR1/2 | MERSEN 1/2 AMP CC FUSE TYPE | 2 | EA |
| | | | |
| ST | DIN RAIL SUPPORT BRACKET | 4 | EA |
| | | | |
| OMEGA 3F | DIN RAIL, STYLE 3F | 5 | EA |
| | | | |
| T1E-1530G | 1.5" X 3" NARROW FINGER DUCT | 4 | EA |
| | | | |
| T1E-2230G | 2.25" X 3" NARROW FINGER DUCT | 5 | EA |
| | | | |
| 35401 | PRESSURE TERMINAL LUG | 1 | EA |
| | | | |
| 29986 | RAIL SUPPORT | 2 | EA |
| | | | |
| 50286 | SCREW CLAMP W/INS | 8 | EA |
| | | | |
| | BUSBAR | 1 | EA |
| | | | |
| ABD110NU-B | IDEC PUSHBUTTON BLACK FLUSH HEAD | 2 | EA |
| | 1NO | | |
| ABD110NU-S | IDEC PUSHBUTTON BLUE FLUSH HEAD | 1 | EA |
| A DD 4 OL IODAU NA/ | 1NO | 4 | |
| APD1QH2DNUW | IDEC PILOT LIGHT WHITE | 1 | EA |
| ASD211NU | 120VAC IDEC SELECTOR SWITCH 2 POSITION | 4 | Ε. |
| ASDZTINU | | 1 | EA |
| AVD302UR | INO1NC IDEC MUSH HEAD RED TWIST TO RELEASE | 1 | EA |
| AVD30ZUR | 2NC | 1 | EA |
| | ZNO | | EA |
| | | | |
| 800H-W100E*004 | ENGRAVED LEGEND "SILENCE" 30 MM | 1 | EA |
| 00011 W 1002 001 | WHITE LETTERS BLACK BACKGROUND | ' | |
| 800T-X646 | YELLOW BLANG "EMERG STOP" 30 MM | 1 | EA |
| | | | |
| 800H-W117 | ENGRAVED LEGEND "ON" 30 MM | 1 | EA |
| | WHITE LETTERS BLACK BACKGROUND | | |
| 800H-W121 | ENGRAVED LEGEND "RESET" 30 MM | 1 | EA |
| | WHITE LETTERS BLACK BACKGROUND | | |
| 800H-W133 | ENGRAVED LEGEND "OFF ON" 30 MM | 1 | EA |
| | WHITE LETTERS BLACK BACKGROUND | | |
| 800H-W100E*023 | ENGRAVED LEGEND "CB-A RESET" 30 MM | 1 | EA |
| | WHITE LETTERS BLACK BACKGROUND | | |
| #CB-RESET-TAG | CIRCUIT BREAKER RESET TAG | 1 | EA |
| | | | |
| TPMCP-TAG1 | ENGRAVED NAME "CONTROL POWER" | | EA |

| REQ QTY 1 | PARENT ITEM# DESCRIPTION 806.22.593S ETOWAH, GA(DAWSON FOREST) 3BTP22.593S WT# | PANEL B | UILT B |
|--------------|--|----------|--------|
| COMPONENT | COMPONENT | QTY | |
| ITEM NUMBER | DESCRIPTION/COMMENT | REQUIRED | UM |
| | | | |
| #44214 | 460 VOLT RED LABEL | 1 | EΑ |
| | 1-1/8 IN X 4-1/2 IN | | |
| #80026 | ARC FLASH AND SHOCK HAZARD STICKER | 1 | EA |
| | 3-1/2 IN X 5 IN | | |
| #L123F | CAUTION LABEL | 1 | EA |
| | MULTIPLE POWER SOURCES | | |
| #PESW-D-1 | ISO TRIANGLE WARNING LABEL | 1 | EA |

Specifications

General Specifications

| Description | 1766-L32AWA 1766-L32AWAA | 1766-L32BWA 1766-L32BWAA | 1766-L32BXB 1766-L32BXBA |
|--------------------------------|--|-------------------------------------|--|
| Dimensions HxWxD | 90 x 180 x 87 mm 3.5 x 7.087 x 3.43 in. | | |
| Shipping weight | 0.9 kg (2.0 lbs) | | |
| Number of I/O | 24 inputs (20 digital a | nd 4 analog) and 14 outputs (| 12 digital and 2 analog) |
| Power supply voltage | 100240V AC @ 47. | 63 Hz | 24V DC Class 2 SELV |
| Heat dissipation | Refer to the MicroLog Publication <u>1766-UMC</u> | ix 1400 Programmable Contro 101. | ollers User Manual, |
| Power supply inrush current | 120V AC: 25 A for 8 m 240V AC: 40A for 4 m | • | 24V DC: 15 A for 20 ms |
| Power consumption | 100 VA | 120 VA | 50W 7.5W (with no 1762 expansion I/O) |
| 24V DC sensor power | none | 24V DC @ 250 mA 400 μF max. | none |
| Input circuit type | Digital: 120V AC Digital: 24V DC sink/source (standard and high-speed) Analog: 010V DC Analog: 010V DC | | Digital: 24V DC sink/source (standard and high-speed) Analog: 010V DC |
| Output circuit type | Relay | I | Relay/FET |
| Relay life - Electrical | 2 x 10 ⁵ operations min (2.5 A, 250V AC / 30V DC) | | |
| Enclosure type rating | None (open-style) | | |
| Wire size | 0.25 2.5 mm ² (2214 AWG) solid or stranded copper wire rated @ 90 °C (194 °F) or greater. | | |
| Wiring category ⁽¹⁾ | 2 - on signal ports 2 - on power ports 3 - on communications ports | | |
| Terminal screw torque | 0.79 Nm (7.0 in-lb) rated | | |

General Specifications

| Description | 1766-L32AWA 1766-L32AWAA | 1766-L32BWA 1766-L32BWAA | 1766-L32BXB 1766-L32BXBA | |
|--------------------------|-----------------------------|--|-----------------------------|--|
| Pilot duty rating | R300, C300 | | | |
| Expansion bus | | Supports up to seven 1762 modules, up to a maximum of 5V, 1500 mA (1300 mA for Series C only) and 24 V, 1500 mA (1300 mA for Seriec C only). | | |
| North American temp code | T3C | | | |

⁽¹⁾ Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Specifications for Inputs

Digital Inputs

| Description | 1766-L22AWA 1766-L32AWAA | 1766-L32BWA, 1766-L32BWAA, 1766-L32BXB, 1766-L32BXBA | | |
|---------------------------------------|--|---|---|--|
| | | Inputs 0 through 11 (12 high-speed DC inputs) | Inputs 12 and higher (8 standard DC inputs) | |
| On-state voltage range | 79132 V AC | 4.524V DC, Class 2 | 1024V DC, Class 2 | |
| | | (4.526.4V DC @ 60°C/140°F) (4.530V DC @ 30°C/86°F) | (1026.4V DC @ 60°C/140°F) (1030V DC @ 30°C/86°F) | |
| Off-state voltage range | 020 V AC | 01.5V DC | 05V DC | |
| Operating frequency | 4763 Hz | 0 Hz100 kHz | 0 Hz1 kHz (scan time dependent) | |
| On-state current min nom max | 5.0 mA @ 79 V AC 12 mA @ 120 V AC 16.0 mA @ 132 V AC | 7.1 mA @ 4.5V DC 9.9 mA @ 24V DC 10.5 mA @ 30V DC | 3.2 mA @ 10V DC 5.3 mA @ 24V DC 5.5 mA @ 30V DC | |
| Off-state leakage current | 2.5 mA max. | 0.2 mA max. | 1.5 mA max. | |
| Nominal impedance | 12 kΩ @ 50 Hz 10 kΩ @ 60 Hz | 2.4 kΩ | 4.5 kΩ | |
| Inrush current (max.) @ 120V AC | 250 mA | | | |

Analog Inputs

| Description | 1766-L32AWAA, -L32BWAA, -L32BXBA |
|---|----------------------------------|
| Voltage input range | 010.0V DC - 1 LSB |
| Type of data | 12-bit unsigned integer |
| Input coding (010.0V DC - 1 LSB) | 04,095 |
| Voltage input impedance | >199 kΩ |
| Input resolution | 12 bit |
| Non-linearity | ±1.0% of full scale |
| Overall accuracy -2060 °C (-4140 °F) | ±1.0% of full scale |
| Voltage input overvoltage protection | 10.5 V DC |
| Field wiring to logic isolation | Non-isolated with internal logic |

Analog Outputs

| Description | 1766-L32AWAA, -L32BWAA, -L32BXBA |
|--------------------------------------|----------------------------------|
| Number of inputs | 2 single-ended |
| Voltage output range | 010 V DC - 1 LSB |
| Type of data | 12 bit unsigned integer |
| Step response | 2.5 ms @ 95% |
| Load range Voltage output | 1 ΚΩ |
| Output resolution | 12 bit |
| Analog output setting time | 3 ms (max.) |
| Overall Accuracy -2060 °C (-4140 °F) | ±1.0% of full scale |
| Electrical isolation | Non-isolated with internal logic |
| Cable length | 30 m (98 ft) shielded cable |

Relay and FET Outputs

| Description | | 1766-L32AWA, 1766-L32AWAA, 1766-L32BWA, 766-L32BWAA | 1766-L32BXB, 1766-L32BXBA |
|--------------------------------------|-------------|--|------------------------------|
| Maximum controlled load | | 1440 VA | 1080 VA |
| Maximum Continuous Current: | | | |
| Current per channel and group common | | 2.5 A per channel 8A max channel 811 common | 2.5 A per channel |
| Current per controller at 150V max | | 28 A or total of per-point loads, whichever is less | |
| | at 240V max | 20 A or total of per-point loads, whichever is less | |

Relay Outputs

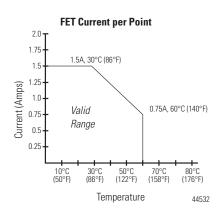
| Description | 1766-L32AWA, 1766-L32AWAA, 1766-L32BWA, 1766-L32BWAA 1766-L32BXB, 1766-L32BXBA |
|----------------------------|---|
| Turn On Time/Turn Off Time | 10 ms (maximum) ⁽¹⁾ |
| Load current | 10 mA (minimum) |

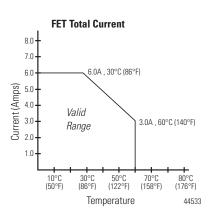
⁽¹⁾ Scan time dependent

| Maximum Volts | Amperes | | Volt-Amper | Volt-Amperes | |
|---------------|---------|--------|------------|--------------|--------|
| | Make | Break | Continuous | Make | Break |
| 240V AC | 7.5 A | 0.75 A | 2.5 A | 1800 VA | 180 VA |
| 120V AC | 15.0 A | 1.5 A | 2.5 A | 1800 VA | 180 VA |
| 250V DC | 0 | .11 A | 1.0 A | | 28 VA |
| 125V DC | 0 | .22 A | 1.0 A | | 28 VA |

1766-L32BXB, 1766-L32BXBA FET Output

Maximum output current (temperature dependent):





| Description | General Operation | High Speed Operation ⁽¹⁾ (Output 2, 3 and 4 Only) |
|---|---|--|
| Power supply voltage | 24V DC (-15%, 10%) Class 2 | |
| On-state voltage drop: at max load current at max surge current | 1V DC 2.5V DC | Not Applicable Not Applicable |
| Current rating per point max load min load max leakage | See graphic above 1.0 mA 1.0 mA | 100 mA 20 mA 1.0 mA |
| Surge current per point: peak current max surge duration max rate of repetition @ 30 °C (86 °F) max rate of repetition @ 60 °C (140 °F) | 4.0 A 10 ms once every second once every 2 seconds | Not Applicable Not Applicable Not Applicable Not Applicable |

| Description | | High Speed Operation ⁽¹⁾ (Output 2, 3 and 4 Only) |
|-------------------------|-------|---|
| Turn-On Time (maximum) | 11 μs | 28 ns (250 ns for Series C only) |
| Turn-Off Time (maximum) | 89 μs | 2.3 μs (3.5 μs for Series C only) |

Output 2, 3 and 4 are designed to provide increased functionality over the other FET outputs. Output 2, 3 and 4 may be used like the other FET transistor outputs, but in addition, within a limited current range, they may be operated at a higher speed. Output 2, 3 and 4 also provide a pulse train output (PTO) or pulse width modulation output (PWM) function.

Working Voltage

Working Voltage for 1766-L32AWA, 1766-L32AWAA

| Description | Recommendation | |
|---|---|--|
| Power supply input to backplane isolation | Verified by one of the following dielectric tests: 1836V AC for 1 second or 2596V DC for 1 second | |
| | 265V AC Working Voltage (IEC Class 2 reinforced insulation) | |
| Input group to backplane isolation | Verified by one of the following dielectric tests:1517V AC for 1 second or 2145V DC for 1 second | |
| | 132V AC Working Voltage (IEC Class 2 reinforced insulation) | |
| Input group to input group isolation | Verified by one of the following dielectric tests:1517V AC for 1 second or 2145V DC for 1 second | |
| | 132V AC Working Voltage (basic insulation) | |
| Output group to backplane isolation | Verified by one of the following dielectric tests: 1836V AC for 1 second or 2596V DC for 1 second | |
| | 265V AC Working Voltage (IEC Class 2 reinforced insulation) | |
| Output group to output group isolation | Verified by one of the following dielectric tests: 1836V AC for 1 second or 2596V DC for 1 second | |
| | 265V AC Working Voltage (basic insulation), 150V AC Working Voltage (IEC Class 2 reinforced insulation) | |

Working Voltage for 1766-L32BWA, 1766-L32BWAA

| Description | Recommendation | |
|---|---|--|
| Power supply input to backplane isolation | Verified by one of the following dielectric tests:1836V AC for 1 second or 2596V DC for 1 second | |
| | 265V AC Working Voltage (IEC Class 2 reinforced insulation) | |
| Input group to backplane isolation and input group to | Verified by one of the following dielectric tests: 1100V AC for 1 second or 1697V DC for 1 second | |
| input group isolation | 75V DC Working Voltage (IEC Class 2 reinforced insulation) | |
| Output group to backplane Isolation | Verified by one of the following dielectric tests: 1836V AC for 1 second or 2596V DC for 1 second | |
| | 265V AC Working Voltage (IEC Class 2 reinforced insulation). | |
| Output group to output group isolation | Verified by one of the following dielectric tests: 1836V AC for 1 second or 2596V DC for 1 second | |
| | 265V AC Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation) | |

Working Voltage for 1766-L16BXB, 1766-L16BXBA

| Description | Recommendation | | |
|---|--|--|--|
| Input group to backplane isolation and input group to | Verified by one of the following dielectric tests: 1100V AC for 1 second or 1697V DC for 1 second | | |
| input group isolation | 75V DC Working Voltage (IEC Class 2 reinforced insulation) | | |
| FET output group to backplane isolation | Verified by one of the following dielectric tests: 1100V AC for 1 second or 1697V DC for 1 second | | |
| | 75V DC Working Voltage (IEC Class 2 reinforced insulation) | | |
| Relay output group to backplane isolation | Verified by one of the following dielectric tests: 1836V AC for 1 second or 2596V DC for 1 second | | |
| | 265V AC Working Voltage (IEC Class 2 reinforced insulation) | | |
| Relay output group to relay output group and FET output | Verified by one of the following dielectric tests: 1836V AC for 1 second or 2596V DC for 1 second | | |
| group isolation | 265V AC Working Voltage (basic insulation), 150V Working Voltage (IEC Class 2 reinforced insulation) | | |

Environmental Specifications

| Description | 1766-L32AWA | 1766-L32BWA 1766-L32BWAA | 1766-L32BXB 1766-L32BXBA | |
|------------------------|--|---|-----------------------------|--|
| Temperature, operating | IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20 60 °C (-4140 °F) | | | |
| Temperature, storage | IEC 60068-2-1 (Test Ab, Unpackaged Non-operating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Non-operating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Non-operating Thermal Shock): -4085 °C (-40185 °F) | | | |
| Relative humidity | IEC 60068-2-30 (Test Db, Ur 595% non-condensing | npackaged Damp Heat): | | |
| Vibration | IEC 60068-2-6 (Test Fc, Ope 3 g @ 10 500 Hz | IEC 60068-2-6 (Test Fc, Operating): 3 g @ 10 500 Hz | | |
| Shock, operating | IEC 60068-2-27 (Test Ea, Unpackaged Shock): 30 g | | | |
| Shock, nonoperating | IEC 60068-2-27 (Test Ea, Unpackaged Shock): Panel mount - 50 g DIN mount - 40 g | | | |
| Emissions | CISPR 11 Group 1, Class A | | | |
| ESD immunity | IEC 61000-4-2: 6 kV contact discharges 8 kV air discharges | | | |
| Radiated RF immunity | IEC 61000-4-3: 10V/m with 1 kHz sine-wave 80% AM from 801000 MHz 3 V/m with 1 kHz sine-wave 80% AM from 1.42.0 GHz 1 V/m with 1 kHz sine-wave 80% AM from 2.02.7 GHz | | | |
| EFT/B immunity | IEC 61000-4-4: ±2 kV @ 5 kHz on power ports ±2 kV @ 5 kHz on signal ports ±1 kV @ 5 kHz on communications ports | | | |

| Description | 1766-L32AWA 1766-L32AWAA | 1766-L32BWA 1766-L32BWAA | 1766-L32BXB 1766-L32BXBA |
|--------------------------|---|-----------------------------|-----------------------------|
| Surge transient immunity | IEC 61000-4-5: ±1 kV line-line(DM) and ±2 kV line-earth(CM) on AC power ports ±1 kV line-line(DM) and ±2 kV line-earth(CM) on signal ports ±1 kV line-earth(CM) on communications ports | | |
| Conducted RF immunity | IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz80 MHz | | |
| Voltage variation | IEC 6100-4-11: 60% dip for 10 periods on AC supply ports 30% dips for 25 periods @ 0° and 180° on AC supply ports 100% dip for 250 periods @ 0° and 180° on AC supply ports 100% dip for 0.5 periods, arbitrary angle, on AC supply ports | | |

Certifications for 1766-L32AWA, 1766-L32AWAA, 1766-L32BWA, 1766-L32BWAA, 1766-L32BXB, 1766-L32BXBA

| Certification (when product is marked) ⁽¹⁾ | Value | |
|---|--|--|
| UL | UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations. See UL File E10314. | |
| c-UL | UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for Canada. See UL File E10314. | |
| CE | European Union 2014/30/EU EMC Directive, compliant with: EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2014/35/EU LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11) | |
| RCM | Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions | |
| EAC | Russian Customs Union TR CU 020/2011 EMC Technical Regulation | |
| KC | Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3 | |

^[1] See the Product Certification link at http://www.ab.com for Declaration of Conformity, Certificates, and other certification

1762 Digital I/O

1762 Digital Expansion Input Modules Specifications

| Attribute | 1762-IA8 | 1762-IQ8 | 1762-IQ80W6 (inputs) | 1762-IQ16 | 1762-IQ32T |
|---------------------------------------|---|---|---|---|--|
| Voltage Category | 100/120V AC | 24V DC (sink/source)(1) | 24V DC (sink/source) ⁽¹⁾ | 24V DC (sink/source) ⁽¹⁾ | 24V DC sink/source ⁽¹⁾ |
| Operating Voltage Range | 79132V AC @ 4763 Hz | 1026.4V DC @ 55 °C (131 °F) 1030V DC @ 30 °C (86 °F) | 1026.4V DC @ 65 °C (149 °F) 1030V DC @ 30 °C (86 °F) | 1026.4V DC 1030V DC ⁽³⁾⁽²⁾ | 1026.4V DC 1030V DC |
| Number of Inputs | 8 | 8 | 8 | 16 | 32 |
| Number of Commons | 1 | 1 | inputs: 2 outputs: 1 | 2 | 4 |
| Bus Current Draw, max | 50 mA @ 5V DC (0.25 W) | 50 mA @ 5V DC (0.25 W) | 110 mA @ 5V DC (0.55 W) 80 mA @ 24V DC (1.92 W) | 70 mA @ 5V DC (0.35 W) ⁽³⁾ | 170 mA @ 5V DC 0 mA @ 24V DC |
| Heat Dissipation, max | 2.0 Total Watts | 3.7 Total Watts | 5.0 Total Watts @ 30V 4.4 Total Watts @ 26.4V | 5.4 Total Watts @ 30V 4.3 Total Watts @ 26.4V (3) | 5.4 Total Watts @ 26.4V 6.8 Total Watts @ 30.0V |
| Signal Delay, max | On Delay: 20.0 ms Off Delay: 20.0 ms | On Delay: 8.0 ms Off Delay: 8.0 ms | On Delay: 8.0 ms Off Delay: 8.0 ms | On Delay: 8.0 ms Off Delay: 8.0 ms | On Delay: 8.0 ms Off Delay: 8.0 ms |
| Off-state Voltage, max | 20V AC | 5V DC | 5V DC | 5V DC | 5V DC |
| Off-state Leakage Current, max | 2.5 mA | 1.5 mA | 1.5 mA | 1.5 mA | 1.0 mA |
| On-state Voltage, min | 79V AC, min, 132V AC, max | 10V DC | 10V DC | 10V DC | 10V DC |
| On-state Current min nom max | 5.0 mA @ 79V AC 47 Hz 12.0 mA @ 120V AC 60 Hz 16.0 mA @ 132V AC 63 Hz | 2.0 mA @ 10V DC 8.0 mA @ 24V DC 12.0 mA @ 30V DC | 2.0 mA @ 10V DC 8.0 mA @ 24V DC 12.0 mA @ 30V DC | 2.0 mA @ 10V DC 8.0 mA @ 24V DC 12.0 mA @ 30V DC | 1.6 mA @ 10V DC (min) 2 mA @ 15V DC (min) 5.7 mA @ 26.4V DC (max) 6.5 mA @ 30.0V DC (max) |
| Inrush Current, max | 250 mA | _ | 250 mA | _ | _ |

| Attribute | 1762-IA8 | 1762-IQ8 | 1762-IQ80W6 (inputs) | 1762-IQ16 | 1762-IQ32T |
|---------------------------------------|---|---|---|---|--|
| Impedance, nom | 12 kΩ @ 50 Hz 10 kΩ @ 60 Hz | 3 kΩ | 3 kΩ | 3 kΩ | 4.7 kΩ |
| Isolated Groups | Group 1: inputs 07 (internally connected commons) | Group 1: inputs 07 (internally connected commons) | Group 1: inputs 03 Group 2: inputs 47 Group 3: outputs 05 | Group 1: inputs 07 Group 2: inputs 815 | Group 1: Inputs 07 Group 2: Inputs 815 Group 3: Inputs 1623 Group 4: Inputs 2431 |
| Input Group to Backplane Isolation | Verified by one of the following dielectric tests: 1517V AC for 1 s or 2145V DC for 1 s 132V AC working voltage (IEC Class 2 reinforced insulation) | Verified by one of the following dielectric tests: 1200V AC for 1 s or 1697V DC for 1 s 75V DC working voltage (IEC Class 2 reinforced insulation) | Verified by one of the following dielectric tests: Input Group to Backplane isolation - 1200V AC for 1 s or 1697V DC for 1 s 75V DC working voltage (IEC Class 2 reinforced insulation) Output Group to Backplane isolation - 1836V AC for 1 s or 2596V DC for 1 s 265V AC working voltage (IEC Class 2 reinforced insulation) Input Group to Output Group isolation - 1836V AC for 1 s or 2596V DC for 1 s 265V AC working voltage (IEC Class 2 reinforced insulation) Input Group to Output Group isolation - 1836V AC for 1 s or 2596V DC for 1 s 265V AC working voltage (basic insulation) 150V AC working voltage (IEC Class 2 reinforced insulation) | Verified by one of the following dielectric tests: 1200V AC for 1 s or 1697V DC for 1 s 75V DC working voltage (IEC Class 2 reinforced insulation) | Verified by one of the following dielectric tests: 1,200V AC for 2 s or 1,697V DC for 2 s 75V DC working voltage (IEC Class 2 reinforced insulation) |

⁽¹⁾ Sinking/Sourcing Inputs - Sourcing/sinking describes the current flow between the I/O module and the field device. Sourcing I/O circuits supply (source) current to sinking field devices. Sinking I/O circuits are driven by a current sourcing field device. Field devices connected to the negative side (DC Common) of the field power supply are sinking field devices. Field devices connected to the positive side (+V) of the field supply are sourcing field devices.

⁽²⁾ Refer to Publication 1762-IN010, MicroLogix 1762-IQ16 DC Input Module Installation Instructions, for the derating chart.

⁽³⁾ Only applicable to Series B I/O modules

1762 Digital Expansion Relay Output Modules Specifications

| Attribute | 1762-IQ80W6 (outputs) | 1762-0W8 | 1762-0W16 | 1762-0X6I |
|------------------------------------|--|---|--|--|
| Voltage Category | AC/DC normally open relay | AC/DC normally open relay | AC/DC normally open relay | AC/DC Type C Relay |
| Operating Voltage Range | 5265V AC 5125V DC | 5265V AC 5125V DC | 5265V AC 5125V DC | 5265V AC 5125V DC |
| Number of Outputs | 6 | 8 | 16 | 6 (N.C., N.O.) |
| Number of Commons | inputs: 2 outputs: 1 | 2 | 2 | 6 |
| Bus Current Draw, max | 110 mA @ 5V DC (0.55 W) 80 mA @ 24V DC (1.92 W) | 80 mA @ 5V DC (0.40 W) 90 mA @ 24V DC (2.16 W) | 140 mA @ 5V DC (0.70 W) 180 mA @ 24V DC (4.32 W) ⁽¹⁾ | 110 mA @ 5V DC (0.55 W) 110 mA @ 24V DC (2.64 W) |
| Heat Dissipation, max | 5.0 Total Watts @ 30V 4.4 Total Watts @ 26.4V | 2.9 Total Watts | 6.1 Watts ⁽¹⁾ | 2.8 Watts |
| Signal Delay, max - resistive load | On Delay: 10 ms Off Delay: 10 ms | On Delay: 10 ms Off Delay: 10 ms | On Delay: 10 ms Off Delay: 10 ms | On Delay: 10 ms Off Delay: 20 ms |
| Off-state Leakage, max | 0 mA | 0 mA | 0 mA | 0 mA |
| On-state Current, min | 10 mA @ 5V DC | 10 mA @ 5V DC | 10 mA | 100 mA |
| On-state Voltage Drop, max | N/A | N/A | N/A | N/A |
| Continuous Current per Point, max | 2.5 A (Also see MicroLogix 1200 Controller Relay Contact Rating on page 44.) | | 7 A (Also see MicroLogix 1200 Controller Relay Contact Rating on page 44.) | |
| Continuous Current per Common, max | 8 A | 8 A | 8 A | 7 A (Also see MicroLogix 1200 Controller Relay Contact Rating on page 44.) |
| Continuous Current per Module, max | 8 A | 16 A | 16 A | 30 A |
| Surge Current, max | See MicroLogix 1200 Contro | oller Relay Contact Rating on | page 44. | · |

⁽¹⁾ Only applicable to Series B I/O modules

1762 Analog Modules

1762 Analog Expansion Modules Common Specifications

| Attribute | 1762-IF4 | 1762-IF20F2 | 1762-0F4 |
|---|--|--------------------------------------|--|
| Bus Current Draw, max | 40 mA @ 5V DC 50 mA @ 24V DC | 40 mA @ 5V DC 105 mA @ 24V DC | 40 mA @ 5V DC 165 mA @ 24V DC |
| Analog Normal Operating Range | Voltage: -1010V DC Current: 420 mA | Voltage: 010V DC Current: 420 mA | Voltage: 00V DC Current: 420 mA |
| Full Scale ⁽¹⁾ Analog Ranges | Voltage: -10.510.5V DC Current: -2121 mA | Voltage: 00.5V DC Current: 021 mA | Voltage: 00.5V DC Current: 021 mA |
| Resolution | 15 bits (bipolar) ⁽²⁾ | 12 bits (unipolar) | 12 bits (unipolar) |
| Repeatability ⁽³⁾ | ±0.12% ⁽²⁾ | ±0.12% ⁽²⁾ | ±0.12% ⁽²⁾ |
| Input and Output Group to System Isolation | 30V AC/30V DC rated working voltage ⁽⁴⁾ (N.E.C. Class 2 required) (IEC Class 2 reinforced insulation) type test: 500V AC or 707V DC for 1 minute | | 30V AC/30V DC rated working voltage (IEC Class 2 reinforced insulation) type test: 500V AC or 707V DC for 1 minute |

- (1) The over- or under-range flag is set when the normal operating range is exceeded. The module continues to convert the analog input up to the maximum full scale range.
- (2) Only applicable to Series B I/O modules.
- (3) Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal.
- (4) Rated working voltage is the maximum continuous voltage that can be applied at the terminals with respect to Earth ground.



Analog Output Module

Catalog Number 1762-0F4

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Specifications

Output

| Attribute | Value |
|--|---|
| Number of outputs | 4 single-ended (unipolar) |
| D/A converter type | R-2R Ladder Voltage Switching |
| Module update time | 2.5 ms |
| Resistive load on current output | 0500Ω (includes wire resistance) |
| Load range on voltage output | >1ΚΩ |
| Reactive load, current output | < 0.1 mH |
| Reactive load, voltage output | <1 μF |
| Typical overall accuracy ⁽¹⁾ | ±1.17% full scale @ -2065 °C (-4149 °F) ±0.5% full scale @ 25 °C (77 °F) |
| Output ripple range 0500 Hz (referred to output range) | <±0.1% |
| Non-linearity (in percent full scale) | < ±0.59% |
| Open and short-circuit protection | Continuous |
| Output protection | ±32 mA |

⁽¹⁾ Includes offset, gain, non-linearity and repeatability error terms.

General

| Attribute | Value | |
|---|---|--|
| Dimensions, HxWxD | 90 x 40.4 x 87 mm (3.54 x 1.59 x 3.43 in.) | |
| Approximate shipping weight (with carton) | 235 g (8.28 oz) | |
| Bus current draw, max | 40 mA @ 5V DC 165 mA @ 24V DC | |
| Analog normal operating range | Voltage: 010V DC Current: 420 mA | |
| Full scale ⁽¹⁾ analog ranges | Voltage: 010.5V DC Current: 021 mA | |
| Resolution | 12 bits (unipolar) | |
| Repeatability ⁽²⁾ | ±0.12% | |
| Output group to system isolation | 30V AC/30V DC rated working voltage ⁽⁴⁾ (IEC Class 2 reinforced insulation) type test: 500V AC or 707V DC for 1 minute | |
| Module power LED | On: indicates power is applied. | |
| Recommended cable | Belden 8761 (shielded) | |
| Heat Dissipation | 2.8 W | |
| Wiring category ⁽³⁾ | 2 - on signal ports | |
| Pilot duty rating | Not rated | |
| Enclosure type rating | IP20 | |
| North American temp code | T3C | |
| Vendor ID code | 1 | |
| Product type code | 10 | |
| Product code | 66 | |

⁽¹⁾ The over- or under-range flag comes on when the normal operating range (over/under) is exceeded. The module continues to convert the analog output up to the maximum full scale range.

⁽²⁾ Repeatability is the ability of the output module to reproduce output reading when the same controller value is applied to it consecutively, under the same conditions and in the same direction.

⁽³⁾ Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

⁽⁴⁾ Rated working voltage is the maximum continuous voltage that can be applied at the terminals with respect to earth ground.

Environmental

| Attribute | Value | |
|--------------------------|--|--|
| Temperature, operating | IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20 65 °C (-4149 °F) | |
| Temperature, storage | IEC 60068-2-1 (Test Ab, Unpackaged Non-operating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Non-operating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Non-operating Thermal Shock): -4085 °C (-40185 °F) | |
| Relative humidity | IEC 60068-2-30 (Test Db, Unpackaged Damp Heat): 595% non-condensing | |
| Vibration | IEC 60068-2-6 (Test Fc, Operating): 5 g @ 10 500 Hz | |
| Altitude, operating max | 2000 m (6562 ft) | |
| Shock, operating | IEC 60068-2-27 (Test Ea, Unpackaged Shock): 30 g | |
| Shock, nonoperating | IEC 60068-2-27 (Test Ea, Unpackaged Shock): Panel mount - 50 g DIN mount - 40 g | |
| Emissions | CISPR 11 Group 1, Class A | |
| ESD immunity | IEC 61000-4-2: 4 kV contact discharges 8 kV air discharges 4 kV indirect | |
| Radiated RF immunity | IEC 61000-4-3: 10V/m with 1 kHz sine-wave 80% AM from 802700 MHz | |
| EFT/B immunity | IEC 61000-4-4: ±2 kV @ 5 kHz on signal ports | |
| Surge transient immunity | IEC 61000-4-5: ±1 kV shielded line-earth (CM) on signal ports | |
| Conducted RF immunity | IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz80 MHz | |

Certifications

| Certification (when product is marked) ⁽¹⁾ | Value |
|---|--|
| c-UL-us | UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E322657. |
| | UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E334470. |
| CE | European Union 2004/108/EC EMC Directive, compliant with: EN 61326-1; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) |
| C-Tick | Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions |
| KC | Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3 |

See the Product Certification link at http://www.rockwellautomation.com/products/certification for Declaration of Conformity, Certificates, and other certification details.

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience a problem within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your product up and running.

| United States or Canada | 1.440.646.3434 |
|----------------------------|--|
| States or | Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative. |

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

| | Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process. |
|-----------------------|---|
| Outside United States | Please contact your local Rockwell Automation representative for the return procedure. |

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PanelView Plus 7 Standard Terminals

Catalog Numbers 2711P-T4W21D8S, 2711P-T4W22D8S, 2711P-T4W21D8S-B, 2711P-T4W22D8S-B, 2711P-T6C21D8S, 2711P-T6C22D8S, 2711P-T6C21D8S-B, 2711P-T6C22D8S-B, 2711P-T7C21D8S, 2711P-T7C22D8S, 2711P-T7C21D8S-B, 2711P-T7C22D8S-B, 2711P-T9W21D8S, 2711P-T9W22D8S, 2711P-T9W21D8S-B, 2711P-T9W22D8S-B, 2711P-T10C21D8S, 2711P-T10C22D8S, 2711P-T10C21D8S-B, 2711P-T10C22D8S-B, 2711P-T12W21D8S, 2711P-T12W22D8S, 2711P-T12W21D8S-B, 2711P-T12W22D8S-B, 2711P-T15C21D8S, 2711P-T15C22D8S, 2711P-T15C21D8S-B, 2711P-T15C22D8S-B

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Summary of Changes

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| In the Technical Specifications table, added "Recommended" to the Replacement option in the Power Supply line. | 46 |

The PanelView[™] Plus 7 Standard terminals are operator interface devices. They monitor and control devices that are attached to ControlLogix® 5570 and CompactLogix™ 5370 controllers on an EtherNet/IP network. Animated graphic and text displays provide operators a view into the operating state of a machine or process. Operators interact with the control system by using touch screen input.

The PanelView Plus 7 Standard terminals include these features:

- Terminal functionality permits connection to 1 controller, up to 25 screens, and up to 200 alarms.
- FactoryTalk® View Machine Edition software provides a familiar environment for creating HMI applications.
- Windows CE operating system with desktop access for configuration and third-party applications.
- Ethernet communication that supports linear and star network topology.
- PDF viewer to access PDF files that are stored on the terminal.







- More screen options including 4-in., 6-in., 7-in., 9-in., 10-in., 12-in., and 15-in. terminals.
- Widescreen on three sizes, 4-in., 9-in., and 12-in. terminals.
- Greater screen resolution.
- Terminals are available with an Allen-Bradley brand marking, or with no marking for customers who want to put their own brand label on the terminal.
- Certifications including Class I, Div. 2; Class II, Div. 2; Class III; and ATEX and INMETRO Zones 2 and 22.

Environmental Specifications

Table 1 - Environmental Specifications - 2711P-T4W21D8S, 2711P-T4W22D8S, 2711P-T4W21D8S-B, 2711P-T4W22D8S-B, 2711P-T6C21D8S, 2711P-T6C22D8S-B, 2711P-T6C22D8S-B, 2711P-T7C22D8S-B, 2711P-T7C2D8S-B, 2711P-T7C2D8S-B, 2711P-T9W21D8S, 2711P-T9W22D8S-B, 2711P-T9W22D8S-B, 2711P-T10C21D8S, 2711P-T10C22D8S, 2711P-T10C22D8S, 2711P-T10C2D8S, 2711P-T12W21D8S-B, 2711P-T12W22D8S-B, 2711P-T12W22D8S-B, 2711P-T12W22D8S, 2711P-T15C22D8S, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C2D8S-B,
| Attribute | Value | |
|---|--|--|
| Temperature, operating | 055 °C (32131 °F) | |
| Temperature, nonoperating | -25+70 °C (-13+158 °F) | |
| Relative humidity | 595% without condensation | |
| Heat dissipation | 4 in., 15 W = 51 BTU | |
| | 6 in., 15 W = 51 BTU | |
| | 7 in., 15 W = 51 BTU | |
| | 9 in., 20 W = 68 BTU | |
| | 10 in., 20 W= 68 BTU | |
| | 12 in., 30 W= 102 BTU | |
| | 15 in., 30 W= 102 BTU | |
| Altitude, operating | 2000 M | |
| Vibration | | |
| 4.3-in., 5.7-in., 6.5-in., 9.0-in., 10.4-in., 12.1-in., and | 0.012 pk-pk, 1057 Hz | |
| 15-in. | 2g peak at 57500 Hz | |
| Shock, operating | 15 g at 11 ms | |
| Shock, nonoperating | 30 g at 11 ms | |
| Enclosure ratings | NEMA and UL Type 12, 13, 4X (indoor use only), also rated IP54 or IP66 as Classified by UL | |

⁽¹⁾ Catalog numbers with a -B extension denote terminals that do not include the Allen-Bradley brand marking. Customers can put their own brand labels on these terminals.

Certifications

Table 2 Certifications - 2711P-T4W21D8S, 2711P-T4W22D8S, 2711P-T4W21D8S-B, 2711P-T4W22D8S-B, 2711P-T6C22D8S, 2711P-T6C22D8S, 2711P-T6C21D8S-B, 2711P-T7C22D8S-B, 2711P-T7C22D8S-B, 2711P-T7C2D8S-B, 2711P-T7C2D8S-B, 2711P-T9W21D8S, 2711P-T9W21D8S-B, 2711P-T9W22D8S-B, 2711P-T10C21D8S-B, 2711P-T10C21D8S-B, 2711P-T10C21D8S-B, 2711P-T10C22D8S-B, 2711P-T12W21D8S, 2711P-T12W22D8S-B, 2711P-T12W21D8S-B, 2711P-T15C22D8S, 2711P-T15C22D8S, 2711P-T15C22D8S, 2711P-T15C21D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C2D8S-B, 2711P-

| Certification ⁽²⁾ | Value |
|------------------------------|---|
| cULus | cULus Listed Industrial Control Equipment for use in Hazardous Locations (E10314) per standards ANSI / ISA 12.12.01 and CSA C22.2 No. 213. rated: • Class I, Division 2, Groups A, B, C and D • Class II, Division 2, Groups F and G • Class III Enclosure type ratings per UL50 and CSA C22.2 No. 94.2-07. Enclosure ingress protection classified by UL per IEC 60529 |
| ATEX | European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-0:2009; EN 60079-11:2012; EN 60079-15:2010; and EN 60079-31:2009 • II 3 GD • Ex ic nA IIC T4 Gc • Ex tc IIIC T135 °C (275 °F) Dc IP66 • Tamb = 0 °C to +55 °C (32 °F to +131 °F) • DEMKO 14 ATEX 1302X |
| INMETRO | ABNT NBR IEC 60079-0:2008+Errata 1:2011; ABNT NBR IEC 60079-11:2009; ABNT NBR IEC 60079-15:2012; ABNT NBR IEC 60079-31:2011 Ex ic nA IIC T4 Gc Ex tc IIIC T135 °C (275 °F) Dc IP66 Tamb = 0 °C to +55 °C (32 °F to +131 °F) UL-BR 14.0716X |
| CE (EMC) | European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers |
| CE (LVD) | European Union 2006/95/EC Low Voltage Directive, compliant with: • EN 61131-2; Programmable Controllers |
| RCM | Australian Radio Communications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions |
| EAC | Certificate of compliance |
| RoHS | China RoHS, Turkey RoHS, European RoHS |
| KCC | Certificate of compliance |

⁽¹⁾ Catalog numbers with a -B extension denote terminals that do not include the Allen-Bradley brand marking. Customers can put their own brand labels on these terminals

⁽²⁾ When marked. See the Product Certification link on http://www.ab.com for declarations of conformity, certificates, and other certification details.

Technical Specifications

Table 3 - PanelView Plus 7 Standard 4-in and 6-in Terminals

| Attribute | 4-in. Touch 2711P-T4W21D8S, 2711P-T4W21D8S-B, 2711P-T4W22D8S, 2711P-T4W22D8S-B | 6-in. Touch 2711P-T6C21D8S, 2711P-T6C21D8S-B, 2711P-T6C22D8S, 2711P-T6C22D8S-B |
|--|---|--|
| Operator input | Touch | Touch |
| Display type | Color TFT LCD | Color TFT LCD |
| Display size, diagonal | 4.3 in. widescreen | 5.7 in. |
| Viewing area | 95 x 54 mm | 115 x 86 mm |
| Display resolution | 480 x 272 WQVGA, 18-bit color graphics | 640 x 480 VGA, 18-bit color graphics |
| Aspect ratio | 16:9 | 4:3 |
| Brightness, typical | 300 nits | |
| Backlight life | 50,000 h life, min. at 40° C to half-brightness. Backlight is not replaceable | |
| Touch screen | Analog resistive Actuation rating: 1 million presses Operating force: 100 grams | |
| Battery (real-time clock backup) | Accuracy: +/-2 minutes per month. Battery life: 4 years min at 25 °C (77 °F) Replacement: CR2032 lithium coin cell (Allen-Bradley part number 2711P-RY2032) | |
| Memory System User | 512 MB RAM and 512 MB storage 80 MB nonvolatile storage for applications | |
| Secure Digital (SD) card slot | One SD card slot for storing application files Replacement: Allen-Bradley part number 1784-SD1 (1 GB) and 1784-SD2 (2 GB) | |
| USB ports Host Device | One USB 2.0 high-speed host port (type A) support removal flash drives for storage One high-speed 1.0 device port (type B) supports connection to host computer | |
| Ethernet port Cat. Nos. with 21 Cat. Nos. with 22 | | |
| Operating system | Windows CE includes FTP, VNC client server, ActiveX o | controls, PDF reader, third-party device support |
| Software FactoryTalk View Studio for Machine Edition, version 8.0 or later, Factor | | 8.0 or later, FactoryTalk ViewPoint, version 2.6 or late |
| Electrical | | |
| Input voltage, DC | 24V DC nom (1830V DC), nonisolated DC power supply | |
| Power consumption, DC | 35 W max (1.46A at 24V DC) | |
| Power supply | DIN-rail power supply, AC-to-DC, 85265V AC, 4763 Hz Recommended Replacement: Allen-Bradley part number 2711P-RSACDIN | |
| Mechanical | | |
| Weight, approx | 0.44 kg (0.97 lb) | 0.70 kg (1.53 lb) |
| Dimensions, HxWxD, approx. | 110 x 135 x 56.5 mm (4.33 x 5.31 x 2.22 in.) | 152 x 176 x 56.5 mm (5.98 x 6.93 x 2.22 in.) |
| Cutout dimensions, HxW, approx. | 92 x 117 mm (3.62 in. x 4.61 in.) | 123 x 156 mm (4.84 x 6.14 in.) |

Table 4 - PanelView Plus 7 Standard 7-in., 9-in., and 10-in. Terminals

| Attribute | 7-in. Touch 2711P-T7C21D8S, 2711P-T7C21D8S-B, 2711P-T7C22D8S, 2711P-T7C22D8S-B | 9-in. Touch 2711P-T9W21D8S, 2711P-T9W21D8S-B, 2711P-T9W22D8S, 2711P-T9W22D8S-B | 10-in. Touch 2711P-T10C21D85, 2721P-T10C21D85-B, 2711P-T10C22D85, 2711P-T10C22D85-B | | | | | |
|---|--|--|---|--|--|--|--|--|
| Operator input | Touch | Touch | Touch | | | | | |
| Display type | Color TFT LCD | Color TFT LCD | Color TFT LCD | | | | | |
| Display size, diagonal | 6.5 in. | 9 in. widescreen | 10.4 in. | | | | | |
| Viewing area | 132 x 99 mm | 196 x 118 mm | 211 x 158 mm | | | | | |
| Display resolution | 640 x 480 VGA, 18-bit color graphics | 800 x 600 SVGA, 18-bit color graphics | | | | | | |
| Aspect ratio | 4:3 | 5:3 | 4:3 | | | | | |
| Brightness, typical | 300 nits | | | | | | | |
| Backlight life | 50,000 hr life, min at 40° C (104 °F) to half-brightne | ss. Backlight is not replaceable. | | | | | | |
| Touch screen | Analog resistive Actuation rating: 1 million presses Operating force: 100 grams | | | | | | | |
| Battery (real-time clock backup) Accuracy: ±2 minutes per month. Battery life: 4 years min at 25 °C (77 °F) Replacement: CR2032 lithium coin cell (Allen-Bradley part number 2711P-RY2032) | | | | | | | | |
| Memory System User | 512 MB RAM and 512 MB storage 80 MB nonvolatile storage for applications | | | | | | | |
| Secure Digital (SD) card slot | One SD card slot for storing application files Replacement: Allen-Bradley part number 1784-SD1 | (1 GB) and 1784-SD2 (2 GB) | | | | | | |
| USB ports Host Device | One USB 2.0 high-speed host port (type A) support r One high-speed 1.0 device port (type B) supports co | | | | | | | |
| Ethernet port Cat. Nos. with 21 Cat. Nos. with 22 | One 10/100Base-T, Auto MDI/MDI-X Ethernet port w Two 10/100Base-T, Auto MDI/MDI-X Ethernet ports s | | | | | | | |
| Operating system | Windows CE includes FTP, VNC client server, ActiveX | controls, PDF reader, third-party device support | | | | | | |
| Software | FactoryTalk View Studio for Machine Edition, version | 8.0 or later, FactoryTalk ViewPoint, version 2.6 or late | r | | | | | |
| Electrical | | | | | | | | |
| nput voltage, DC | 24V DC nom (1830V DC), nonisolated DC powers | upply | | | | | | |
| Power consumption, DC | 50 W max (2.1A at 24V DC) | | | | | | | |
| Power supply | DIN-rail power supply, AC-to-DC, 85265V AC, 47. Recommended Replacement: Allen-Bradley part nu | | | | | | | |
| Mechanical | | | | | | | | |
| Weight, approx | 0.85 kg (1.86 lb) | 1.29 kg (2.84 lb) | 1.82 kg (4.0 lb) | | | | | |
| Dimensions, HxWxD, approx | 170 x 212 x 56.5 mm (6.69 x 8.35 x 2.22 in.) | 190 x 280 x 56.5 mm (7.48 x 11.02 x 2.22 in.) | 252 x 297 x 56.5 mm (9.92 x 11.69 x 2.22 in.) | | | | | |
| Cutout dimensions, HxW, approx. | 142 x 184 mm (5.59 x 7.24 in.) | 162 x 252 mm (6.38 x 9.92 in.) | 224 x 269 mm (8.82 x 10.59 in.) | | | | | |

Table 5 - PanelView Plus 7 Standard 12-in. and 15-in. Terminals

| Attribute | 12-in. Touch 2711P-T12W21D8S, 2711P-T12W21D8S-B, 2711P-T12W22D8S, 2711P-T12W22D8S-B | 15-in. Touch 2711P-T15C21D8S, 2711P-T15C21D8S-B, 2711P-T15C22D8S, 2711P-T15C22D8S-B | | | | |
|---|---|---|--|--|--|--|
| Operator Input | Touch | Touch | | | | |
| Display type | Color TFT LCD | Color TFT LCD | | | | |
| Display size, diagonal | 12.1 in. widescreen | 15-in. | | | | |
| Viewing area | 261 x 163 mm | 304 x 228 mm | | | | |
| Display resolution | 1280 x 800 WXGA, 18-bit color graphics | 1024 x 768 XGA, 18-bit color graphics | | | | |
| Aspect ratio | 5:3 | 4:3 | | | | |
| Brightness, typical | 300 nits | | | | | |
| Backlight life | 50,000 h life, min. at 40° C to half-brightness. Backli | ght is not replaceable | | | | |
| Touch screen | Analog resistive Actuation rating: 1 million presses Operating force: 100 grams | | | | | |
| Battery (real-time clock backup) | Accuracy: $+/-2$ minutes per month Battery life: 4 years min at 25 °C (77 °F) Replacement: CR2032 lithium coin cell | | | | | |
| Memory System User | 512 MB RAM and 512 MB storage 80 MB nonvolatile storage for applications | | | | | |
| Secure Digital (SD) card slot | One SD card slot for storing application files Replacement: Allen-Bradley part number 1784-SD1 (1 GB) and 1784-SD2 (2 GB) | | | | | |
| USB ports Host Device | One USB 2.0 high-speed host port (type A) support removal flash drives for storage One high-speed 1.0 device port (type B) supports connection to host computer | | | | | |
| Ethernet port Cat. Nos. with 21 Cat. Nos. with 22 | One 10/100Base-T, Auto MDI/MDI-X Ethernet port w Two 10/100Base-T, Auto MDI/MDI-X Ethernet ports s | | | | | |
| Operating system | Windows CE includes FTP, VNC client server, ActiveX controls, PDF reader, third-party device support | | | | | |
| Software | FactoryTalk View Studio for Machine Edition, version 8.0 or later, FactoryTalk ViewPoint, version 2.6 or later | | | | | |
| Electrical | | | | | | |
| Input voltage, DC | 24V DC nom (1830V DC), nonisolated DC power supply | | | | | |
| Power consumption, DC | 50 W max (2.1A at 24V DC) | | | | | |
| Power supply | DIN-rail power supply, AC-to-DC, 85265V AC, 4763 Hz Recommended Replacement: Allen-Bradley part number 2711P-RSACDIN | | | | | |
| Mechanical | | | | | | |
| Weight, approx. | 1.95 kg (4.29 lb) | 3.07 kg (6.75 lb) | | | | |
| Dimensions, HxWxD, approx. | 240 x 340 x 56.5 mm (9.65 x 13.39 x 2.22 in.) | 318 x 381 x 56.5mm (12.52 x 15.00 x 2.22 in.) | | | | |
| Cutout dimensions, HxW, approx. | 218 x 312 mm (8.58 x 12.28 in.) | 290 x 353 mm (11.42 x 13.90 in.) | | | | |

Catalogue No: 1784-SD1

1 GB SECURE DIGITAL (SD) CARD

Automation Systems > Modular Programmable Controllers > Large PLC Systems > Allen-Bradley ControlLogix® > ControlLogix® Accessories





Representative Photo Only (actual product may vary based on configuration selections)

ControlLogix Secure Digital (SD) Card For 5570 Processor, 1GB

- High performance in an easy-to-use environment
- Tight integration between the programming software, controller, and I/O modules reduces development time and cost at commissioning and during normal operation
- Perform standard and safety control in the same chassis for a truly integrated system
- Leverage the high-availability and extreme environment capabilities to meet your application needs

| SPECIFICATIONS | |
|---|--|
| Product Series | ControlLogix (Bul. 1756 / 1757) |
| Component Type PLC & I/O | Accessory |
| Module Specific Functions | 1784 Memory Card, 1GB |
| Operating Temperature, Max | 70 °C max |
| Operating Temperature, Min | -25 °C min |
| Storage Temperature, Max | 85 °C max |
| Storage Temperature, Min | -40 °C min |
| Relative Humidity, Max | 95 %RH |
| Vibration Acceleration (Max.) | 2 g |
| Vibration Frequency, Operational (Max.) | 500 Hz |
| Standards Compliance | IEC 60068-2-1 IEC 60068-2-14 IEC 60068-2-2 IEC 60068-2-27 IEC 60068-2-30 IEC 60068-2-6 IEC 61000-4-2 IEC 61000-4-3 IEC 61000-6-4 |
| Certifications | CE C-Tick KC (KCC) |

Catalogue No: 1784-SD1

1 GB SECURE DIGITAL (SD) CARD



| REFERENCES | |
|---|---|
| IECEx Certificate | - |
| Supplier Declaration of Conformity: | - |
| Installation Guide: | - |
| User Manual: | - |
| Manufacturer Datasheet: | - |
| Manufacturer Catalogue & Product Selection: | - |



[+ Worldwide]



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Terminal Blocks, NEMA/EEMAC

- Terminal Blocks, NEMA/EEMAC Overview
- NEMA/EEMAC Terminal Blocks
- Finger-Safe Terminal Blocks
- Panel Mount Blocks
- NEMA Terminal Block Accessories

<u>Catalogs</u> > <u>Industrial Controls Catalog</u> > <u>Terminal Blocks and Wiring Systems</u> > <u>Terminal Blocks, NEMA/EEMAC</u> > Finger-Safe Terminal Blocks

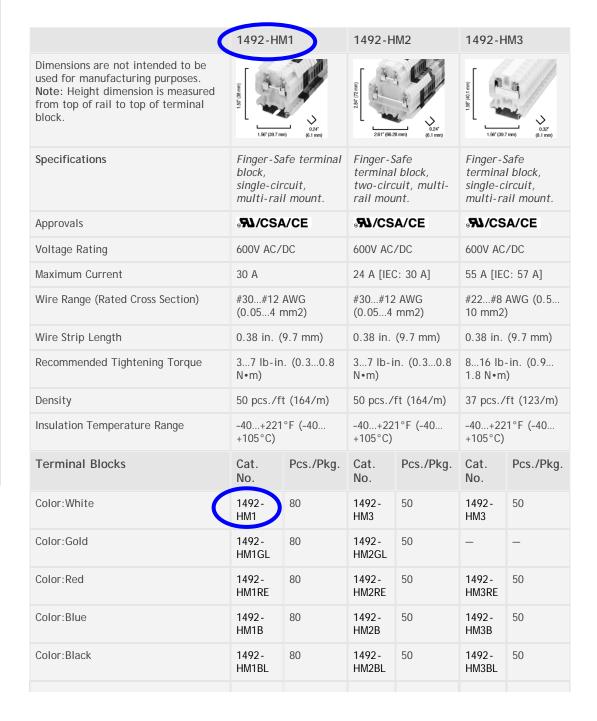
FINGER-SAFE TERMINAL BLOCKS

Introduction

High Density Blocks Fuse and Surge Suppressor Blocks Resistor, Voltage Indicating, and Component Blocks Short-Circuit Current Ratings



High Density Blocks



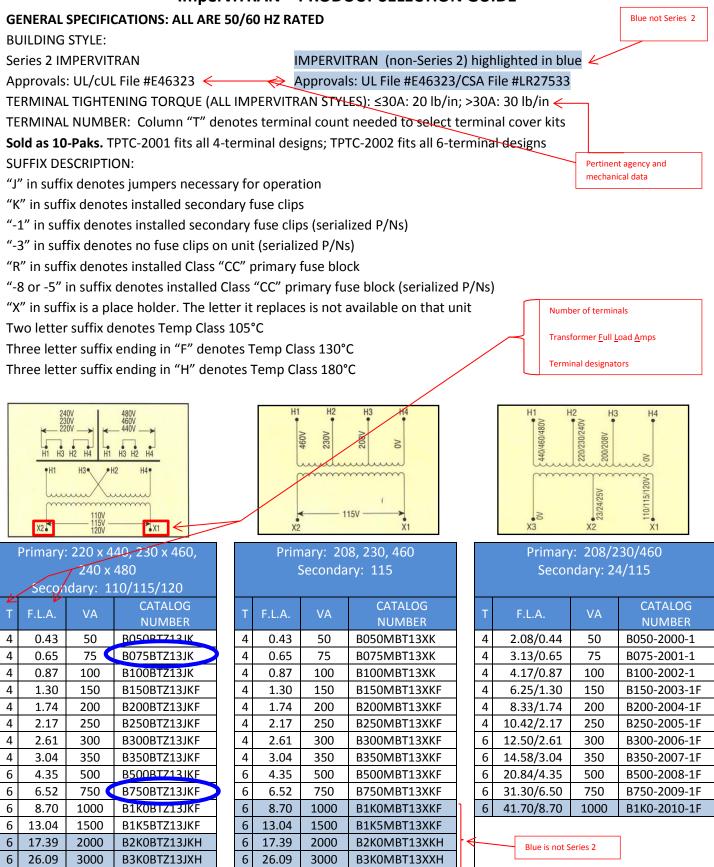
| Color:Green | 1492 - HM1G | 80 | 1492 - HM2G | 50 | 1492 - HM3G | 50 |
|---|-----------------|-----------|--------------------|-----------|-----------------|-----------|
| Color:Yellow | 1492 - HM1Y | 80 | 1492 - HM2Y | 50 | 1492 - HM3Y | 50 |
| Color:Brown | 1492 - HM1BR | 80 | 1492 - HM2BR | 50 | 1492 - HM3BR | 50 |
| Color:Violet | 1492- HM1VT | 80 | 1492 - HM2VT | 50 | 1492 - HM3VT | 50 |
| Color:Grey | 1492- HM1GY | 80 | 1492 - HM2GY | 50 | 1492 - HM3GY | 50 |
| Color:Orange | 1492 - HM1OR | 80 | 1492 - HM2OR | 50 | 1492 - HM3OR | 50 |
| Accessories (<u>Accessories</u>) | Cat. No. | Pcs./Pkg. | Cat. No. | Pcs./Pkg. | Cat. No. | Pcs./Pkg. |
| Mounting Rails: A-B Rail | 1492 - N1 | 20 | 1492 - N1 | 20 | 1492 - N1 | 20 |
| 3 ft Rigid A-B Rail | 1492 - N22 | 20 | 1492 - N22 | 20 | 1492 - N22 | 20 |
| 3 ft High-Rise A-B Rail | 1492 - N44 | 2 | - | - | 1492 - N44 | - |
| Standoff Brackets (use every 12 in.) | 1492 - N25 | 2 | 1492 - N25 | 2 | 1492 - N25 | 2 |
| DIN Rail | 199- DR1 | 10 | 199- DR1 | 10 | 199- DR1 | 10 |
| 1 m Symmetrical DIN (Aluminum) | 1492 - DR5 | 10 | 1492 - DR5 | 10 | 1492 - DR5 | 10 |
| 1 m Hi-Rise Sym. DIN (Aluminum) | 1492 - DR6 | 2 | 1492 - DR6 | 2 | 1492 - DR6 | 2 |
| 1 m Angled Hi-Rise Sym. DIN (Steel) | 1492 - DR7 | 2 | 1492 - DR7 | 2 | 1492 - DR7 | 2 |
| End Barrier | 1492 - NM36 | 50 | 1492 - NM40 | 50 | 1492 - NM36 | 50 |
| End Anchors: A-B Rail | 1492- N23 | 10 | 1492 - N23 | 10 | 1492 - N23 | 10 |
| A-B Rail — Normal Duty | 1492 - N47 | 50 | - | _ | 1492 - N47 | 50 |
| A-B Rail — Retaining Clip — Light Duty | 1492 - N2 | 50 | _ | _ | _ | _ |
| DIN Rail — Normal Duty | 1492 - EA35 | 50 | 1492 - EA35 | 50 | 1492 - EA35 | 50 |
| DIN Rail — Heavy Duty | 1492 - EAH35 | 10 | 1492 - EAH35 | 10 | 1492 - EAH35 | 10 |
| Color:=26,1165366 | 1492 - N42 | 50 | 1492 - N42 | 50 | _ | 50 |
| Color:=23,1165366 | 1492- SJ8-10 | 10 | 1492 - SJ6 - 10 | 10 | 1492- SJ8-10 | 10 |
| 50-pole Uninsulated | 1492 - N39 | 10 | 1492 - N39 | 10 | - | - |
| Insulating Sleeve | 1492 - SJS | 10 | 1492 - SJS | 10 | - | - |
| Marking System | 1492- | 5 | 1492- | 5 | 1492- | 5 |

| Standard Feed-Through Bi | JUNS | | | | | | | | | |
|---|---------------------|-----------------|---------------------------------------|---|--|-------------------------------|-------------------------------------|----------------------------|-------------------|-------------------------------------|
| | | 1492-J3 | | | 149 | 2-J4 | | 1 | 492-J6 | |
| Dimensions are not intended to be used for manufacturing purposes. Note: Height dimension is measured from top of rail to top of terminal block. | 1.56" (39.5 mm) | (6.1 mm) | | | | (Eu 97 (60 mm) (8.1 mm) (9.2) | | | | |
| Specifications | Feed-thro | ugh terminal | block | Fee | ed-through | terminal | block | Feed-throu | gh terminal | block |
| Certifications | 71 cs | A IEC | ATEX | <i>77</i> | CSA | IEC | ATEX | SAL CSA | IEC | ATEX |
| Voltage Rating | 600V AC/DO | 800V AC/DC | 550V AC/DC | 600V | AC/DC | 800V AC/DC | 690V AC/DC | 600V AC/DC | 800V AC/DC | 550V AC/DC |
| Maximum Current | 25 A 20 | A 24 A | 21 A | 35 A | 25 A | 32 A | 28 A | 50 A | 41 A | 36 A |
| Wire Range (Rated Cross Section) | #2212 #26 AWG AW | | 2.5 mm ² (#2014 AWG) | .14 #2210 #2610 4 mm ² | | | 4 mm ² (#2012 AWG) | #228 AWG | 6 mm ² | 6 mm ² (#2010 AWG) |
| Wire Strip Length | 0.3 | 9 in. (10 mm) | , | | 0.39 in. | (10 mm) | , | 0.47 | in. (12 mm) | , |
| Recommended Tightening Torque | 4.57.1 ll | o•in (0.50.8 | B N∙m) | | 9.0 lb•in | (1.0 N•m) |) | 14.2 lk | •in (1.6 N•n | n) |
| Density | | s/ft (196 pcs/i | | | 49 pcs/ft (| (163 pcs/r | n) | | ft (123 pcs/i | |
| Housing Temperature Range | -58+24 | 3 °F (-50+1 | 20 °C) | -58 | +248 °F | <u> </u> | 20 °C) | -58+248 | °F (-50+1 | 20 °C) |
| Short-Circuit Current Rating | | | | | See pa | ge 12-42 | | | | |
| Tarrainal Blacks | 0-4 | N | Die Ohe | | Cat. No. | | Die Ohe | C-4 A | ۱ | Die Ohe |
| Terminal Blocks Color: Grey | Cat. 1492 | | Pkg Qty. | | 1492-J4 | | Pkg Qty. | Cat. N 1492- | | Pkg Qty. |
| Red | 1492-J | | 100 | | 1492-J4-R | F | 100 | 1492-J6 | | 100 |
| Blue | | | 100 | | 1492-J4-E | | 100 | 1492-J | | 100 |
| Black | | | 100 | | 1492-J4-B | | 100 | 1492-J6 | | 100 |
| Green | 1492- | J3-G | 100 | | 1492-J4-0 | | 100 | 1492-J | | 100 |
| Yellow | 1492- | | 100 | | 1492-J4-Y | | 100 | 1492-J6-Y | | 100 |
| Orange | 1492-J | 100 | - | 1492-J4-O | R | 100 | 1492-J6-OR | | 100 | |
| Brown | 1492-J | 100 | | 1492-J4-BR | | | 1492-J6-BR | | 100 | |
| White | 1492- | 100 | 1492-J4-W | | | 100 | 1492-J6-W | | 100 | |
| Violet | 1492- | 1492-J3-V | | | 1492-J4-V | | 100 | _ | | _ |
| Mounting Rails: 1 m Symmetrical DIN (Steel) | 199-DR1 | | 10 | | 199-DR1 | | 10 | 199-D | R1 | 10 |
| 1 m Symmetrical DIN (Aluminum) | 1492- | 10 | | 1492-DR5 | | | 1492-DR5 | | 10 | |
| 1 m Hi-Rise Sym. DIN (Aluminum) | 1492- | 2 | 1492-DR6 | | | 2 | 1492-DR6 | | 2 | |
| 1 m Angled Hi-Rise Sym. DIN (Steel) | 1492- | 2 | 1492-DR7 | | | 2 | 1492-0 | 2 | | |
| End Barriers Grey | 1492-1 | 50 | 1492-EBJ3 | | | 50 | 1492-EBJ3 | | 50 | |
| Blue | | | 50 | 1492-EBJ3-B | | 50 | 1492-EBJ3-B | | 50 | |
| Yellow | 1492-E | 50 | 1492-EBJ3-Y | | | 50 | 1492-EBJ3-Y | | 50 | |
| End Anchors and Retainers: DIN Rail — Normal Duty | 1492-E | 100 | 1492-EAJ35 | | | 100 | 1492-EAJ35 | | 100 | |
| DIN Rail — Heavy Duty | 1492-E | AHJ35 | 50 | 1- | 1492-EAHJ35 | | 50 | 1492-EAHJ35 | | 50 |
| Screwless End Retainer | 1492-E | RL35 | 20 | 1 | 492-ERL3 | 5 | 20 | 1492-EF | 20 | |
| Jumpers:* Screw Center Jumper — 10-pole | 1492-C | | 20 | | 492-CJJ6- | | 20 | J8-10 | 20 | |
| Screw Center Jumper — 4-pole | 1492-C | | 50 | 1492-CJJ6-4 | | | 50 | 1492-CJJ8-4 1492-CJJ8-3 | | 50 |
| Screw Center Jumper — 3-pole | 1492-C | 50 | 1492-CJJ6-3 | | | 50 50 | | 50 | | |
| Screw Center Jumper — 2-pole Plug-in Center Jumper — 50-Pole | 1492-C 1492-CJ | | 50 10 | | 1492-CJJ6-2 1492-CJLJ6-41 (41-pole) | | | 1492-CJ | JU-2 | 50 |
| Plug-in Center Jumper — 10-Pole | 1492-CJ | | 20 | | 1492-CJLJ6-10 | | | _ | | |
| Plug-in Center Jumper — 9-Pole | 1492-C | | 20 | | _ | | 20 | _ | | _ |
| Plug-in Center Jumper — 8-Pole | 1492-C | | 20 | | _ | | _ | _ | | _ |
| Plug-in Center Jumper — 7-Pole | 1492-C | JLJ5-7 | 20 | | _ | | _ | _ | | |
| Plug-in Center Jumper — 6-Pole | 1492-C | | 20 | | _ | | | _ | | |
| Plug-in Center Jumper — 5-Pole | 1492-C | | 20 | | | | | _ | | _ |
| Plug-in Center Jumper — 4-Pole | 1492-C | | 60 | | 192-CJLJ6 | | 60 | _ | | |
| Plug-in Center Jumper — 3-Pole | 1492-C | | 60 | | 192-CJLJ6 | | 60 | _ | | |
| Plug-in Center Jumper — 2-Pole Insulated Side Jumper — 24-Pole | 1492-C | | 60 50 | 14 | 192-CJLJ6 — |)-2 | 60 | _ | | - |
| Insulated Side Jumper — 24-Pole Insulated Side Jumper — 10-Pole | 1492-Sc | | 50 | | | | | _ | | $\vdash \equiv$ |
| Screw Type Jumper Notching Tool | 1492-30 | | 1 | | — 1492-T1 | | 1 | 1492-T1 | | 1 |
| Other Accessories: Partition Plate | 1492-E | | 20 | | 1492-EBJ16 | | 20 | 1492-EBJ16 | | 20 |
| Test Plug Socket | 1492-T | PS23 | 20 | 1 | 492-TPS2 | 3L | 50 | 1492-TPS23L | | 50 |
| Test Plug | 1492-1 | | 20 | | 1492-TP2 | | 20 | 1492-T | 20 | |
| Test Plug (Stackable) | 1492- | | 25 | | 1492-TPJ | | 25 | _ | _ | |
| Electrical Warning Plate | 1492-E | | 25 | | 492-EWP | | 25 | 1492-EV | 50 | |
| Marking Systems: | 1492-M5X12 | , | 5 | | M6X12 (12 | | 5 | 1492-MR8X12 | 5 | |
| Snap-in Marker Cards | 1492-M5X5 | (200/card) | 5 | 1492- | M6X5 (200 | 0/card) | 5 | 1492-M8X5 (| 160/card) | 5 |

 $[\]star$ Use of center jumpers may affect spacings, requiring derating of terminal blocks. See page 12-83 for details.



ImperviTRAN™ PRODUCT SELECTION GUIDE



MICRON ALSO OFFERS THE *DIN*ergy™ LINE OF INDUSTRIAL DIN-MOUNT POWER SUPPLIES FROM 18 – 960 WATT PLUS SINGLE PHASE AND THREE PHASE LVGP, BUCK-BOOST TRANSFORMERS AND SPECIALTY MAGNETICS

B5K0MBT13XXH

5000

43.48

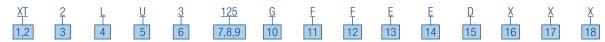
43.48

5000

B5K0BTZ13JXH

Catalog number explanation

Tmax XT Part number explanation



1,2 - Tmax XT prefix, XT

| 3 - | Frame size |
|-----|---|
| 1 | XT1 - to 125A_600V/347V/ULIVThermal magnetic protection |
| 2 | XT2 - to 125A, 600V (UL) - Thermal magnetic and electronic protection |
| 3 | XT3 - to 225A, ouo 17347 v (oc) - mermarmagneuc protection |
| 4 | XT4 - to 250A, 600V (UL) - Thermal magnetic and electronic protection |

4 - Breaking Capacity

| | XT1 | ХІЗ | XT3 | XT4 |
|---|--------------------|---------------|--------------------|--------------------|
| N | 18kA @ 600Y/347Vac | 18kA @ 600Vac | 10kA @ 600Y/347Vac | 18 @ 600Vac |
| S | 22kA @ 600Y/347Vac | ZZKA & OUUVAC | 10kA @ 600Y/347Vac | 22 @ 600Vac |
| H | 25kA @ 600Y/347Vac | 25kA @ 600Vac | - | 25 @ 600Vac |
| L | - | 35kA @ 600Vac | - | 50 @ 600Vac |
| V | - | 42kA @ 600Vac | - | 65 @ 600Vac |
| X | - | 45kA @ 600Vac | - | 100kA @ 600Vac (1) |

 $^{^{(1)}}$ 100kA up to 150A. 65kA from 175A up to 250A

5 - Standard

U UL standard version
UL 100% rated version

6 - Number of poles

2 poles (YT4N UL version only)
3 poles

7,8,9 - Nominal current (amperage)

| | XT1 | XT1 | | | | | | | | XT3 | | | | XT4 | | | | |
|-----|--------------|--------|------|------|---------|--------|----------|--------|----------|------|------|--------|------|---------|--------|------|--------|------|
| | TMF | Elect. | MCP | MCS | TMF/ | Elect. | MCP | Elect. | MCS | TMF | MCP | Elect. | MCS | TMF/ | Elect. | MCP | Elect. | MCS |
| | | | (MA) | | TMA (1) | | (MA) | LIU | | | (MA) | LIU | | TMA (2) | | (MA) | LIU | |
| 003 | - | - | ЗА | - | - | - | ЗА | - | - | - | - | - | - | - | - | - | - | - |
| 007 | - | - | 7A | - | - | - | 7A | - | - | - | - | - | - | - | - | - | - | - |
| 010 | - | - | - | - | - | 10A | - | - | - | - | - | - | - | - | - | - | - | - |
| 015 | 15A | - | 15A | - | 15A | - | 15A | - | - | - | - | - | - | - | - | - | - | - |
| 020 | 20A | - | - | - | 20A | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 025 | 25A | - | - | - | 25A | 25A | - | 25A | - | - | - | - | - | 25A | - | 25A | - | - |
| 030 | 30A | - | 30A | - | 30A | - | 30A | - | - | - | - | - | - | 30A | - | - | - | - |
| 035 | 35A | - | - | - | 35A | - | - | - | - | - | - | - | - | 35A | - | - | - | - |
| 040 | 40A | - | - | - | 40A | Ī- | - | - | - | - | - | - | - | 40A | 40A | - | 40A | - |
| 045 | 45A | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 050 | 50A | - | 50A | - | 50A | - | 50A | - | - | - | - | - | - | 50A | - | 50A | - | - |
| 060 | 60A | - | - | - | 60A | 60A | - | 60A | - | 60A | - | - | - | 60A | 60A | - | 60A | - |
| 070 | 70A | - | 70A | - | 70A | - | 70A | - | - | 70A | - | - | - | 70A | - | - | - | - |
| 080 | 80A | - | 80A | - | 80A | - | 80A | - | - | 80A | - | - | - | 80A | - | 80A | - | - |
| 090 | 90A | - | - | - | 90A | - | | - | - | 90A | - | - | - | 90A | - | - | - | - |
| 100 | 100A | - | 100A | - | 100A | 100 | 100A | 00A | - | 100A | 100A | - | - | 100A | 100A | 100A | 100A | - |
| 110 | 110A | - | - | - | 110A | - | - | - | - | 110A | 110A | - | - | 110A | - | 110A | - | - |
| 125 | 125A | - | 125A | 125A | 125A | 125A | 125A | - | 125A | 125A | 125A | - | - | 125A | - | 125A | - | - |
| 150 | - | - | - | - | - | - | - | - | - | 150A | 150A | - | - | 150A | 150A | 150A | 150A | - |
| 175 | - | - | - | - | - | - | - | - | - | 175A | - | | - | 175A | - | 175A | - | - |
| 200 | - | - | - | - | - | - | | - | - | 200A | 200A | - | - | 200A | - | 200A | - | - |
| 225 | - | - | - | - | - | - | - | - | - | 225A | - | - | 225A | 225A | 225A | 225A | - | - |
| 250 | . | - | - | | - | | <u>.</u> | - | <u>.</u> | | | - | - | 250A | 250A | 250A | i - | 250A |

⁽¹⁾ XT2 TMF FIXED treshold up to 70A, TMA adjustable for 80A and higher.

 $^{^{(2)}}$ XT4 2p version with TMF version only. XT4 3p TMF version up to 70A, TMA adjustable for 80A and higher. XT4 4p TMA version only

Catalog number explanation

| Α | There magnetic incu (Timir) |
|---|---|
| В | Thermal magnetic adjustable (TMD/TMA) |
| D | Moluco (march) |
| E | Ekip LS/I (Electronic, LS/I protection) |
| F | Ekip LSI (Electronic, LSI protection) |
| G | Ekip LSIG (Electronic, LSIG protection) |
| Н | Ekip E-LSIG (Electronic, LSIG plus measurements) |
| J | Ekip I (Electronic, Instantaneous trip only) |
| L | Ekip M-LIU (Electronic Motor Protector with integrated overload and phase loss detection) |
| M | Motor circuit protector (MCP - magnetic only (MA) |

| e side termination (ton) |
|---|
| F Front terminals, no lugs installed |
| FC Cu Terminals for Cu cables (Saddle Clamps) |
| FC CuAl Terminals for CuAl cables, 14-1/0 AWG, 110A (UL XT2) ⁽¹⁾ |
| FC CuAl Terminals for CuAl cables, 14-1/0 AWG, 100A (UL XT3, UL XT4) ⁽²⁾ |
| FC CuAl Terminals for CuAl cables, 14-1/0 AWG, 100A, Control Tap Included (UL XT3, UL XT4)(1)(2) |
| FC CuAl Terminals for CuAl cables, 4 AWG-300 kcmil, 225A (UL XT3, UL XT4) ⁽²⁾ |
| FC CuAl Terminals for CuAl cables, 4 AWG-300 kcmil, 225A, Control Tap Included (UL XT3, UL XT4) ⁽¹⁾⁽²⁾ |
| FC CuAL Terminals for CuAl Cables, 250-350 kcmil, 250A (UL XT4) ⁽¹⁾⁽²⁾ |
| MC Multi-cable terminals for Cu (6 wire) |
| EF Extended front terminals |
| ES Extended spread terminals |
| FB Terminals for flexible busbar (IEC only) |
| R Rear terminals (IEC only) |
| Panel board Adapter ⁽¹⁾ |
| Plug-in kit (Must also use 6 for load side) |
| Withdrawable kit - XT2 & XT4 only (Must also use 7 for the load side) |
| |

(I)Contact ABB for availability.

©Not available for XT4 X version to 150A.

Note: Additional terminal options are available as loose accessories for IEC versions. Please see the IEC catalog for more details.

| 12 - Lo | ad side termination (bottom) |
|---------|---|
| F | F Front terminals, no lugs installed |
| A | FC Cu Terminals for Cu cables (Saddle Clamps) |
| В | FC CuAl Terminals for CuAl cables, 14-1/0 AWG, 110A (UL XT2) ⁽¹⁾ |
| G | FC CuAl Terminals for CuAl cables, 14-1/0 AWG, 100A (UL XT3, UL XT4) ⁽²⁾ |
| Н | FC CuAl Terminals for CuAl cables, 14-1/0 AWG, 100A, Control Tap Included (UL XT3, UL XT4) ⁽¹⁾⁽²⁾ |
| J | FC CuAl Terminals for CuAl cables, 4 AWG-300 kcmil, 225A (UL XT3, UL XT4) ⁽²⁾ |
| K | FC CuAl Terminals for CuAl cables, 4 AWG-300 kcmil, 225A, Control Tap Included (UL XT3, UL XT4) ⁽¹⁾⁽²⁾ |
| L | FC CuAL Terminals for CuAl Cables, 250-350 kcmil, 250A (UL XT4) ⁽¹⁾⁽²⁾ |
| Z | MC Multi-cable terminals for Cu (6 wire) |
| 1 | EF Extended front terminals |
| 2 | ES Extended spread terminals |
| 3 | FB Terminals for flexible busbar (IEC only) |
| 4 | R Rear terminals (IEC only) |
| 6 | Plug-in kit (Must also use 6 for line side) |
| 7 | Withdrawable kit - XT2 & XT4 only (Must also use 7 for the line side) |

"Contact ABB for availability.
 "Not available for XT4 X version to 150A.
 Note: Additional terminal options are available as loose accessories for IEC versions. Please see the IEC catalog for more details.

Catalog number explanation

| is - iiite | rnal accessories - left of mechanism |
|------------|--|
| 0 | None |
| A | SOR Shunt trip 12V DC |
| В | SOR Shunt trip 24-30V AC/DC |
| C | SOR Shunt trip 48-60V AC/DC |
| D | SOR Shunt trip 110-127V AC / 110-125V DC |
| E | SOR Shunt trip 220-240V AC / 220-250V DC |
| F | SOR Shunt trip 380-440V AC |
| G | SOR Shunt trip 480-525V AC |
| Z | AUX 3Q 250V AC/DC (not available for withdrawable) |
| 1 | UVR Undervoltage release 24-30V AC/DC |
| 2 | UVR Undervoltage release 48V AC/DC |
| 3 | UVR Undervoltage release 60V AC/DC |
| 4 | UVR Undervoltage release 110-127V AC 110-125V DC |
| 5 | UVR Undervoltage release 220-240V AC 220-250V DC |
| 6 | UVR Undervoltage release 380-440V AC |
| 7 | UVR Undervoltage release 480-525V AC |
| | option for the left side of the mechanism is available on a 4-pole circuit breaker as a loose accessory. |

| 14 - Int | ternal accessories - right of mechanism |
|----------|---|
| 0 | None |
| A | AUX 1Q, 1SY 250V AC/DC |
| В | AUX 2Q, 1SY 250V AC/DC (not available for withdrawable) |
| C | AUX 3Q, 1SY 250V AC/DC (not available for XT1) |
| D | AUX 3Q, 2SY 250V AC/DC (XT2, XT4) |
| E | AUX 2Q, 2SY, 1 S51 250V AC/DC (XT2, XT4) |
| F | AUX 1 S51 250V AC/DC (XT2, XT4) |
| G | AUX 1Q, 1SY 24V DC |
| Н | AUX 3Q, 1SY 24V DC (not available for XT1) |
| J | AUX 1 S51 24V DC (XT2, XT4) |
| K | AUX 1Q, 1SY 400V AC (XT2, XT4 not compatible with other right side AUX) |
| L | AUX 2Q 400V AC (XT2, XT4 not compatible with other right side AUX) |
| 1 | Ekip Com (XT2, XT4, not compatible with other right side AUX) |
| 2 | Ekip Com + Aux 1S51 24V DC (XT2, XT4, not compatible with other right side AUX) |
| 3 | Ekip Com + Aux 1S51 250V AC/DC (XT2, XT4, not compatible with other right side AUX) |

Catalog number explanation

| 15 - Fro | ont accessories | | | | |
|--|--|---------------------------------------|--------------------------|---------------|---------------|
|) | None | | | | |
| 4 | Motor operator 24V DC | | | | |
| 3 | Motor operator 48-60V DC | | | | |
| ; | Motor operator 110-125V AC/DC | | | | |
|) | Motor operator 220-250V AC/DC | | | | |
| | Motor operator 380-440V AC | | | | |
| F | Motor operator 480 - 525V AC | | | | |
| G | PLL Fixed padlock device in open/closed posit | ion | | | |
| Н | PLL Fixed padlock device in open position | | | | |
| J | PLL Removable padlock device in open positio | on (XT1, XT3) | | | |
| K | FLD Front for locking operating lever mechanis | sm (XT2, XT4) | | | |
| L | RHD Normal direct handle | | | | |
| M | RHD Emergency direct handle | | | | |
| N | RHE Variable depth mechanism, standard | | | | |
| P | RHE Variable depth mechanism, with padlock | | | | |
| Q | RHD Normal direct handle + Early Aux contact | t, opening | | | |
| R | RHD Emergency direct handle + Early Aux con | | | | |
| 3 | RHE Variable depth mechanism, standard + Ea | | | | |
| [| RHE Variable depth mechanism, with padlock | | | | |
| J | RHD Normal direct handle + Early Aux contact | | | | |
| I | RHD Emergency direct handle + Early Aux con | · | | | |
| N | RHE Variable depth mechanism, standard + Ea | | | | |
| ······································ | RHE Variable depth mechanism, with padlock | | | | |
| : I | Motor operator for use with Modbus 24V DC (I | | | | |
| · 2 | Motor operator for use with Modbus 48-60V D | | | | |
| - 3 | Motor operator for use with Modbus 110-125 | | | | |
| - 4 | Motor operator for use with Modbus 220-250 | | | | |
| 5 | Motor operator for use with Modbus 380-440' | | | | |
| 6 | Motor operator for use with Modbus 480 - 52 | | | | |
| | | | | | |
| | ey locks | | | | |
| (| None | | | | |
| \ | Ronis key lock, open position- A type | | | | |
| 3 | Ronis key lock, open position - B type | | | | |
| ; | Ronis key lock, open position - C type | | | | |
|) | Ronis key lock, open position - D type | | | | |
| E | Ronis key lock, open position - different keys | | | | |
| F | Ronis key lock, open/closed - different keys (n | · · · · · · · · · · · · · · · · · · · | | | |
| lote: Key loo | cks are available for placement on the circuit breaker, on rotary handle | mechanisms or on motors. Key locks | for motors are IEC only. | | |
| 17 - Fo | or future u <u>se</u> | | | | |
| (| None | | | | |
| 18 - Ad | dditional certifications | | | | |
| X | None | | | | |
| | | | 3yr warranty | 4yr warranty | 5yr warranty |
| | | | 3 | 4 | 5 |
| Test certi | ificate provided (in English) | E | Α | В | С |
| | | | ······• | j. | j. |

G

Note: Extended warranty options require additional paperwork to be completed per order.

Test certificate provided (in French)

Test certificate provided (in Spanish)

М

Tmax—Molded Case Circuit Breaker Accessory Cable Operated Flange Kit

The new line of cable operated flange handles, cables and mechanisms are fully compatible with Tmax Molded Case Circuit Breakers (XT1, XT2, XT3, XT4, T5, T6, and T7).

- New flange cable operated range
- Modern design
- 2 handle types
 - NEMA 1, 3R, 12, 4 metallic
 - NEMA 4/4X non-metallic
- 3 cable lengths
 - 48", 72", 120"
- Complete assembly with one part number (handle, mechanism, and cable)



Flange handles—UL file #E116596

Metallic handle

| For use with | Catalog number (US) | Catalog number (global) | Description | List price |
|--------------|---------------------|-------------------------|---|------------|
| Tmax XT1 | KXT1N12FLHDL4 | 1SDA080330R1 | 4 ft. Cable NEMA 1 3R 12 4 metallic handle | \$927 |
| | KXT1N12FLHDL6 | 1SDA080331R1 | 6 ft. Cable NEMA 1 3R 12 4 metallic handle | \$962 |
| | KXT1N12FLHDL10 | 1SDA080333R1 | 10 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1013 |
| Tmax XT2 | KXT2N12FLHDL4 | 1SDA080334R1 | 4 ft. Cable NEMA 1 3R 12 4 metallic handle | \$952 |
| | KXT2N12FLHDL6 | 1SDA080335R1 | 6 ft. Cable NEMA 1 3R 12 4 metallic handle | \$989 |
| | KXT2N12FLHDL10 | 1SDA080337R1 | 10 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1040 |
| Tmax XT3 | KXT3N12FLHDL4 | 1SDA080338R1 | 4 ft. Cable NEMA 1 3R 12 4 metallic handle | \$994 |
| | KXT3N12FLHDL6 | 1SDA080339R1 | 6 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1030 |
| | KXT3N12FLHDL10 | 1SDA080341R1 | 10 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1080 |
| Tmax XT4 | KXT4N12FLHDL4 | 1SDA080342R1 | 4 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1020 |
| | KXT4N12FLHDL6 | 1SDA080343R1 | 6 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1057 |
| | KXT4N12FLHDL10 | 1SDA080345R1 | 10 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1107 |
| Tmax T5 | KT5N12FLHDL4 | 1SDA082000R1 | 4 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1237 |
| | KT5N12FLHDL6 | 1SDA082001R1 | 6 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1265 |
| | KT5N12FLHDL10 | 1SDA082002R1 | 10 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1329 |
| Tmax T6 | KT6N12FLHDL4 | 1SDA082376R1 | 4 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1595 |
| | KT6N12FLHDL6 | 1SDA082003R1 | 6 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1652 |
| | KT6N12FLHDL10 | 1SDA082004R1 | 10 ft. Cable NEMA 1 3R 12 4 metallic handle | \$1709 |

Tmax—Molded Case Circuit Breaker Accessory Cable Operated Flange Kit

Non-metallic handle

| For use with | Catalog number (US) | Catalog number (global) | Description | List price |
|--------------|---------------------|-------------------------|--|------------|
| Tmax XT1 | KXT1N4XFLHDL4 | 1SDA082007R1 | 4 ft. Cable NEMA 4/4X non-metallic handle | \$1033 |
| | KXT1N4XFLHDL6 | 1SDA082008R1 | 6 ft. Cable NEMA 4/4X non-metallic handle | \$1074 |
| | KXT1N4XFLHDL10 | 1SDA082009R1 | 10 ft. Cable NEMA 4/4X non-metallic handle | \$1130 |
| Tmax XT2 | KXT2N4XFLHDL4 | 1SDA082010R1 | 4 ft. Cable NEMA 4/4X non-metallic handle | \$1062 |
| | KXT2N4XFLHDL6 | 1SDA082011R1 | 6 ft. Cable NEMA 4/4X non-metallic handle | \$1104 |
| | KXT2N4XFLHDL10 | 1SDA082012R1 | 10 ft. Cable NEMA 4/4X non-metallic handle | \$1160 |
| Tmax XT3 | KXT3N4XFLHDL4 | 1SDA082013R1 | 4 ft. Cable NEMA 4/4X non-metallic handle | \$1108 |
| | KXT3N4XFLHDL6 | 1SDA082014R1 | 6 ft. Cable NEMA 4/4X non-metallic handle | \$1149 |
| | KXT3N4XFLHDL10 | 1SDA082015R1 | 10 ft. Cable NEMA 4/4X non-metallic handle | \$1204 |
| Tmax XT4 | KXT4N4XFLHDL4 | 1SDA082016R1 | 4 ft. Cable NEMA 4/4X non-metallic handle | \$1137 |
| | KXT4N4XFLHDL6 | 1SDA082017R1 | 6 ft. Cable NEMA 4/4X non-metallic handle | \$1179 |
| | KXT4N4XFLHDL10 | 1SDA082018R1 | 10 ft. Cable NEMA 4/4X non-metallic handle | \$1234 |
| Tmax T5 | KT5N4XFLHDL4 | 1SDA082019R1 | 4 ft. Cable NEMA 4/4X non-metallic handle | \$1346 |
| | KT5N4XFLHDL6 | 1SDA082020R1 | 6 ft. Cable NEMA 4/4X non-metallic handle | \$1377 |
| | KT5N4XFLHDL10 | 1SDA082021R1 | 10 ft. Cable NEMA 4/4X non-metallic handle | \$1446 |
| Tmax T6 | KT6N4XFLHDL4 | 1SDA082378R1 | 4 ft. Cable NEMA 4/4X non-metallic handle | \$1755 |
| | KT6N4XFLHDL6 | 1SDA082379R1 | 6 ft. Cable NEMA 4/4X non-metallic handle | \$1818 |
| | KT6N4XFLHDL10 | 1SDA082380R1 | 10 ft. Cable NEMA 4/4X non-metallic handle | \$1880 |
| Tmax T7 | KT7N4XFLHDL4 | 1SDA082381R1 | 4 ft. Cable NEMA 4/4X non-metallic handle | \$1976 |
| | KT7N4XFLHDL6 | 1SDA082382R1 | 6 ft. Cable NEMA 4/4X non-metallic handle | \$2029 |
| | KT7N4XFLHDL10 | 1SDA082383R1 | 10 ft. Cable NEMA 4/4X non-metallic handle | \$2110 |

Loose parts

| For use with | Catalog number (US) | Catalog number (global) | Description | List price |
|------------------|---------------------|-------------------------|---|------------|
| Tmax XT1, XT2, | KXTAN12FLHDL | 1SDA080346R1 | NENA 1 3R 12 4 metal flange handle with | \$377 |
| XT3, XT4, T5, T6 | | | mounting hardware | |
| Tmax XT1, XT2, | KXTAN4XFLHDL | 1SDA082022R1 | NEMA 4/4X non-metallic handle with | \$415 |
| XT3, XT4, T5, T6 | | | mounting hardware | |
| T 7 | KT7AN4XFLHDL | 1SDA082377R1 | NEMA 4/4X extended non-metallic flange handle | \$526 |
| | | | with mounting hardware | |

Contact us

ABB

Electrification Products 8155 T&B Boulevard Memphis, TN 38125 www.abb.com/lowvoltage

Customer Service: 800-816-7809

7:00 a.m. - 5:30 p.m., CST, Monday-Friday

elec_custserv@tnb.com

Technical Support: 888-385-1221, Option 1 7:00 a.m. - 5:00 p.m., CST, Monday-Friday

lvps.support@us.abb.com





Unidrive M200 AC Drives

Flexible machine integration through communications and onboard PLC



Unidrive M200 Frame Size 1

| Voltage ratings | |
|---|---|
| 100 / 120 VAC ± 10% | ✓ |
| 200 / 240 VAC ± 10% | ✓ |
| 380 / 480 VAC ± 10% | ✓ |
| 500 / 575 VAC ± 10% | ✓ |
| 500 / 690 VAC ± 10% | ✓ |
| Control mode | |
| Open loop vector or V/Hz induction motor control | ✓ |
| Open loop Rotor Flux Control for induction motors (RFC-A) | ✓ |



Visit www.Drive-Setup.com for step by step guides, videos, software & product support documentation.

The Unidrive M200 delivers benchmark functionality at no added cost to the base drive itself. Plug-in options, dynamic performance, PLC functionality and other advanced features such as industrial standard fieldbuses, Ethernet, and Modbus RTU communications ensure that in more complex applications Unidrive M200 can deliver more than the average general purpose drive - giving you lower cost solutions and better productivity in your motor control applications.

Enhance up-time and system flexibility

- Flexible system integration and remote diagnostics through optional industrial Ethernet and fieldbus communication
- Flexible I/O that is expandable with SI-I/O option module
- Enhanced functionality and onboard PLC programming provides a low-cost system solution, minimizing the need for additional equipment such as PLCs

High performance open loop motor control

- RFC-A (Rotor Flux Control) algorithm for exceptional induction motor control of demanding applications
- Closed loop current control without a position feedback device
- Speed control for conveyors, fans, pumps, and mixers, where their function are controlled remotely with fieldbus or Ethernet communications

Key data

Heavy Duty Ratings: 0.33 hp to 150 hp (0.25 kW to 110 kW) Normal Duty Ratings: 0.33 hp to 200 hp (0.25 kW to 132 kW) Supply phases: Frame size 1 and 2: 110 V drives 1Ø,

230 V drives 1Ø or 3Ø; Frame size 7 and larger 3Ø;

460, 575 and 690 V drives 3Ø

Control connections: 3x Analog I/O, 5x Digital I/O, 1x Relay Drive rating: IP21 / UL open class as standard

Keypad: Fixed LFD

Option slots: 1 (frame size 2 and above)

Parameter cloning via: PC tools, SD card

How to select a drive (Consult online catalog for complete drive information)

- 1. Electrical Considerations
 - What is the supply voltage?
 - Single or 3Ø input power?
 - What is the motor rating?
 - Continuous current FLA (Full Load Amps)
 - Select the drive based on motor Amps rather than horsepower
- 2. Load Type (choose one)
 - Normal Duty: Peak current is 110% of drive rating (fans, pumps, etc.)
 - Heavy Duty: Peak current is 180% (mixers, conveyors, etc.)
- 3. Drive Mechanical Mounting
 - Panel mounting as standard
 - Wall mounting UL conduit kits are available
 - Through panel mounting frames 5 and up













Order Information & Ratings

| 115 VAC, Single Phase 50/60 Hz Input, 230 VAC 3-Phase Output | | | | | |
|--|------|------------|------|------|--|
| Unidrive M200 | Heav | Heavy Duty | | | |
| Order Code* | hp | Amps | hp | Amps | |
| M200-01100017A | 0.33 | 1.7 | 0.33 | 1.7 | |
| M200-01100024A | 0.5 | 2.4 | 0.5 | 2.4 | |
| M200-02100042A | 1 | 4.2 | 1 | 4.2 | |
| M200-02100056A | 1.5 | 5.6 | 1.5 | 5.6 | |

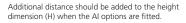
| 230 VAC, Single Phase Input, 3-Phase Output, 50/60 Hz Input | | | | | |
|---|-------------|------|-------------------|------|--|
| Unidrive M200 | Normal Duty | | Heavy Duty | | |
| Order Code* | hp | Amps | hp | Amps | |
| M200-01200017A | 0.33 | 1.7 | 0.33 | 1.7 | |
| M200-01200024A | 0.5 | 2.4 | 0.5 | 2.4 | |
| M200-01200033A | 0.75 | 3.3 | 0.75 | 3.3 | |
| M200-01200042A | 1 | 4.2 | 1 | 4.2 | |
| M200-02200024A | 0.5 | 2.4 | 0.5 | 2.4 | |
| M200-02200033A | 0.75 | 3.3 | 0.75 | 3.3 | |
| M200-02200042A | 1 | 4.2 | 1 | 4.2 | |
| M200-02200056A | 1.5 | 5.6 | 1.5 | 5.6 | |
| M200-02200075A | 2 | 7.5 | 2 | 7.5 | |
| M200-03200100A | 3 | 10 | 3 | 10 | |
| M200-04200133A | 3 | 13.3 | 3 | 13.3 | |

| 230 VAC, Three Phase Input, 3-Phase Output, 50/60 Hz Input | | | | | |
|--|-------|---------|------|--------|--|
| Unidrive M200 | Norma | al Duty | Heav | y Duty | |
| Order Code* | hp | Amps | hp | Amps | |
| M200-02200024A | 0.5 | 2.4 | 0.5 | 2.4 | |
| M200-02200033A | 0.75 | 3.3 | 0.75 | 3.3 | |
| M200-02200042A | 1 | 4.2 | 1 | 4.2 | |
| M200-02200056A | 1.5 | 5.6 | 1.5 | 5.6 | |
| M200-02200075A | 2 | 7.5 | 2 | 7.5 | |
| M200-03200100A | 3 | 10 | 3 | 10 | |
| M200-04200133A | 3 | 13.3 | 3 | 13.3 | |
| M200-04200176A | 5 | 17.6 | 5 | 17.6 | |
| M200-05200250A | 10 | 30 | 7.5 | 25 | |
| M200-06200330A | 15 | 50 | 10 | 33 | |
| M200-06200440A | 20 | 58 | 15 | 44 | |
| M200-07200610A | 25 | 75 | 20 | 61 | |
| M200-07200750A | 30 | 94 | 25 | 75 | |
| M200-07200830A | 40 | 117 | 30 | 83 | |
| M200-08201160A | 50 | 149 | 40 | 116 | |
| M200-08201320A | 60 | 180 | 50 | 132 | |
| M200-09201760x** | 75 | 216 | 60 | 176 | |
| M200-09202190x** | 100 | 266 | 75 | 219 | |

^{*}Add 10101AB100 to the base order code when ordering standard US (60Hz) default products

Dimensions & Weights

| Frame Size | Dimensions H x W x D (in) | Weight (lbs) | | |
|------------|------------------------------|-----------------|--|--|
| 01 | 6.3 x 3.0 x5.1 | 1.7 | | |
| 02 | 8.1 x 3.1 x 5.9 | 2.2 | | |
| 03 | 8.9 x 3.5 x 6.3 | 3.3 | | |
| 04 | 10.9 x 4.5 x 6.9 | 6.9 | | |
| 05 | 15.4 x 5.6 x 7.9 | 16.3 | | |
| 06 | 15.4 x 8.3 x 9.0 | 30.9 | | |
| 07 | 21.9 x 10.6 x 11.0 | 61.7 | | |
| 08 | 31.7 x 12.2 x 11.4 | 114.6 | | |
| 09E | 39.8 x 12.2 x 11.4 | 101.4 | | |
| 09A | 43.6 x 12.2 x 11.4 | 146.6 | | |





Diagnostic Software

Our Drive Diagnostics APP allows users to quickly diagnose faults. In the unlikely event that you get a drive error, download our complimentary Diagnostics Tool app. Just input the error code on your device and you'll be given a solution. Download our Diagnostics Tool App at:



| M200-02400013A | 0.5 | 1.3 | 0.5 | 1.3 | |
|---|-------------------------------|------|------|------|--|
| M200-02400018A | 0.75 | 1.8 | 0.75 | 1.8 | |
| M200-02400023A | 1 | 2.3 | 1 | 2.3 | |
| M200-02400032A | 1.5 | 3.2 | 1.5 | 3.2 | |
| M200-02400041A | 2 | 4.1 | 2 | 4.1 | |
| M200-03400056A | 3 | 5.6 | 3 | 5.6 | |
| WIZ00-05-100075A | 3 | 7.3 | 3 | 7.3 | |
| M300 03400004A | 5 | 9.4 | 5 | 9.4 | |
| M200-04400135A | 7.5 | 13.5 | 7.5 | 13.5 | |
| M200-04400170A | 10 | 17 | 10 | 17 | |
| MZ00-054002/0A | 20 | 30 | 20 | 27 | |
| M200-05400300A | 20 | 30 | 20 | 30 | |
| M200-06400350A | 25 | 38 | 25 | 35 | |
| M200-06400420A | 30 | 48 | 30 | 42 | |
| M200-06400470A | 50 | 63 | 30 | 47 | |
| M200-07400660A | 60 | 79 | 50 | 66 | |
| M200-07400770A | 75 | 94 | 60 | 77 | |
| M200-07401000A | 75 | 112 | 75 | 100 | |
| M200-08401340A | 125 | 155 | 100 | 134 | |
| M200-08401570A | 150 | 184 | 125 | 157 | |
| M200-09402000x** | 150 | 221 | 150 | 180 | |
| M200-09402240x** | 200 | 255 | 150 | 211 | |
| **x= A or E (9E frame requires an externa | al AC Line Reac | tor) | | | |
| Order String - Frame Size K | Order String - Frame Size Key | | | | |

460 VAC, Three Phase Input, 3-Phase Output, 50/60 Hz Input

Normal Duty

Heavy Duty

Amps

| Order String - Frame Size Key |
|-------------------------------|
| Example: M200-XX |
| XX = Frame Size (01-09 above) |

OPTIONS AT-A-GLANCE

Unidrive M200 Order Code*

| Option | Description | Order Code | |
|--------------------------------------|---|-----------------------------|--|
| | Configuration software | UNIDRIVE-M-CONNECT | |
| | Drive to PC USB cable (requires a 485 adaptor) | CT-USB-CABLE | |
| Drive Configuration & Programming | Parameter cloning 4 GB (includes 4 GB SD card) | AI-SMART-ADAPTOR | |
| | Parameter cloning (requires an SD card) | AI-BACKUP-ADAPTOR | |
| | 8 GB SD card | CTSD8GB | |
| | Remote LCD display | REMOTE-KEYPAD | |
| Operator Interfaces | Remote LCD display with real-time clock | REMOTE-KEYPAD-RTC | |
| | Remote display cable | UM-LCD-485-XXX**** | |
| Input / Output*** | Extended I/O | SI-I/O | |
| | Modbus RTU | AI-485-ADAPTOR | |
| | Modbus RTU with 24 V | AI-485-24V-ADAPTOR | |
| | PROFIBUS DP | SI-PROFIBUS | |
| Communications*** | DeviceNet | SI-DEVICENET | |
| Communications | CANopen | SI-CANOPEN | |
| | PROFINET RT | SI-PROFINET-V2 | |
| | EtherCAT | SI-ETHERCAT | |
| | EtherNet/IP, Modbus TCP | SI-ETHERNET | |
| Application Programming | PLC programming | MACHINE-CONTROL-STUDIO | |
| Software & Diagnostics | Digital oscilloscope | CTSCOPE | |
| | External EMC filter | See the Unidrive M: General | |
| Power Accessories | Line & load reactors | Purpose AC Drives brochure | |
| | Dynamic braking resistors | | |
| | UL Type 1 conduit kits | | |
| Environmental Protection | Retrofit for | See the Unidrive M: General | |
| & Cable Management | Commander SK | Purpose AC Drives brochure | |
| | Fan replacement kits | | |

^{***}frame sizes 2 and up accept 1 SI option

See the Unidrive M: General Purpose AC Drives brochure for our full product offering including 575 V and 690 V solutions.







^{**}x= A or E (9E frame requires an external AC Line Reactor)

^{****}Shielded RS485 patch cable, CAT5e, conductive metal RJ45 connectors, XXX=cable length in 5 foot increments (max 330 ft), standard lengths are (005, 010, 015, 025 and 050)

SIEMENS

Data sheet 3RT2015-1AK61

Power contactor, AC-3 7 A, 3 kW / 400 V 1 NO, 110 V AC, 50 Hz 120 V, 60 Hz, 3-pole, Size S00, screw terminal



| Product brand name | SIRIUS |
|--------------------------|-----------------|
| Product designation | Power contactor |
| Product type designation | 3RT2 |

| General technical data | |
|---|-------|
| Size of contactor | S00 |
| Product extension | |
| function module for communication | No |
| Auxiliary switch | Yes |
| Power loss [W] for rated value of the current | |
| at AC in hot operating state | 1.2 W |
| at AC in hot operating state per pole | 0.4 W |
| Power loss [W] for rated value of the current without | 4.4 W |
| load current share typical | |
| Surge voltage resistance | |
| of main circuit rated value | 6 kV |
| of auxiliary circuit rated value | 6 kV |
| maximum permissible voltage for safe isolation | |
| between coil and main contacts acc. to EN | 400 V |
| 60947-1 | |
| | |

| Protection class IP | |
|--|----------------------------|
| • on the front | IP20 |
| of the terminal | IP20 |
| Shock resistance at rectangular impulse | |
| ● at AC | 6,7g / 5 ms, 4,2g / 10 ms |
| Shock resistance with sine pulse | |
| • at AC | 10,5g / 5 ms, 6,6g / 10 ms |
| Mechanical service life (switching cycles) | |
| of contactor typical | 30 000 000 |
| of the contactor with added electronics- | 5 000 000 |
| compatible auxiliary switch block typical | |
| of the contactor with added auxiliary switch block typical | 10 000 000 |
| Reference code acc. to DIN 40719 extended | К |
| according to IEC 204-2 acc. to IEC 750 | |
| Reference code acc. to DIN EN 81346-2 | Q |
| Ambient conditions | |
| Installation altitude at height above sea level | |
| • maximum | 2 000 m |
| Ambient temperature | |
| during operation | -25 +60 °C |
| during storage | -55 +80 °C |
| Main circuit | |
| Number of poles for main current circuit | 3 |
| Number of NO contacts for main contacts | 3 |
| Operating voltage | |
| at AC-3 rated value maximum | 690 V |
| Operating current | |
| ● at AC-1 at 400 V | |
| — at ambient temperature 40 °C rated value | 18 A |
| ● at AC-1 | |
| — up to 690 V at ambient temperature 40 °C rated value | 18 A |
| — up to 690 V at ambient temperature 60 °C rated value | 16 A |
| • at AC-2 at 400 V rated value | 7 A |
| • at AC-3 | |
| — at 400 V rated value | 7 A |
| — at 500 V rated value | 6 A |
| — at 690 V rated value | 4.9 A |
| • at AC-4 at 400 V rated value | 6.5 A |
| at AC-5a up to 690 V rated value | 15.8 A |
| at the out up to ood virated value | |

| at AC-5b up to 400 V rated value | 5.8 A |
|--|----------------------------------|
| ● at AC-6a | |
| up to 230 V for current peak value n=20 rated value | 4 A |
| up to 400 V for current peak value n=20 rated value | 4 A |
| up to 500 V for current peak value n=20 rated value | 3.8 A |
| up to 690 V for current peak value n=20 rated value | 3.6 A |
| ● at AC-6a | |
| up to 230 V for current peak value n=30 rated value | 2.7 A |
| up to 400 V for current peak value n=30 rated value | 2.7 A |
| — up to 500 V for current peak value n=30 rated value | 2.5 A |
| — up to 690 V for current peak value n=30 rated value | 2.4 A |
| Minimum cross-section in main circuit | |
| • at maximum AC-1 rated value | 2.5 mm ² |
| Operating current for approx. 200000 operating cycles at AC-4 | |
| • at 400 V rated value | 2.6 A |
| • at 690 V rated value | 1.8 A |
| Operating current | |
| • at 1 current path at DC-1 | |
| — at 24 V rated value | 15 A |
| — at 110 V rated value | 1.5 A |
| — at 220 V rated value | 0.6 A |
| — at 440 V rated value | 0.42 A |
| — at 600 V rated value | 0.42 A |
| • with 2 current noths in series at DC 1 | |
| with 2 current paths in series at DC-1 | |
| — at 24 V rated value | 15 A |
| • | 15 A 8.4 A |
| — at 24 V rated value | |
| — at 24 V rated value— at 110 V rated value | 8.4 A |
| — at 24 V rated value— at 110 V rated value— at 220 V rated value | 8.4 A 1.2 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value | 8.4 A 1.2 A 0.6 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value | 8.4 A 1.2 A 0.6 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 3 current paths in series at DC-1 | 8.4 A 1.2 A 0.6 A 0.5 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 3 current paths in series at DC-1 at 24 V rated value | 8.4 A 1.2 A 0.6 A 0.5 A |

| — at 600 V rated value | 0.7 A |
|---|------------|
| Operating current | |
| • at 1 current path at DC-3 at DC-5 | |
| — at 24 V rated value | 15 A |
| — at 110 V rated value | 0.1 A |
| • with 2 current paths in series at DC-3 at DC-5 | |
| — at 24 V rated value | 15 A |
| — at 110 V rated value | 0.25 A |
| • with 3 current paths in series at DC-3 at DC-5 | |
| — at 24 V rated value | 15 A |
| — at 110 V rated value | 15 A |
| — at 220 V rated value | 1.2 A |
| — at 440 V rated value | 0.14 A |
| — at 600 V rated value | 0.14 A |
| Operating power | |
| • at AC-1 | |
| — at 230 V rated value | 6.3 kW |
| — at 230 V at 60 °C rated value | 6 kW |
| — at 400 V rated value | 11 kW |
| — at 400 V at 60 °C rated value | 10.5 kW |
| — at 690 V rated value | 19 kW |
| — at 690 V at 60 °C rated value | 18 kW |
| • at AC-2 at 400 V rated value | 3 kW |
| • at AC-3 | |
| — at 230 V rated value | 1.5 kW |
| — at 400 V rated value | 3 kW |
| — at 500 V rated value | 3 kW |
| — at 690 V rated value | 4 kW |
| Operating power for approx. 200000 operating cycles | |
| at AC-4 | |
| • at 400 V rated value | 1.15 kW |
| at 690 V rated value | 1.15 kW |
| No-load switching frequency | |
| • at AC | 10 000 1/h |
| Operating frequency | 4 000 4 % |
| • at AC-1 maximum | 1 000 1/h |
| • at AC-2 maximum | 750 1/h |
| • at AC-3 maximum | 750 1/h |
| at AC-4 maximum | 250 1/h |
| Control circuit/ Control | |
| Type of voltage of the control supply voltage | AC |

| Control supply voltage at AC | |
|---|------------------|
| • at 50 Hz rated value | 110 V |
| • at 60 Hz rated value | 120 V |
| Operating range factor control supply voltage rated | |
| value of magnet coil at AC | |
| ● at 50 Hz | 0.8 1.1 |
| ● at 60 Hz | 0.8 1.1 |
| Apparent pick-up power of magnet coil at AC | |
| ● at 50 Hz | 26.4 V·A |
| ● at 60 Hz | 26.4 V·A |
| Inductive power factor with closing power of the coil | |
| ● at 50 Hz | 0.81 |
| ● at 60 Hz | 0.81 |
| Apparent holding power of magnet coil at AC | |
| ● at 50 Hz | 4.4 V·A |
| ● at 60 Hz | 4.4 V·A |
| Inductive power factor with the holding power of the coil | |
| • at 50 Hz | 0.24 |
| ● at 60 Hz | 0.24 |
| Closing delay | |
| • at AC | 9 35 ms |
| Opening delay | |
| • at AC | 3.5 14 ms |
| Arcing time | 10 15 ms |
| Control version of the switch operating mechanism | Standard A1 - A2 |
| Auxiliary circuit | |
| Number of NO contacts for auxiliary contacts | |
| instantaneous contact | 1 |
| Operating current at AC-12 maximum | 10 A |
| Operating current at AC-15 | |
| • at 230 V rated value | 10 A |
| • at 400 V rated value | 3 A |
| • at 500 V rated value | 2 A |
| • at 690 V rated value | 1 A |
| Operating current at DC-12 | |
| • at 24 V rated value | 10 A |
| at 48 V rated value | 6 A |
| at 60 V rated value | 6 A |
| at 110 V rated value | 3 A |
| at 176 V rated value at 125 V rated value | 2 A |
| at 123 V rated value at 220 V rated value | 1 A |
| | 1 A |

| Contact reliability of auxiliary contacts | 1 faulty switching per 100 million (17 V, 1 mA) |
|---|---|
| ● at 600 V rated value | 0.1 A |
| • at 220 V rated value | 0.3 A |
| ● at 125 V rated value | 0.9 A |
| ● at 110 V rated value | 1 A |
| • at 60 V rated value | 2 A |
| • at 48 V rated value | 2 A |
| • at 24 V rated value | 10 A |
| Operating current at DC-13 | |
| at 600 V rated value | 0.15 A |

| UL/CSA ratings | |
|--|-------------|
| Full-load current (FLA) for three-phase AC motor | |
| • at 480 V rated value | 4.8 A |
| • at 600 V rated value | 6.1 A |
| Yielded mechanical performance [hp] | |
| for single-phase AC motor | |
| — at 110/120 V rated value | 0.25 hp |
| — at 230 V rated value | 0.75 hp |
| for three-phase AC motor | |
| — at 200/208 V rated value | 1.5 hp |
| — at 220/230 V rated value | 2 hp |
| — at 460/480 V rated value | 3 hp |
| — at 575/600 V rated value | 5 hp |
| Contact rating of auxiliary contacts according to UL | A600 / Q600 |

| Short-circuit protection | |
|---|---|
| Design of the fuse link | |
| for short-circuit protection of the main circuit | |
| — with type of coordination 1 required | gG: 35A (690V,100kA), aM: 20A (690V,100kA), BS88: 35A (415V,80kA) |
| with type of assignment 2 required | gG: 20A (690V,100kA), aM: 16A (690V, 100kA), BS88: 20A (415V, 80kA) |
| for short-circuit protection of the auxiliary switch required | gG: 10 A (500 V, 1 kA) |

| nstallation/ mounting/ dimensions | |
|---|--|
| Mounting position | +/-180° rotation possible on vertical mounting surface; can be |
| | tilted forward and backward by +/- 22.5° on vertical mounting |
| | surface |
| Mounting type | screw and snap-on mounting onto 35 mm standard mounting rail |
| | according to DIN EN 60715 |
| Side-by-side mounting | Yes |
| Height | 58 mm |
| Width | 45 mm |

| Depth | 73 mm |
|---|---|
| Required spacing | |
| with side-by-side mounting | |
| — forwards | 10 mm |
| — upwards | 10 mm |
| — downwards | 10 mm |
| — at the side | 0 mm |
| • for grounded parts | |
| — forwards | 10 mm |
| — upwards | 10 mm |
| — at the side | 6 mm |
| — downwards | 10 mm |
| • for live parts | |
| — forwards | 10 mm |
| — upwards | 10 mm |
| — downwards | 10 mm |
| — at the side | 6 mm |
| Connections/ Terminals | |
| Type of electrical connection | |
| for main current circuit | screw-type terminals |
| for auxiliary and control current circuit | screw-type terminals |
| at contactor for auxiliary contacts | Screw-type terminals |
| of magnet coil | Screw-type terminals |
| Type of connectable conductor cross-sections | |
| • for main contacts | |
| — solid | 2x (0.5 1.5 mm²), 2x (0.75 2.5 mm²), 2x 4 mm² |
| — single or multi-stranded | 2x (0,5 1,5 mm²), 2x (0,75 2,5 mm²), 2x 4 mm² |
| finely stranded with core end processing | 2x (0.5 1.5 mm²), 2x (0.75 2.5 mm²) |
| at AWG conductors for main contacts | 2x (20 16), 2x (18 14), 2x 12 |
| Connectable conductor cross-section for main contacts | |
| • solid | 0.5 4 mm² |
| • stranded | 0.5 4 mm² |
| finely stranded with core end processing | 0.5 2.5 mm² |
| Connectable conductor cross-section for auxiliary | |
| contacts | |
| single or multi-stranded | 0.5 4 mm² |
| • finely stranded with core end processing | 0.5 2.5 mm² |
| Type of connectable conductor cross-sections | |
| • for auxiliary contacts | 0. (0.5. 4.5 |
| — single or multi-stranded | 2x (0,5 1,5 mm²), 2x (0,75 2,5 mm²), 2x 4 mm² |

| finely stranded with core end processing | 2x (0.5 1.5 mm²), 2x (0.75 2.5 mm²) |
|--|-------------------------------------|
| at AWG conductors for auxiliary contacts | 2x (20 16), 2x (18 14), 2x 12 |
| AWG number as coded connectable conductor cross section | |
| • for main contacts | 20 12 |
| • for auxiliary contacts | 20 12 |

| D40 value | |
|--|-----------------|
| B10 value | |
| with high demand rate acc. to SN 31920 | 1 000 000 |
| Proportion of dangerous failures | |
| with low demand rate acc. to SN 31920 | 40 % |
| • with high demand rate acc. to SN 31920 | 73 % |
| Failure rate [FIT] | |
| with low demand rate acc. to SN 31920 | 100 FIT |
| Product function | |
| Mirror contact acc. to IEC 60947-4-1 | Yes; with 3RH29 |
| T1 value for proof test interval or service life acc. to | 20 y |
| IEC 61508 | |
| Protection against electrical shock | finger-safe |

Certificates/ approvals

General Product Approval







KC





EMC

| Functional Safety/Safety of Machinery | Declaration of Conformity | Test Certificates | Marine / Ship- ping |
|---|---------------------------|---|------------------------|
| Type Examination Certificate | Miscellaneous EG-Konf. | Type Test Certificates/Test Report Special Test Certificate | ABS |

Marine / Shipping





LRS









other

Confirmation



Further information

Information- and Downloadcenter (Catalogs, Brochures,...)

www.siemens.com/sirius/catalogs

Industry Mall (Online ordering system)

https://mall.industry.siemens.com/mall/en/en/Catalog/product?mlfb=3RT2015-1AK61

Cax online generator

http://support.automation.siemens.com/WW/CAXorder/default.aspx?lang=en&mlfb=3RT2015-1AK61

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)

https://support.industry.siemens.com/cs/ww/en/ps/3RT2015-1AK61

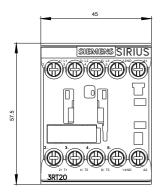
Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, EPLAN macros, ...) http://www.automation.siemens.com/bilddb/cax_de.aspx?mlfb=3RT2015-1AK61&lang=en

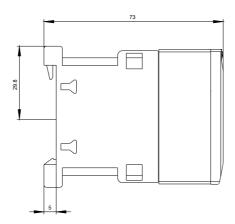
Characteristic: Tripping characteristics, I2t, Let-through current

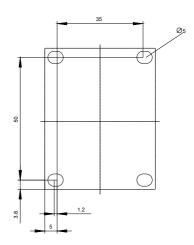
https://support.industry.siemens.com/cs/ww/en/ps/3RT2015-1AK61/char

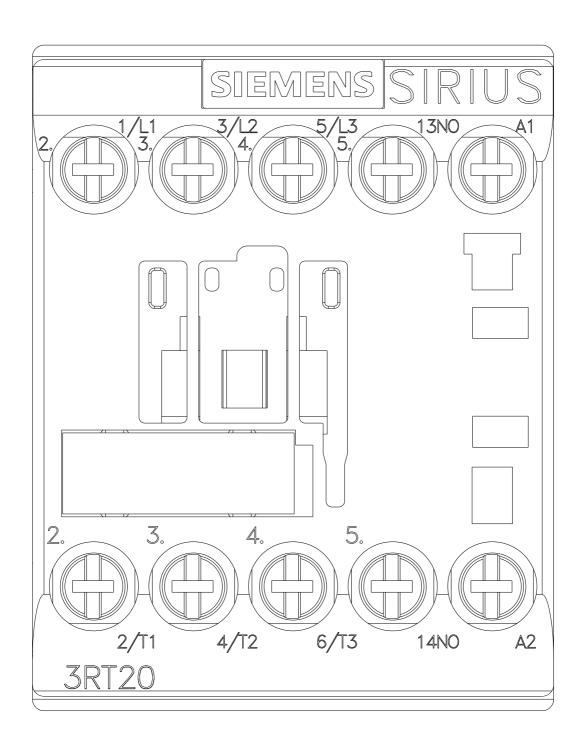
Further characteristics (e.g. electrical endurance, switching frequency)

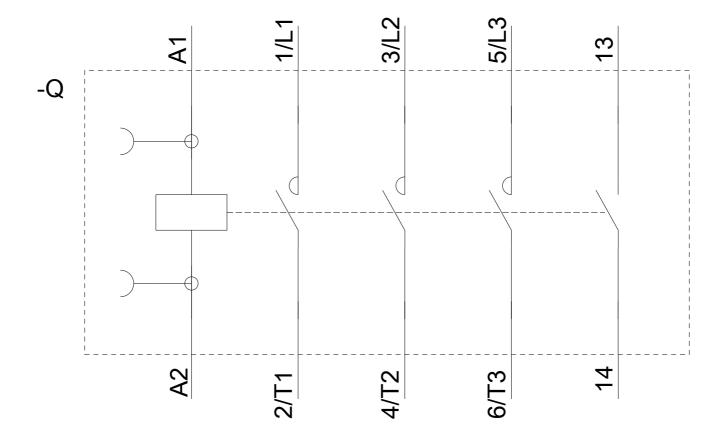
http://www.automation.siemens.com/bilddb/index.aspx?view=Search&mlfb=3RT2015-1AK61&objecttype=14&gridview=view1











last modified: 11/19/2019

SIEMENS

Data sheet 3RU2116-1GB0

Overload relay 4.5...6.3 A Thermal For motor protection Size S00, Class 10 Contactor mounting Main circuit: Screw Auxiliary circuit: Screw Manual-Automatic-Reset



| Product brand name | SIRIUS |
|--------------------------|------------------------|
| Product designation | thermal overload relay |
| Product type designation | 3RU2 |

| Size of overload relay | S00 |
|--|-------|
| Size of contactor can be combined company-specific | S00 |
| Power loss [W] for rated value of the current | |
| • at AC in hot operating state | 6.6 W |
| • at AC in hot operating state per pole | 2.2 W |
| Insulation voltage with degree of pollution 3 rated value | 690 V |
| Surge voltage resistance rated value | 6 kV |
| maximum permissible voltage for safe isolation | |
| in networks with grounded star point between auxiliary and auxiliary circuit | 440 V |
| in networks with grounded star point between auxiliary and auxiliary circuit | 440 V |
| in networks with grounded star point between main and auxiliary circuit | 440 V |

| in networks with grounded star point between main and auxiliary circuit | 440 V |
|---|-------------------------------|
| Protection class IP | |
| • on the front | IP20 |
| of the terminal | IP20 |
| Shock resistance | |
| • acc. to IEC 60068-2-27 | 8g / 11 ms |
| Type of protection according to ATEX directive 2014/34/EU | Ex II (2) GD |
| Certificate of suitability according to ATEX directive 2014/34/EU | DMT 98 ATEX G 001 |
| Reference code acc. to DIN EN 81346-2 | F |
| Ambient conditions | |
| Installation altitude at height above sea level | |
| • maximum | 2 000 m |
| Ambient temperature | |
| during operation | -40 +70 °C |
| during storage | -55 +80 °C |
| during transport | -55 +80 °C |
| Temperature compensation | -40 +60 °C |
| Relative humidity during operation | 10 95 % |
| Main circuit | |
| Number of poles for main current circuit | 3 |
| Adjustable pick-up value current of the current- dependent overload release | 4.5 6.3 A |
| Operating voltage | |
| • rated value | 690 V |
| at AC-3 rated value maximum | 690 V |
| Operating frequency rated value | 50 60 Hz |
| Operating current rated value | 6.3 A |
| Operating power at AC-3 | |
| ● at 400 V rated value | 2.2 kW |
| ● at 500 V rated value | 3 kW |
| ● at 690 V rated value | 4 kW |
| Auxiliary circuit | |
| Design of the auxiliary switch | |
| | integrated |
| Number of NC contacts for auxiliary contacts | integrated 1 |
| Number of NC contacts for auxiliary contacts Note | - |
| | 1 |
| • Note | 1 for contactor disconnection |
| Note Number of NO contacts for auxiliary contacts | 1 for contactor disconnection |

| Operating current of auxiliary contacts at AC-15 | |
|--|-------------|
| ● at 24 V | 3 A |
| • at 110 V | 3 A |
| ● at 120 V | 3 A |
| ● at 125 V | 3 A |
| ● at 230 V | 2 A |
| ● at 400 V | 1 A |
| Operating current of auxiliary contacts at DC-13 | |
| ● at 24 V | 2 A |
| ● at 60 V | 0.3 A |
| ● at 110 V | 0.22 A |
| ● at 125 V | 0.22 A |
| ● at 220 V | 0.11 A |
| Contact rating of auxiliary contacts according to UL | B600 / R300 |

| Protective and monitoring functions | |
|-------------------------------------|----------|
| Trip class | CLASS 10 |
| Design of the overload release | thermal |

| Full-load current (FLA) for three-phase AC motor | |
|--|-------|
| • at 480 V rated value | 6.3 A |
| • at 600 V rated value | 6.3 A |

Short-circuit protection

Design of the fuse link

• for short-circuit protection of the auxiliary switch required

fuse gG: 6 A, quick: 10 A

| nstallation/ mounting/ dimensions | |
|--|--------------------|
| Mounting position | any |
| Mounting type | Contactor mounting |
| Height | 76 mm |
| Width | 45 mm |
| Depth | 70 mm |
| Required spacing | |
| with side-by-side mounting | |
| — forwards | 0 mm |
| — Backwards | 0 mm |
| — upwards | 6 mm |
| — downwards | 6 mm |
| — at the side | 6 mm |
| • for grounded parts | |
| — forwards | 0 mm |

| — Backwards | 0 mm |
|------------------|------|
| — upwards | 6 mm |
| — at the side | 6 mm |
| — downwards | 6 mm |
| • for live parts | |
| — forwards | 0 mm |
| — Backwards | 0 mm |
| — upwards | 6 mm |
| — downwards | 6 mm |
| — at the side | 6 mm |
| | |

| Connections/ Terminals | |
|--|---|
| Product function | |
| removable terminal for auxiliary and control | No |
| circuit | |
| Type of electrical connection | |
| for main current circuit | screw-type terminals |
| for auxiliary and control current circuit | screw-type terminals |
| Arrangement of electrical connectors for main current circuit | Top and bottom |
| Type of connectable conductor cross-sections | |
| • for main contacts | |
| — single or multi-stranded | 2x (0,5 1,5 mm²), 2x (0,75 2,5 mm²), 2x 4 mm² |
| finely stranded with core end processing | 2x (0.5 1.5 mm²), 2x (0.75 2.5 mm²) |
| at AWG conductors for main contacts | 2x (20 16), 2x (18 14), 2x 12 |
| Type of connectable conductor cross-sections | |
| for auxiliary contacts | |
| — single or multi-stranded | 2x (0,5 1,5 mm²), 2x (0,75 2,5 mm²) |
| finely stranded with core end processing | 2x (0.5 1.5 mm²), 2x (0.75 2.5 mm²) |
| at AWG conductors for auxiliary contacts | 2x (20 16), 2x (18 14) |
| Tightening torque | |
| for main contacts with screw-type terminals | 0.8 1.2 N·m |
| for auxiliary contacts with screw-type terminals | 0.8 1.2 N·m |
| Design of screwdriver shaft | Diameter 5 6 mm |
| Size of the screwdriver tip | Pozidriv PZ 2 |
| Design of the thread of the connection screw | |
| • for main contacts | M3 |
| of the auxiliary and control contacts | M3 |
| | |

| Safety related data | |
|---|---------|
| Failure rate [FIT] | |
| with low demand rate acc. to SN 31920 | 50 FIT |
| MTTF with high demand rate | 2 280 y |

T1 value for proof test interval or service life acc. to IEC 61508

20 y

Display version

• for switching status

Slide switch

Certificates/ approvals

General Product Approval











For use in hazardous locations

IECEx

Declaration of Conformity

Test Certificates



Marine / Shipping



Miscellaneous

Type Test Certificates/Test Report

Special Test Certificate





other

Marine / Shipping



LRS









Confirmation

Railway

Vibration and Shock

Further information

Information- and Downloadcenter (Catalogs, Brochures,...)

www.siemens.com/sirius/catalogs

Industry Mall (Online ordering system)

https://mall.industry.siemens.com/mall/en/en/Catalog/product?mlfb=3RU2116-1GB0

Cax online generator

http://support.automation.siemens.com/WW/CAXorder/default.aspx?lang=en&mlfb=3RU2116-1GB0

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)

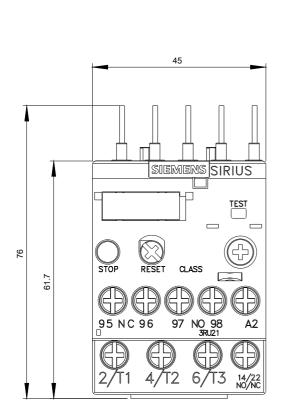
https://support.industry.siemens.com/cs/ww/en/ps/3RU2116-1GB0

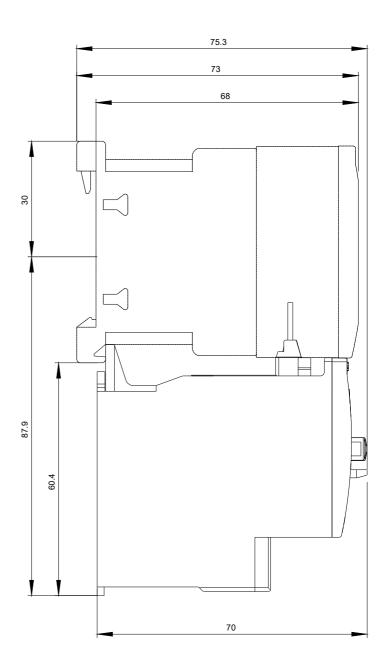
Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, EPLAN macros, ...) http://www.automation.siemens.com/bilddb/cax_de.aspx?mlfb=3RU2116-1GB0&lang=en

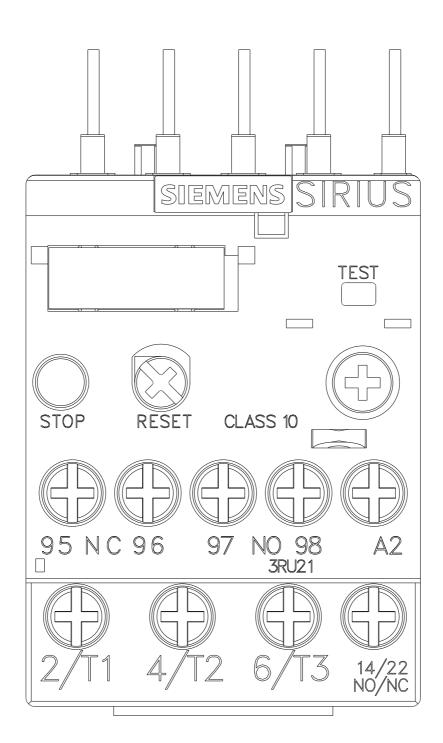
Characteristic: Tripping characteristics, I2t, Let-through current https://support.industry.siemens.com/cs/ww/en/ps/3RU2116-1GB0/char

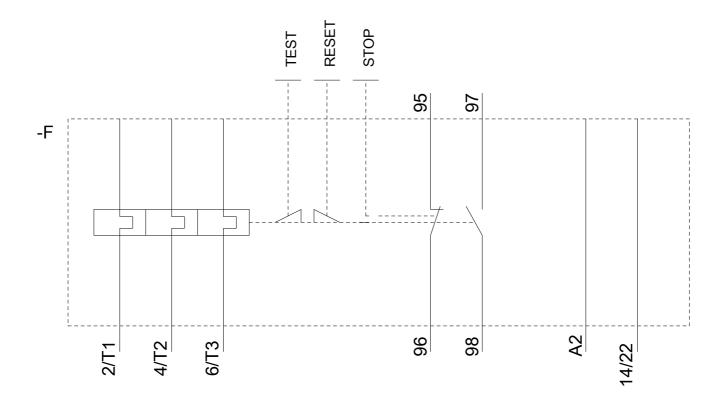
Further characteristics (e.g. electrical endurance, switching frequency)

http://www.automation.siemens.com/bilddb/index.aspx?view=Search&mlfb=3RU2116-1GB0&objecttype=14&gridview=view1









last modified: 11/19/2019

Data sheet 3RU2116-1EB0

Overload relay 2.8...4.0 A Thermal For motor protection Size S00, Class 10 Contactor mounting Main circuit: Screw Auxiliary circuit: Screw Manual-Automatic-Reset



| Product brand name | SIRIUS |
|--------------------------|------------------------|
| Product designation | thermal overload relay |
| Product type designation | 3RU2 |

| General technical data | |
|--|-------|
| Size of overload relay | S00 |
| Size of contactor can be combined company-specific | S00 |
| Power loss [W] for rated value of the current | |
| at AC in hot operating state | 5.7 W |
| • at AC in hot operating state per pole | 1.9 W |
| Insulation voltage with degree of pollution 3 rated value | 690 V |
| Surge voltage resistance rated value | 6 kV |
| maximum permissible voltage for safe isolation | |
| in networks with grounded star point between auxiliary and auxiliary circuit | 440 V |
| in networks with grounded star point between auxiliary and auxiliary circuit | 440 V |
| in networks with grounded star point between main and auxiliary circuit | 440 V |

| in networks with grounded star point between main and auxiliary circuit | 440 V |
|--|-------------------------------|
| Protection class IP | |
| • on the front | IP20 |
| of the terminal | IP20 |
| Shock resistance | |
| • acc. to IEC 60068-2-27 | 8g / 11 ms |
| Type of protection according to ATEX directive 2014/34/EU | Ex II (2) GD |
| Certificate of suitability according to ATEX directive 2014/34/EU | DMT 98 ATEX G 001 |
| Reference code acc. to DIN EN 81346-2 | F |
| Ambient conditions | |
| Installation altitude at height above sea level | |
| • maximum | 2 000 m |
| Ambient temperature | |
| during operation | -40 +70 °C |
| during storage | -55 +80 °C |
| during transport | -55 +80 °C |
| Temperature compensation | -40 +60 °C |
| Relative humidity during operation | 10 95 % |
| Main circuit | |
| Number of poles for main current circuit | 3 |
| Adjustable pick-up value current of the current- dependent overload release | 2.8 4 A |
| Operating voltage | |
| • rated value | 690 V |
| at AC-3 rated value maximum | 690 V |
| Operating frequency rated value | 50 60 Hz |
| Operating current rated value | 4 A |
| Operating power at AC-3 | |
| ● at 400 V rated value | 1.5 kW |
| ● at 500 V rated value | 2.2 kW |
| • at 690 V rated value | 3 kW |
| Auxiliary circuit | |
| | |
| Design of the auxiliary switch | integrated |
| | 1 |
| Design of the auxiliary switch Number of NC contacts for auxiliary contacts Note | |
| Design of the auxiliary switch Number of NC contacts for auxiliary contacts | 1 |
| Design of the auxiliary switch Number of NC contacts for auxiliary contacts Note | 1 for contactor disconnection |
| Design of the auxiliary switch Number of NC contacts for auxiliary contacts Note Number of NO contacts for auxiliary contacts | 1 for contactor disconnection |

| Contact rating of auxiliary contacts according to UL | B600 / R300 |
|--|-------------|
| • at 220 V | 0.11 A |
| ● at 125 V | 0.22 A |
| • at 110 V | 0.22 A |
| ● at 60 V | 0.3 A |
| ● at 24 V | 2 A |
| Operating current of auxiliary contacts at DC-13 | |
| ● at 400 V | 1 A |
| ● at 230 V | 2 A |
| ● at 125 V | 3 A |
| ● at 120 V | 3 A |
| ● at 110 V | 3 A |
| ● at 24 V | 3 A |
| Operating current of auxiliary contacts at AC-15 | |

| Protective and monitoring functions | |
|-------------------------------------|----------|
| Trip class | CLASS 10 |
| Design of the overload release | thermal |

| UL/CSA ratings | |
|--|-----|
| Full-load current (FLA) for three-phase AC motor | |
| • at 480 V rated value | 4 A |
| at 600 V rated value | 4 A |

Short-circuit protection

Design of the fuse link

• for short-circuit protection of the auxiliary switch required

fuse gG: 6 A, quick: 10 A

| Installation/ mounting/ dimensions | |
|--|--------------------|
| Mounting position | any |
| Mounting type | Contactor mounting |
| Height | 76 mm |
| Width | 45 mm |
| Depth | 70 mm |
| Required spacing | |
| with side-by-side mounting | |
| — forwards | 0 mm |
| — Backwards | 0 mm |
| — upwards | 6 mm |
| — downwards | 6 mm |
| — at the side | 6 mm |
| • for grounded parts | |
| — forwards | 0 mm |

| — Backwards | 0 mm |
|------------------|------|
| — upwards | 6 mm |
| — at the side | 6 mm |
| — downwards | 6 mm |
| • for live parts | |
| — forwards | 0 mm |
| — Backwards | 0 mm |
| — upwards | 6 mm |
| — downwards | 6 mm |
| — at the side | 6 mm |
| | |

| Product function | |
|--|---|
| removable terminal for auxiliary and control | No |
| circuit | 110 |
| Type of electrical connection | |
| • for main current circuit | screw-type terminals |
| for auxiliary and control current circuit | screw-type terminals |
| Arrangement of electrical connectors for main current | Top and bottom |
| circuit | Top and bottom |
| Type of connectable conductor cross-sections | |
| • for main contacts | |
| single or multi-stranded | 2x (0,5 1,5 mm²), 2x (0,75 2,5 mm²), 2x 4 mm² |
| — finely stranded with core end processing | 2x (0.5 1.5 mm²), 2x (0.75 2.5 mm²) |
| at AWG conductors for main contacts | 2x (20 16), 2x (18 14), 2x 12 |
| Type of connectable conductor cross-sections | |
| • for auxiliary contacts | |
| single or multi-stranded | 2x (0,5 1,5 mm²), 2x (0,75 2,5 mm²) |
| — finely stranded with core end processing | 2x (0.5 1.5 mm²), 2x (0.75 2.5 mm²) |
| at AWG conductors for auxiliary contacts | 2x (20 16), 2x (18 14) |
| Tightening torque | |
| • for main contacts with screw-type terminals | 0.8 1.2 N·m |
| • for auxiliary contacts with screw-type terminals | 0.8 1.2 N·m |
| Design of screwdriver shaft | Diameter 5 6 mm |
| Size of the screwdriver tip | Pozidriv PZ 2 |
| Design of the thread of the connection screw | |
| • for main contacts | M3 |
| of the auxiliary and control contacts | M3 |

| Safety related data | |
|---|---------|
| Failure rate [FIT] | |
| • with low demand rate acc. to SN 31920 | 50 FIT |
| MTTF with high demand rate | 2 280 y |

T1 value for proof test interval or service life acc. to IEC 61508

20 y

Display

Display version

• for switching status

Slide switch

Certificates/ approvals

General Product Approval















IECEx

Declaration of Conformity

Test Certificates

Marine / Shipping



Miscellaneous

Type Test Certificates/Test Report

Special Test Certificate





Marine / Shipping

other











Confirmation

Railway

Vibration and Shock

Further information

Information- and Downloadcenter (Catalogs, Brochures,...)

www.siemens.com/sirius/catalogs

Industry Mall (Online ordering system)

https://mall.industry.siemens.com/mall/en/en/Catalog/product?mlfb=3RU2116-1EB0

Cax online generator

http://support.automation.siemens.com/WW/CAXorder/default.aspx?lang=en&mlfb=3RU2116-1EB0

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)

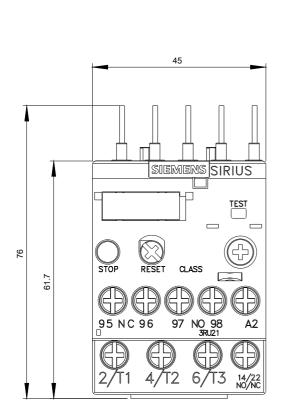
https://support.industry.siemens.com/cs/ww/en/ps/3RU2116-1EB0

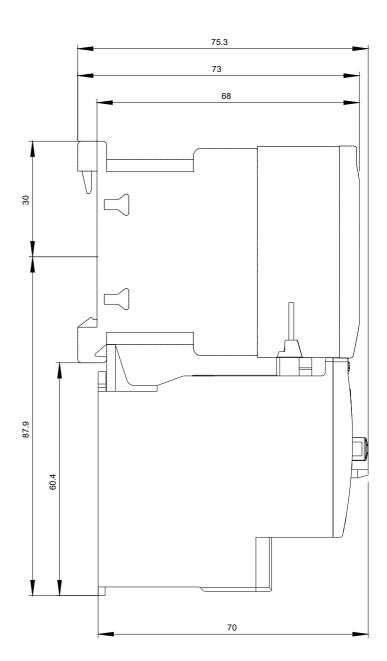
Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, EPLAN macros, ...) http://www.automation.siemens.com/bilddb/cax_de.aspx?mlfb=3RU2116-1EB0&lang=en

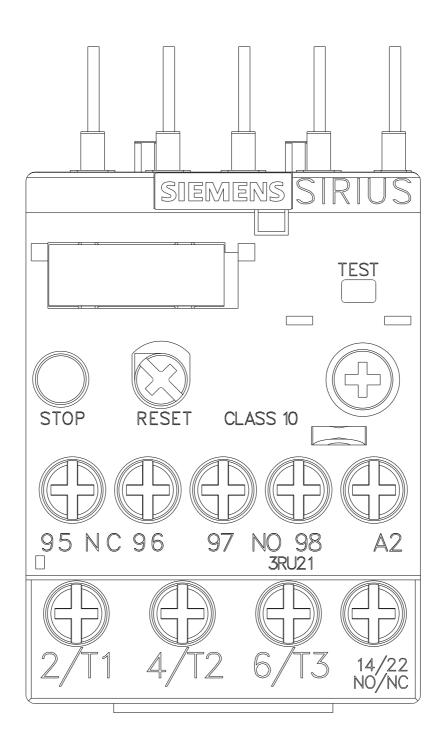
Characteristic: Tripping characteristics, I²t, Let-through current https://support.industry.siemens.com/cs/ww/en/ps/3RU2116-1EB0/char

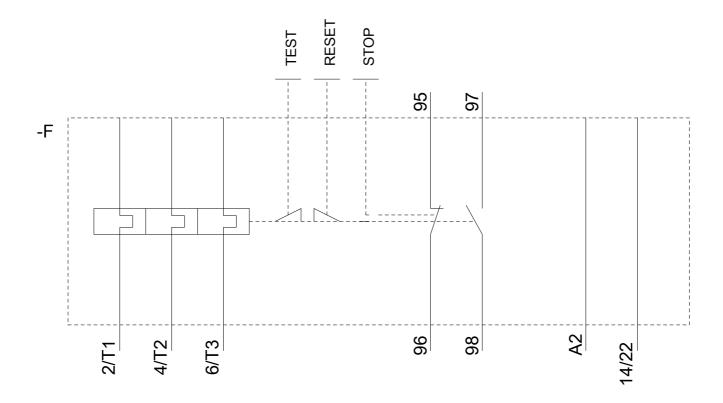
Further characteristics (e.g. electrical endurance, switching frequency)

http://www.automation.siemens.com/bilddb/index.aspx?view=Search&mlfb=3RU2116-1EB0&objecttype=14&gridview=view1









last modified: 12/05/2019

Data sheet 3RT2027-1AK60

Contactor, AC-3, 15 kW / 400 V, 1 NO + 1 NC, 110 V AC, 50 Hz, 120 V, 60 Hz, 3-pole, Size S0, screw terminal



| Product brand name | SIRIUS |
|--------------------------|-----------------|
| Product designation | Power contactor |
| Product type designation | 3RT2 |

| General technical data | |
|---|--------|
| Size of contactor | S0 |
| Product extension | |
| function module for communication | No |
| Auxiliary switch | Yes |
| Power loss [W] for rated value of the current | |
| at AC in hot operating state | 8.1 W |
| at AC in hot operating state per pole | 2.7 W |
| Power loss [W] for rated value of the current without | 10.5 W |
| load current share typical | |
| Surge voltage resistance | |
| of main circuit rated value | 6 kV |
| of auxiliary circuit rated value | 6 kV |
| maximum permissible voltage for safe isolation | |
| between coil and main contacts acc. to EN | 400 V |
| 60947-1 | |
| | |

| Protection class IP | |
|--|----------------------------|
| • on the front | IP20 |
| of the terminal | IP20 |
| Shock resistance at rectangular impulse | |
| • at AC | 8,3g / 5 ms, 5,3g / 10 ms |
| Shock resistance with sine pulse | |
| • at AC | 13,5g / 5 ms, 8,3g / 10 ms |
| Mechanical service life (switching cycles) | |
| of contactor typical | 10 000 000 |
| of the contactor with added electronics- | 5 000 000 |
| compatible auxiliary switch block typical | |
| of the contactor with added auxiliary switch block typical | 10 000 000 |
| Reference code acc. to DIN 40719 extended | К |
| according to IEC 204-2 acc. to IEC 750 | |
| Reference code acc. to DIN EN 81346-2 | Q |
| Ambient conditions | |
| Installation altitude at height above sea level | |
| • maximum | 2 000 m |
| Ambient temperature | |
| during operation | -25 +60 °C |
| during storage | -55 +80 °C |
| Main circuit | |
| Number of poles for main current circuit | 3 |
| Number of NO contacts for main contacts | 3 |
| Operating voltage | |
| • at AC-3 rated value maximum | 690 V |
| Operating current | |
| ● at AC-1 at 400 V | |
| — at ambient temperature 40 °C rated value | 50 A |
| ● at AC-1 | |
| — up to 690 V at ambient temperature 40 °C rated value | 50 A |
| — up to 690 V at ambient temperature 60 °C rated value | 42 A |
| • at AC-2 at 400 V rated value | 32 A |
| • at AC-3 | |
| — at 400 V rated value | 32 A |
| — at 500 V rated value | 32 A |
| — at 690 V rated value | 21 A |
| ● at AC-4 at 400 V rated value | 22 A |
| at AC-5a up to 690 V rated value | 44 A |
| a Ja ap 13 000 v latou raido | |

| at AC-5b up to 400 V rated value | 26.5 A |
|--|--|
| ● at AC-6a | |
| up to 230 V for current peak value n=20 rated value | 30.8 A |
| up to 400 V for current peak value n=20 rated value | 30.8 A |
| up to 500 V for current peak value n=20 rated value | 27 A |
| up to 690 V for current peak value n=20 rated value | 21 A |
| ● at AC-6a | |
| — up to 230 V for current peak value n=30 rated value | 20.5 A |
| up to 400 V for current peak value n=30 rated value | 20.5 A |
| up to 500 V for current peak value n=30 rated value | 18 A |
| — up to 690 V for current peak value n=30 rated value | 18 A |
| Minimum cross-section in main circuit | |
| at maximum AC-1 rated value | 10 mm² |
| Operating current for approx. 200000 operating cycles at AC-4 | |
| • at 400 V rated value | 12 A |
| • at 690 V rated value | 12 A |
| Operating current | |
| at 1 current path at DC-1 | |
| | |
| — at 24 V rated value | 35 A |
| | 35 A 4.5 A |
| — at 24 V rated value | |
| — at 24 V rated value— at 110 V rated value | 4.5 A |
| at 24 V rated valueat 110 V rated valueat 220 V rated value | 4.5 A 1 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value | 4.5 A 1 A 0.4 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value | 4.5 A 1 A 0.4 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 2 current paths in series at DC-1 | 4.5 A 1 A 0.4 A 0.25 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 2 current paths in series at DC-1 at 24 V rated value | 4.5 A 1 A 0.4 A 0.25 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 2 current paths in series at DC-1 at 24 V rated value at 110 V rated value | 4.5 A 1 A 0.4 A 0.25 A 35 A 35 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 2 current paths in series at DC-1 at 24 V rated value at 110 V rated value at 220 V rated value | 4.5 A 1 A 0.4 A 0.25 A 35 A 35 A 5 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 2 current paths in series at DC-1 at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value | 4.5 A 1 A 0.4 A 0.25 A 35 A 35 A 5 A 1 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 2 current paths in series at DC-1 at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value | 4.5 A 1 A 0.4 A 0.25 A 35 A 35 A 5 A 1 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 2 current paths in series at DC-1 at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 3 current paths in series at DC-1 | 4.5 A 1 A 0.4 A 0.25 A 35 A 35 A 5 A 1 A 0.8 A |
| at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value with 2 current paths in series at DC-1 at 24 V rated value at 110 V rated value at 220 V rated value at 440 V rated value at 600 V rated value at 600 V rated value at 24 V rated value at 24 V rated value | 4.5 A 1 A 0.4 A 0.25 A 35 A 35 A 5 A 1 A 0.8 A |

| — at 600 V rated value | 1.4 A |
|--|---|
| Operating current | |
| • at 1 current path at DC-3 at DC-5 | |
| — at 24 V rated value | 20 A |
| — at 110 V rated value | 2.5 A |
| — at 220 V rated value | 1 A |
| — at 440 V rated value | 0.09 A |
| — at 600 V rated value | 0.06 A |
| • with 2 current paths in series at DC-3 at DC-5 | |
| — at 24 V rated value | 35 A |
| — at 110 V rated value | 15 A |
| — at 220 V rated value | 3 A |
| — at 440 V rated value | 0.27 A |
| — at 600 V rated value | 0.16 A |
| • with 3 current paths in series at DC-3 at DC-5 | |
| — at 24 V rated value | 35 A |
| — at 110 V rated value | 35 A |
| — at 220 V rated value | 10 A |
| — at 440 V rated value | 0.6 A |
| — at 600 V rated value | 0.6 A |
| Operating power | |
| • at AC-1 | |
| — at 230 V rated value | 16 kW |
| — at 230 V at 60 °C rated value | 15.5 kW |
| — at 400 V rated value | 28 kW |
| — at 400 V at 60 °C rated value | 27.5 kW |
| — at 690 V rated value | 48 kW |
| — at 690 V at 60 °C rated value | 47.5 kW |
| • at AC-2 at 400 V rated value | 15 kW |
| • at AC-3 | |
| — at 230 V rated value | 7.5 kW |
| — at 400 V rated value | 15 kW |
| — at 500 V rated value | 15 kW |
| — at 690 V rated value | 18.5 kW |
| Operating power for approx. 200000 operating cycles at AC-4 | |
| • at 400 V rated value | 6 kW |
| • at 690 V rated value | 10.3 kW |
| Short-time withstand current in cold operating state up to 40 °C | |
| limited to 1 s switching at zero current maximum | 499 A; Use minimum cross-section acc. to AC-1 rated value |

| limited to 5 s switching at zero current maximum | 395 A; Use minimum cross-section acc. to AC-1 rated value |
|---|---|
| limited to 10 s switching at zero current maximum | 260 A; Use minimum cross-section acc. to AC-1 rated value |
| limited to 30 s switching at zero current maximum | 186 A; Use minimum cross-section acc. to AC-1 rated value |
| limited to 60 s switching at zero current maximum | 152 A; Use minimum cross-section acc. to AC-1 rated value |
| No-load switching frequency | |
| • at AC | 5 000 1/h |
| Operating frequency | |
| • at AC-1 maximum | 1 000 1/h |
| • at AC-2 maximum | 750 1/h |
| • at AC-3 maximum | 750 1/h |
| • at AC-4 maximum | 250 1/h |

| Control circuit/ Control | |
|--|------------------|
| Type of voltage of the control supply voltage | AC |
| Control supply voltage at AC | |
| ● at 50 Hz rated value | 110 V |
| • at 60 Hz rated value | 120 V |
| Operating range factor control supply voltage rated value of magnet coil at AC | |
| ● at 50 Hz | 0.8 1.1 |
| ● at 60 Hz | 0.8 1.1 |
| Apparent pick-up power of magnet coil at AC | |
| ● at 50 Hz | 81 V·A |
| ● at 60 Hz | 79 V·A |
| Inductive power factor with closing power of the coil | |
| ● at 50 Hz | 0.72 |
| ● at 60 Hz | 0.74 |
| Apparent holding power of magnet coil at AC | |
| ● at 50 Hz | 10.5 V·A |
| ● at 60 Hz | 8.5 V·A |
| Inductive power factor with the holding power of the coil | |
| ● at 50 Hz | 0.25 |
| ● at 60 Hz | 0.28 |
| Closing delay | |
| • at AC | 8 40 ms |
| Opening delay | |
| • at AC | 4 16 ms |
| Arcing time | 10 10 ms |
| Control version of the switch operating mechanism | Standard A1 - A2 |

| Auxiliary circuit | |
|--|---|
| Number of NC contacts for auxiliary contacts | |
| • instantaneous contact | 1 |
| Number of NO contacts for auxiliary contacts | |
| • instantaneous contact | 1 |
| Operating current at AC-12 maximum | 10 A |
| Operating current at AC-15 | |
| • at 230 V rated value | 10 A |
| • at 400 V rated value | 3 A |
| • at 500 V rated value | 2 A |
| • at 690 V rated value | 1 A |
| Operating current at DC-12 | |
| • at 24 V rated value | 10 A |
| ● at 48 V rated value | 6 A |
| • at 60 V rated value | 6 A |
| • at 110 V rated value | 3 A |
| • at 125 V rated value | 2 A |
| • at 220 V rated value | 1 A |
| • at 600 V rated value | 0.15 A |
| Operating current at DC-13 | |
| • at 24 V rated value | 10 A |
| • at 48 V rated value | 2 A |
| • at 60 V rated value | 2 A |
| • at 110 V rated value | 1 A |
| • at 125 V rated value | 0.9 A |
| • at 220 V rated value | 0.3 A |
| • at 600 V rated value | 0.1 A |
| Contact reliability of auxiliary contacts | 1 faulty switching per 100 million (17 V, 1 mA) |
| UL/CSA ratings | |
| Full-load current (FLA) for three-phase AC motor | |
| • at 480 V rated value | 27 A |
| • at 600 V rated value | 27 A |
| Yielded mechanical performance [hp] | |
| for single-phase AC motor | |
| — at 110/120 V rated value | 2 hp |
| — at 230 V rated value | 5 hp |
| • for three-phase AC motor | |
| — at 200/208 V rated value | 10 hp |
| — at 220/230 V rated value | 10 hp |
| — at 460/480 V rated value | 20 hp |
| — at 575/600 V rated value | 25 hp |

Short-circuit protection

Design of the fuse link

- for short-circuit protection of the main circuit
 - with type of coordination 1 required

gG: 125A (690V,100kA), aM: 50A (690V,100kA), BS88: 125A

(415V,80kA)

— with type of assignment 2 required

gG: 50A (690V,100kA), aM: 25A (690V, 100kA), BS88: 50A

(415V, 80kA)

• for short-circuit protection of the auxiliary switch

required

gG: 10 A (500 V, 1 kA)

| Mounting position | +/-180° rotation possible on vertical mounting surface; can be |
|--|--|
| | tilted forward and backward by +/- 22.5° on vertical mounting |
| | surface |
| Mounting type | screw and snap-on mounting onto 35 mm standard mounting rai |
| | according to DIN EN 60715 |
| Side-by-side mounting | Yes |
| Height | 85 mm |
| Width | 45 mm |
| Depth | 97 mm |
| Required spacing | |
| with side-by-side mounting | |
| — forwards | 10 mm |
| — upwards | 10 mm |
| — downwards | 10 mm |
| — at the side | 0 mm |
| • for grounded parts | |
| — forwards | 10 mm |
| — upwards | 10 mm |
| — at the side | 6 mm |
| — downwards | 10 mm |
| • for live parts | |
| — forwards | 10 mm |
| — upwards | 10 mm |
| — downwards | 10 mm |
| — at the side | 6 mm |

Connections/ Terminals

Type of electrical connection

• for main current circuit

screw-type terminals

• for auxiliary and control current circuit

screw-type terminals

• at contactor for auxiliary contacts

Screw-type terminals

• of magnet coil

Screw-type terminals

| Type of connectable conductor cross-sections | |
|--|---|
| • for main contacts | |
| — solid | 2x (1 2.5 mm²), 2x (2.5 10 mm²) |
| — single or multi-stranded | 2x (1 2,5 mm²), 2x (2,5 10 mm²) |
| finely stranded with core end processing | 2x (1 2.5 mm²), 2x (2.5 6 mm²), 1x 10 mm² |
| at AWG conductors for main contacts | 2x (16 12), 2x (14 8) |
| Connectable conductor cross-section for main | |
| contacts | |
| • solid | 1 10 mm² |
| • stranded | 1 10 mm² |
| finely stranded with core end processing | 1 10 mm² |
| Connectable conductor cross-section for auxiliary | |
| contacts | |
| • single or multi-stranded | 0.5 2.5 mm² |
| finely stranded with core end processing | 0.5 2.5 mm² |
| Type of connectable conductor cross-sections | |
| for auxiliary contacts | |
| — single or multi-stranded | 2x (0,5 1,5 mm²), 2x (0,75 2,5 mm²) |
| finely stranded with core end processing | 2x (0.5 1.5 mm²), 2x (0.75 2.5 mm²) |
| at AWG conductors for auxiliary contacts | 2x (20 16), 2x (18 14) |
| AWG number as coded connectable conductor cross | |
| section | |
| • for main contacts | 16 8 |
| for auxiliary contacts | 20 14 |

| Safety related data | |
|--|-------------|
| B10 value | |
| with high demand rate acc. to SN 31920 | 1 000 000 |
| Proportion of dangerous failures | |
| with low demand rate acc. to SN 31920 | 40 % |
| • with high demand rate acc. to SN 31920 | 73 % |
| Failure rate [FIT] | |
| with low demand rate acc. to SN 31920 | 100 FIT |
| Product function | |
| Mirror contact acc. to IEC 60947-4-1 | Yes |
| T1 value for proof test interval or service life acc. to IEC 61508 | 20 y |
| Protection against electrical shock | finger-safe |
| Certificates/ approvals | |

General Product Approval







KC





EMC

| Functional Safety/Safety of Machinery | Declaration of Conformity | Test Certificates | Marine / Ship- ping |
|---|---------------------------|--|------------------------|
| Type Examination Certificate | Miscellaneous | Type Test Certificates/Test Report Special Test Certificates Special Test Certificate | OF SHIPP OF |

Marine / Shipping





EG-Konf.









other

ABS

Confirmation

other



Further information

Information- and Downloadcenter (Catalogs, Brochures,...)

www.siemens.com/ic10

Industry Mall (Online ordering system)

https://mall.industry.siemens.com/mall/en/en/Catalog/product?mlfb=3RT2027-1AK60

http://support.automation.siemens.com/WW/CAXorder/default.aspx?lang=en&mlfb=3RT2027-1AK60

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)

https://support.industry.siemens.com/cs/ww/en/ps/3RT2027-1AK60

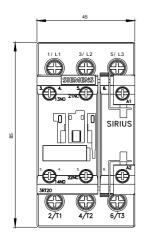
Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, EPLAN macros, ...) http://www.automation.siemens.com/bilddb/cax_de.aspx?mlfb=3RT2027-1AK60&lang=en

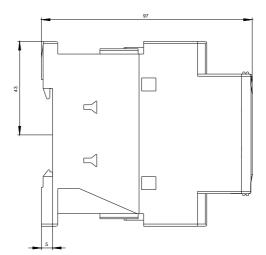
Characteristic: Tripping characteristics, I2t, Let-through current

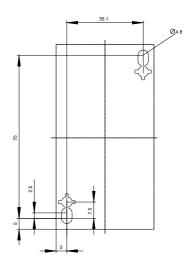
https://support.industry.siemens.com/cs/ww/en/ps/3RT2027-1AK60/char

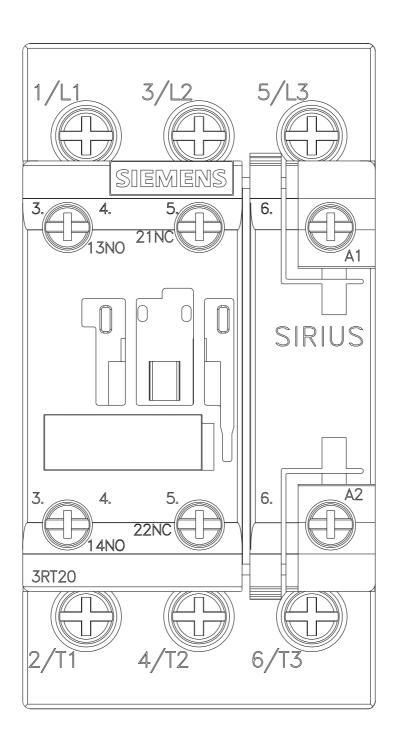
Further characteristics (e.g. electrical endurance, switching frequency)

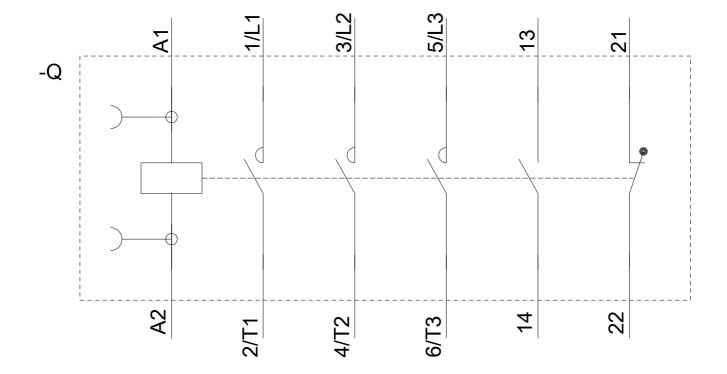
http://www.automation.siemens.com/bilddb/index.aspx?view=Search&mlfb=3RT2027-1AK60&objecttype=14&gridview=view1











last modified: 01/16/2020

Data sheet 3RU2126-4CB0

Overload relay 17...22 A Thermal For motor protection Size S0, Class 10 Contactor mounting Main circuit: Screw Auxiliary circuit: Screw Manual-Automatic-Reset



| Product brand name | SIRIUS |
|--------------------------|------------------------|
| Product designation | thermal overload relay |
| Product type designation | 3RU2 |

| Size of overload relay | S0 |
|--|-------|
| Size of contactor can be combined company-specific | S0 |
| Power loss [W] for rated value of the current | |
| • at AC in hot operating state | 8.1 W |
| • at AC in hot operating state per pole | 2.7 W |
| Insulation voltage with degree of pollution 3 at AC rated value | 690 V |
| Surge voltage resistance rated value | 6 kV |
| maximum permissible voltage for safe isolation | |
| in networks with grounded star point between auxiliary and auxiliary circuit | 440 V |
| in networks with grounded star point between auxiliary and auxiliary circuit | 440 V |
| in networks with grounded star point between main and auxiliary circuit | 440 V |

| in networks with grounded star point between main and auxiliary circuit | 440 V | | |
|---|-----------------------------|--|--|
| Protection class IP | | | |
| • on the front | IP20 | | |
| • of the terminal | IP20 | | |
| Shock resistance | | | |
| • acc. to IEC 60068-2-27 | 8g / 11 ms | | |
| Type of protection according to ATEX directive 2014/34/EU | Ex II (2) GD | | |
| Certificate of suitability according to ATEX directive 2014/34/EU | DMT 98 ATEX G 001 | | |
| Reference code acc. to DIN EN 81346-2 | F | | |
| Ambient conditions | | | |
| Installation altitude at height above sea level | | | |
| • maximum | 2 000 m | | |
| Ambient temperature | | | |
| during operation | -40 +70 °C | | |
| during storage | -55 +80 °C | | |
| during transport | -55 +80 °C | | |
| Temperature compensation | -40 +60 °C | | |
| Relative humidity during operation | 10 95 % | | |
| Main circuit | | | |
| Number of poles for main current circuit | 3 | | |
| Adjustable pick-up value current of the current- dependent overload release | 17 22 A | | |
| Operating voltage | | | |
| • rated value | 690 V | | |
| • at AC-3 rated value maximum | 690 V | | |
| Operating frequency rated value | 50 60 Hz | | |
| Operating current rated value | 22 A | | |
| Operating power at AC-3 | | | |
| • at 400 V rated value | 11 kW | | |
| • at 500 V rated value | 11 kW | | |
| • at 690 V rated value | 18.5 kW | | |
| Auxiliary circuit | | | |
| Design of the auxiliary switch | integrated | | |
| Number of NC contacts for auxiliary contacts | 1 | | |
| • Note | for contactor disconnection | | |
| Number of NO contacts for auxiliary contacts | 1 | | |
| Note | for message "Tripped" | | |
| Number of CO contacts | | | |
| for auxiliary contacts | 0 | | |

| Contact rating of auxiliary contacts according to UL | B600 / R300 |
|--|-------------|
| ● at 220 V | 0.11 A |
| ● at 125 V | 0.22 A |
| ● at 110 V | 0.22 A |
| ● at 60 V | 0.3 A |
| ● at 24 V | 2 A |
| Operating current of auxiliary contacts at DC-13 | |
| ● at 400 V | 1 A |
| ● at 230 V | 2 A |
| ● at 125 V | 3 A |
| ● at 120 V | 3 A |
| ● at 110 V | 3 A |
| ● at 24 V | 3 A |
| Operating current of auxiliary contacts at AC-15 | |

| Protective and monitoring functions | | | |
|-------------------------------------|---------|--|--|
| Trip class CLASS 10 | | | |
| Design of the overload release | thermal | | |

| Full-load current (FLA) for three-phase AC motor | |
|--|------|
| • at 480 V rated value | 22 A |
| at 600 V rated value | 22 A |

Short-circuit protection

Design of the fuse link

• for short-circuit protection of the auxiliary switch required

fuse gG: 6 A, quick: 10 A

| Installation/ mounting/ dimensions | | | |
|--|--------------------|--|--|
| Mounting position | any | | |
| Mounting type | Contactor mounting | | |
| Height | 85 mm | | |
| Width | 45 mm | | |
| Depth | 85 mm | | |
| Required spacing | | | |
| with side-by-side mounting | | | |
| — forwards | 0 mm | | |
| — Backwards | 0 mm | | |
| — upwards | 6 mm | | |
| — downwards | 6 mm | | |
| — at the side | 6 mm | | |
| • for grounded parts | | | |
| — forwards | 0 mm | | |

| — Backwards | 0 mm |
|------------------|------|
| — upwards | 6 mm |
| — at the side | 6 mm |
| — downwards | 6 mm |
| • for live parts | |
| — forwards | 0 mm |
| — Backwards | 0 mm |
| — upwards | 6 mm |
| — downwards | 6 mm |
| — at the side | 6 mm |
| | |

| Connections/ Terminals | | | | |
|--|---|--|--|--|
| Product function | | | | |
| removable terminal for auxiliary and control circuit | No | | | |
| Type of electrical connection | | | | |
| • for main current circuit | screw-type terminals | | | |
| for auxiliary and control current circuit | screw-type terminals | | | |
| Arrangement of electrical connectors for main current circuit | Top and bottom | | | |
| Type of connectable conductor cross-sections | | | | |
| • for main contacts | | | | |
| — single or multi-stranded | 2x (1 2,5 mm²), 2x (2,5 10 mm²) | | | |
| — finely stranded with core end processing | 2x (1 2.5 mm²), 2x (2.5 6 mm²), 1x 10 mm² | | | |
| at AWG conductors for main contacts | 2x (16 12), 2x (14 8) | | | |
| Type of connectable conductor cross-sections | | | | |
| • for auxiliary contacts | | | | |
| — single or multi-stranded | 2x (0,5 1,5 mm²), 2x (0,75 2,5 mm²) | | | |
| finely stranded with core end processing | 2x (0.5 1.5 mm²), 2x (0.75 2.5 mm²) | | | |
| at AWG conductors for auxiliary contacts | 2x (20 16), 2x (18 14) | | | |
| Tightening torque | | | | |
| for main contacts with screw-type terminals | 2 2.5 N·m | | | |
| for auxiliary contacts with screw-type terminals | 0.8 1.2 N·m | | | |
| Design of screwdriver shaft | Diameter 5 6 mm | | | |
| Size of the screwdriver tip | Pozidriv PZ 2 | | | |
| Design of the thread of the connection screw | | | | |
| • for main contacts | M4 | | | |
| • of the auxiliary and control contacts | M3 | | | |
| Safaty related data | | | | |

| Safety related data | |
|---|---------|
| Failure rate [FIT] | |
| with low demand rate acc. to SN 31920 | 50 FIT |
| MTTF with high demand rate | 2 280 y |

T1 value for proof test interval or service life acc. to IEC 61508

20 y

Display

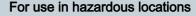
Display version

• for switching status

Slide switch

Certificates/ approvals

General Product Approval















IECEx

Declaration of Conformity

Test Certificates

Marine / Shipping



Miscellaneous

Type Test Certificates/Test Report

Special Test Certificate





Marine / Shipping

other











Confirmation

Railway

Vibration and Shock

Further information

Information- and Downloadcenter (Catalogs, Brochures,...)

www.siemens.com/ic10

Industry Mall (Online ordering system)

https://mall.industry.siemens.com/mall/en/en/Catalog/product?mlfb=3RU2126-4CB0

Cax online generator

http://support.automation.siemens.com/WW/CAXorder/default.aspx?lang=en&mlfb=3RU2126-4CB0

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)

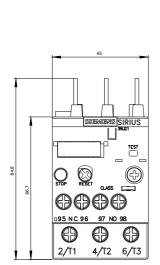
https://support.industry.siemens.com/cs/ww/en/ps/3RU2126-4CB0

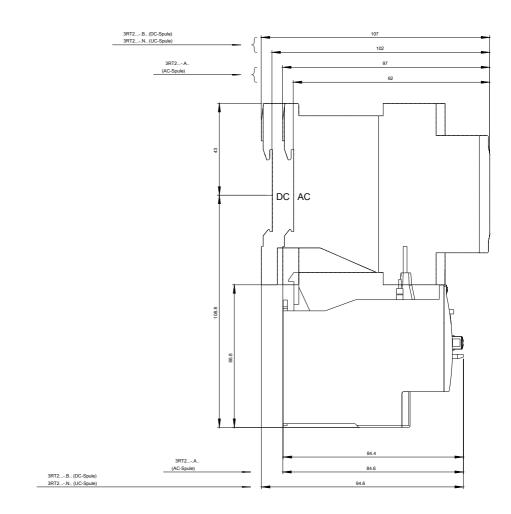
Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, EPLAN macros, ...) http://www.automation.siemens.com/bilddb/cax_de.aspx?mlfb=3RU2126-4CB0&lang=en

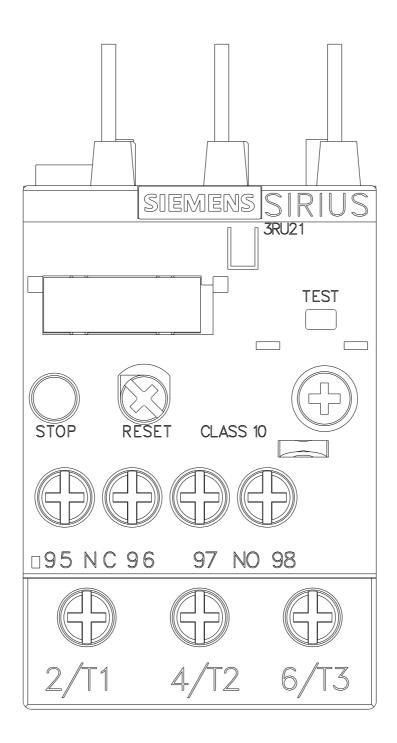
Characteristic: Tripping characteristics, I²t, Let-through current https://support.industry.siemens.com/cs/ww/en/ps/3RU2126-4CB0/cha

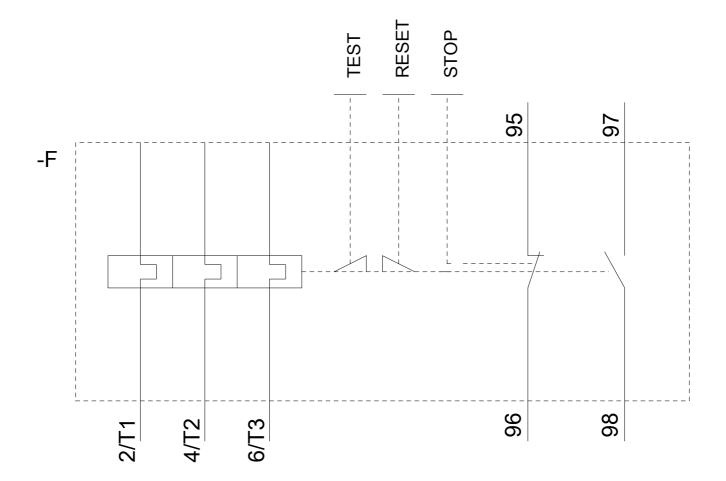
Further characteristics (e.g. electrical endurance, switching frequency)

http://www.automation.siemens.com/bilddb/index.aspx?view=Search&mlfb=3RU2126-4CB0&objecttype=14&gridview=view1









last modified: 01/16/2020

Data sheet 3RU2916-3AA01



stand-alone assembly support for 3RU21/3RB30/3RB31/3RR2 Size S00 Stand-alone installation Main circuit: Screw Auxiliary circuit: --

| General technical data: | | | | |
|------------------------------------|----|------------------|--|--|
| Product brand name | | SIRIUS | | |
| Product designation | | individual mount | | |
| Size of overload relay | | S00 | | |
| Ambient temperature | | | | |
| during storage | °C | -50 + 80 | | |
| during operation | °C | -20 +70 | | |

| Installation/ mounting/ dimensions: | | | | |
|-------------------------------------|----|--|--|--|
| Mounting type | | screw and snap-on mounting onto 35 mm standard | | |
| | | mounting rail | | |
| Width | mm | 45 | | |
| Height | mm | 89 | | |
| Depth | mm | 75 | | |

| Connections/ Terminals: | |
|-------------------------------|----------------------|
| Type of electrical connection | |
| • for main current circuit | screw-type terminals |
| • | |

- Type of connectable conductor crosssections for main contacts finely stranded
 - with core end processing
- Type of connectable conductor cross-sections at AWG conductors

- for main contacts

0.5 ... 2.5 mm²

1x (20 ... 12)

Certificates/ approvals:

| General Product Approval | | Declaration of | Declaration of Conformity | | |
|--------------------------|-------|----------------|---------------------------|---------------|------------------------------------|
| (SA | UL UL | EHE | EG-Konf. | Miscellaneous | Type Test Certificates/Test Report |

| Test | Certific- |
|------|-----------|
| ates | |

Shipping Approval

Special Test Certificate



other









Shipping Approval



Confirmation

Further information

Information- and Downloadcenter (Catalogs, Brochures,...)

http://www.siemens.com/industrial-controls/catalogs

Industry Mall (Online ordering system)

http://www.siemens.com/industrymall

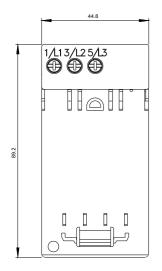
Cax online generator

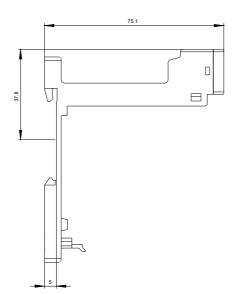
 $\underline{\text{http://support.automation.siemens.com/WW/CAXorder/default.aspx?lang=en\&mlfb=3RU2916-3AA01}}$

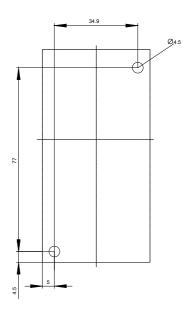
Service&Support (Manuals, Certificates, Characteristics, FAQs,...)

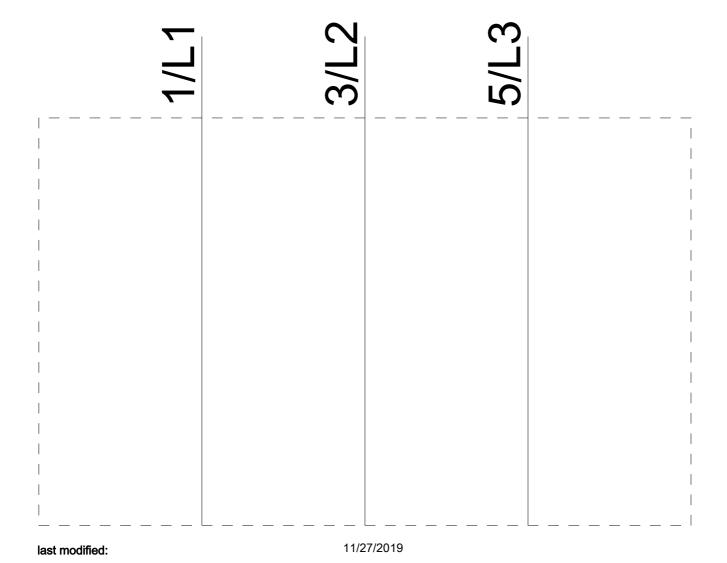
https://support.industry.siemens.com/cs/ww/en/ps/3RU2916-3AA01

Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, EPLAN macros, ...) http://www.automation.siemens.com/bilddb/cax_de.aspx?mlfb=3RU2916-3AA01&lang=en









Industrial **Control** Relays

The miniature relay system with big advantages







CS8 front mount auxiliaries are positive guidance

Despite increasing complexity, control systems and installations must become increasingly compact. And the CS8 Miniature Relay System packs maximum performance into minimum space.

Small but rugged

Sprecher + Schuh has subjected this relay series to monitored endurance tests that demonstrate their ruggedness. Under normal duty, CS8 contacts have an electrical life of 700,000 operations, while the AC magnet system has a mechanical life of 15,000,000 operations.

The coil is designed for absolute undervoltage reliability. Undervoltages that do not cause the contactor to close can be withstood indefinitely without damage.

The body of the device is sturdy as well. The front housing, containing the phase partitions and screwdriver guides, is manufactured in one piece. Front and rear housing are then joint fitted together.

Superior Contact Reliability

The standard CS8 base relay and auxiliary contacts are bifurcated H-bridge design which divides each movable contact into two sections at the tip of the spanner which provides a higher degree of reliability for low signal applications. Perfect fit for PLC and other electronic circuits operate at signals as low as 15V @ 2mA.

Mechanically linked contacts for safety

The CS8 control relay are the perfect choice for fail-safe control circuits to meet mechanically linked performance per IEC 60947-4-1. Mechanically linked is an interlock contact design that maintains minimum 0.5mm clearance which prevents the NC contact from reclosing if the NO contact is welded when in operation. This feature applies to CS8 base relays with AC & DC coils; base relays and addon auxiliaries for DC coils only.



Accessories require no additional panel space

The entire CS8 system is logically engineered. Auxiliary contact blocks are modular and snap-on without increasing the CS8's original width of 45mm. Also, due to its sideways switching movement, the basic relay has the same low profile whether an AC or DC operating magnet is used. This permits the use of enclosures with shallow mounting depths. Once the CS8 is installed, all auxiliary contact blocks can be snapped on or removed without changing any existing wiring.

Auxiliary components provide flexibility

CS8 auxiliary components allow you to convert the basic four pole relay up to an 8 pole relay.

Effortless installation

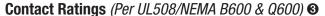
CS8 relays are DIN-rail mountable for instant installation and modification. Fittings are also included for base mounting. All terminals are clearly marked and shipped in the open position for installation with either manual or power screwdrivers. Using self-adhesive labels, or plastic clip-on tags.

The entire line is cULus Listed and CE Certified and offers finger and back of hand protection to the strictest international standards.



CS8 Complete Assemblies - 4 Pole

| | Contact Arrangement and | | tacts | AC Operation | 1 | DC Operation | |
|---|---|-----------|-----------|----------------|-------|----------------|-------|
| CS8 Relay | Numbering | NO | NC | Catalog Number | Price | Catalog Number | Price |
| | $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | 4 | 0 | CS8-40E-* | 72.17 | CS8C-40E-* | 91.55 |
| 10 NO 42 NO 21 NO 31 NO A1 NO | 13 33 43 21 | 3 | 1 | CS8-31Z-* | 72.17 | CS8C-31Z-* | 91.55 |
| CSB 222 = 10 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 | 13 43 21 31 | 2 | 2 | CS8-22Z-* | 72.17 | CS8C-22Z-* | 91.55 |
| | 13 47 21 35 1 | 1+ 1EM | 1+ 1LB | CS8-L22Z-* | 72.17 | CS8C-L22Z-* | 91.55 |



| Standard | Circuit Make Voltage (Amps/VA) | | Break (Amps/VA) | Continuous Amps |
|----------|-----------------------------------|-------------|--------------------|--------------------|
| | 120AC | 30A/3600VA | 3.0A/360VA | |
| B600 | 240AC | 15A/3600VA | 1.5A/360VA | 10 |
| | 480AC | 7.5A/3600VA | 0.75A/360VA | 10 |
| | 600AC | 6A/3600VA | 0.60A/360VA | |
| 125DC | | 0.55A/69VA | 0.55A/69VA | |
| Q600 | 250DC | 0.27A/69VA | 0.27A/69VA | 2.5 |
| | 301-600DC | 0.1A/69VA | 0.1A/69VA | |

Mechanical Link

• Base relay meets IEC 60947-5-1. See page G20 for additional information.

AC Coil Codes •

| AC | Voltage | Voltage Range | | | | | |
|--------------|-------------------|---------------|--|--|--|--|--|
| Coil Code | 50 Hz | 60 Hz | | | | | |
| 12 | 12V | 12V | | | | | |
| 24Z | 24V | 24V | | | | | |
| 48Z | 48V | 48V | | | | | |
| 120 | 110V | 120V | | | | | |
| 208 | 200V-220V | 208V-220V | | | | | |
| 240 | 240V | 240V | | | | | |
| 380 🕹 | Use Coil Code 400 | | | | | | |
| 400 4 | 400V | 400V | | | | | |
| 480 | 440V | 480V | | | | | |
| 575 ூ | Use Coil Code 600 | | | | | | |
| 600 ூ | 525V | 600V | | | | | |

DC Coil Codes 0

| DC Coil Code | Voltage |
|-----------------|---------|
| 12D | 12V |
| 24D | 24V @ |
| 110D | 110V |
| 125D | 125V |
| 220D | 220V |

Ordering Instructions

| Specify Catalog Number | |
|----------------------------|--------------------------------|
| Replace (*) with Coil Code | See Coil Codes on this page |

- The coil codes shown are for the most commonly stocked items. Contact your Sprecher + Schuh representative to determine if other voltages are on-hand or can be specially ordered in quantity.
- 2 Integrated diode surge suppressor coils available. Order coil code 24DD. For example CS8C-22Z-24D becomes CS8C-22Z-24DD. Add \$42 to list price.
- ② Contacts are bifurcated (H-bridge) with a minimum current rating of 2mA @ 15V.
- The European Community has agreed that 400V is the nominal voltage in lieu of 380V. Use this code when 380V is required.
- Use this code for 575V applications.



Auxiliary Contact Blocks (2 & 4 Pole) 68

| Auxiliary Contact Blocks | NO | NC | Contact Arrangement | Catalog Number | | Auxiliary Contact Blocks | NO | NC | Contact Arrangement | Catalog Number | | | | | |
|-----------------------------|----|----|--|-------------------|--|-----------------------------|----|---------------------------------------|---------------------------------------|-------------------|-----|---|------------------|----------|--|
| 12000 | 1 | 1 | 23 31 - \ | CA8-P11 | | 14000 | 1 | 1 | 53 61 - \ | CS8-P11E | | | | | |
| | 0 | 2 | 21 31 | CA8-P02 | 2-Pole | 0 | 2 | 51 61 | CS8-P02E | | | | | | |
| 2-Pole | 2 | 0 | 23 33 - \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ | CA8-P20 | | 2 | 0 | 53 63 -\ | CS8-P20E | | | | | | |
| Typical auxiliary | 2 | 2 | 23 53 31 41 1 1 1 1 24 54 32 42 | CA8-P22 | CA8-P31 CA8-P13 CA8-P04 See page A21 CA8-P31 CA8-P13 CA8-P04 | Tunical auviliaru | 2 | 2 | 53 83 61 71 1 1 L 54 84 62 72 | CS8-P22Z | See | | | | |
| contact block | 3 | 1 | 23 43 53 31 1 1 1 1 24 44 54 32 | CA8-P31 | | 3 | 1 | 53 73 83 61 1 1 1 1 54 74 84 62 | CS8-P31Z | A21 | | | | | |
| | 1 | 3 | 23 31 41 51 1 | CA8-P13 | | | | | A8-P13 | 2222 | 1 | 3 | 53 61 71 81 1 | CS8-P13E | |
| | 0 | 4 | 21 31 41 51 L L L L | CA8-P04 | | 2 2 2 2 - !! * | 0 | 4 | 51 61 71 81 | CS8-P04E | | | | | |
| 4-Pole | 4 | 0 | 23 33 43 53 1 1 1 1 24 34 44 54 | CA8-P40 | | 4-Pole | 4 | 0 | 53 63 73 83 1 1 1 1 54 64 74 84 | CS8-P40E | | | | | |

Miscellaneous Accessories

| Accessory | Description | Catalog Number | |
|--|--|---------------------------------|--------------------|
| | Surge Suppressor CR_8 - for limiting voltage spikes when switching off coil. Coil itself provides sufficient limitation at voltages over 240V. | | |
| 13 10 43 10 21 10 31 10 10 | RC Link (Type CRC8) for AC Control 24-48VAC 110-280VAC 380-480VAC | CRC8-50 CRC8-280 CRC8-480 | See page A22 |
| 00000 | Diode Link (Type CRD8) for DC Control ② 12-250VDC (diode) | CRD8-250 | AZZ |
| | Varistor Link (Type CRV8) for AC/DC Control 12-55VAC/12-77VDC | CRV8-55 | |
| | 56-136VAC/78-180VDC | CRV8-55 | |
| | 137-277VAC/181-250VDC | CRV8-277 | |

- Auxiliary contact ratings per UL 508/NEMA (B600/Q600). Contacts are bifurcated (H-bridge) with a minimum current rating of 15V@2mA.
- 2 CS8 relays with 24 VDC coils can be special ordered with integrated diodes (builtin) rather than applying CRD8 to the coil terminals.
- 3 Base relay with add-on auxiliaries meet mechanically linked IEC 60947-5-1 for CS8 DC coil versions only. See page G20 for additional information.



Technical Information

| iecnnicai informatio |)1 1 | | | CS8 | Auxiliary Contacts |
|---|---------------------------------------|-------------|-------------|----------------------|----------------------|
| Electrical | | | | 030 | Auxiliary Colliacis |
| Contact Ratings — NEMA | | | | B600, Q600 | B600, Q600 |
| Contact Ratings — IEC | | | | 2000, 4000 | 2000, 4000 |
| AC-15 (solenoids, contactors) | | 24120V | [A] | 3 | 3 |
| at rated voltage | | 230240V | [A] | 2 | 2 |
| IEC 947, EN 60947 | | 400V | [A] | 1.2 | 1.2 |
| NEMA B600 | | 480500V | [A] | 1 | 1 |
| | | 600690V | [A] | 0.6 | 0.6 |
| AC-12 (Rated thermal current) | | | | | |
| Ambient Temperature 40°C | I_{th} | 24690V | [A] | 10 | 10 |
| Ambient Temperature 60°C | I_{th} | 24240V | [A] | 6 | 6 |
| | | | | | |
| Low Level Signal Switching | | | | II bridge bifurested | II bridge bifurested |
| Contact design | | | | H-bridge bifurcated | H-bridge bifurcated |
| Minimum switching recommendation | | | | 15V 2mA | 15V 2mA |
| Short Circuit Protection | | | | ZIIIA | ZIIIA |
| | | | | | |
| Coordination Type 2 acc. IEC 947-5-1 | | Fuse gG | [A] | 10 | 10 |
| Switching DC-13 (Q600) | | | | | |
| 1 pole | | 24V | [A] | 2.3 | 2.3 |
| i pole | | 48V | [A] | 2.3 | 2.3 1 |
| | | 46V 110V | [A] [A] | 0.55 | 0.55 |
| | | 125V | [A] | 0.55 | 0.55 |
| | | 220V | [A] [A] | 0.33 | 0.33 |
| | | 250V | [A] | 0.27 | 0.27 |
| | | 400V | [A] | 0.27 | 0.15 |
| | | 440V | [A] | 0.15 | 0.15 |
| | | 600V | [A] [A] | 0.13 | 0.13 |
| Load Carrying Capacity acco | rding to II | | [/] | 0.1 | 0.1 |
| Rated voltage | rung to o | AC | [V] | max. 600 | max. 600 |
| nated voltage | | DC | [V] | max. 600 | max. 600 |
| Continuous rating (40°C) | | AC | [A] | 10 | 10 |
| Switching Capacity | | AC | [A] | B600 | B600 |
| ownering dapacity | | DC | [A] | Q600 | Q600 |
| Continuous rating (general pur | oose) | 300V | [V] | 5 | 5 |
| continuous rating (goneral par | | 600V | [V] | 10 | 10 |
| Resistance and Power Dissip | ation | | | | |
| Main current circuit resistand | ce, 1 pole | | $[m\Omega]$ | 6.5 | 6.5 |
| Power dissipation I_{th} , 4 poles | · · · · · · · · · · · · · · · · · · · | | [W] | 2.6 | 2.6 |
| Total Power dissipation | | | | | |
| I_{th} | AC contro | ol, warm | [W] | 4.4 | 4.4 |
| | DC contr | ol, warm | [W] | 5.2 | 5.2 |
| | | | | | |

Mechanically Linked Contacts and Mirror Contact Performance

| mediamount Emikea Contacts and mirror Contact i Cricimanoc | | | | | | |
|--|----------|--------------------------------|--------------------|--|--|--|
| Туре | Coil | Add-on Auxiliary Contact | Conforms to IEC | Status | | |
| | AC or DC | None | 60947-5-1 | Mechanically linked within the base relay | | |
| CS8 | DC | Yes | 60947-5-1 | Mechanically linked within the base relay and with add-on auxiliary contacts | | |
| AC ' | | Yes | ~ | Mechanically linked within the base relay only | | |

- Mechanically linked contacts (IEC 60947-5-1 Annex L):

- N.C. Auxiliary Contact will not re-close if a N.O. power pole welds.

 N.O. Power Pole or Auxiliary Contact will not close if N.C. contact welds.

 The term "Positive Guided" contacts is the same as mechanically linked.



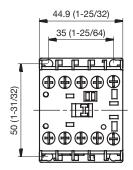
Technical Information

| Maahani | | | | | CS8 Relays | |
|--|--------------------------------|-------------------|----------------|----------------------------|---------------------------|--|
| Mechanical Mechanical | | | | [Mil. Op] | 15 | |
| Electrical Lif | | | | [min. op] | | |
| AC-15 (240V, | 2A) AC 0 | perations | | [Mil. Op] | 0.7 | |
| Weight | , | | AC control | [kg/lbs] | 0.16 (0.35) | |
| | | | DC control | [kg/lbs] | 0.2 (0.44) | |
| Terminatio Main contac | | uxiliary con | tacts | | | |
| Terminal Type | 9 | С | ombination S | crew Head: | Cross, Slotted, Pozidrive | |
| S (€ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ | Fine stranded w/ ferrule | 1 wire 2 wires | [mm²] [mm²] | | 0.752.5 0.752.5 | |
| $S \Leftrightarrow (\bigcirc)$ | Solid or coarse stranded | 1 wire 2 wires | [mm²] [mm²] | - | | |
| Max. Wire Si | ize 0 | | , | [AWG] | 1812 | |
| Tightening T | orque | | | [Nm] | 1.2 | |
| | | | | [lb-in] | 10.6 | |
| Control C | ircuit | | | | | |
| Operating Vo | oltage | | | | | |
| AC 50/60 Hz | | Pickup | | [x <i>U</i> _s] | 0.851.1 | |
| | | Dropout | | [x <i>U</i> _s] | 0.20.75 | |
| DC | | Pickup | | [x <i>U</i> _s] | 0.81.1 | |
| | | | | $[x U_s]$ | 9,12,24,110V DC: | |
| | | | | | 0.71.25 | |
| with protection | | Dropout | | [x <i>U</i> _s] | 0.10.75 | |
| Coil Consum AC 50/60 Hz | ιμιισιί | Inruoh | | Π/Α ΛΑΠ | 25/22 | |
| AC 30/60 HZ | | Inrush Seal | | [VA/W] [VA/W] | 35/32 5/1.8 | |
| DC | | Inrush/Seal | | [W] | cold 3.0, warm 2.6 | |
| Operating Ti | mes | IIII usii/ocai | | [vv] | Cold 5.0, Warm 2.0 | |
| AC- 50/60 Hz | | Pickup Time | e | [ms] | 1540 | |
| 2 23,00112 | | Dropout Tin | | [ms] | 1533 | |
| With RC mod | ule | Pickup Time | | [ms] | 1528 | |
| DC | | Pickup Time | | [ms] | 1840 | |
| | | Dropout Tin | | [ms] | 612 | |
| With Integ. di | ode | Pickup Time | 8 | [ms] | 812 | |
| With External | diodo | Pickup Time | ۵ | [ms] | 3550 | |

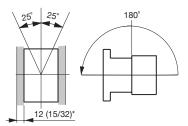
| | CS8 Relays |
|--------------------------------------|---|
| General | • |
| Rated Voltage Withstand <i>U</i> | |
| IEC | 690V |
| UL; CSA | 600V |
| Rated Impulse Strength $U_{\rm imp}$ | 6 kV |
| Rated Voltage <i>U</i> _e | |
| AC | [V] 24, 48, 120, 230, 400, 500, 600, 690 |
| DC | [V] 24, 48, 110, 220, 440V |
| Rated Frequency | AC 50/60 Hz, DC |
| Ambient Temperature | |
| Storage | -55+80°C (-67176°F) |
| Operation at nominal current | -25+60°C (-13140°F) |
| At 85% rated operation current | −25+70°C (−13 158°F) |
| Resistance to Climatic Change | 40° C (104° F), 95% relative humidity, 56 days |
| | 23° C (73.4 ° F), 83%/40 °C (104 °F), 93%, 56 cycles |
| Altitude | 2000m M.S.L., per IEC 60947-4-1 |
| Type of Protection | IP2X |
| Standards | IEC/EN 60947-1, -5-1, -5-4; UL 508; CSA 22.2. No. 14 |
| Approvals UL File E33916 | C € c û lna |

Series CS8 Industrial Control Relays

Dimensions are in millimeters (inches). Dimensions not intended for manufacturing purposes.

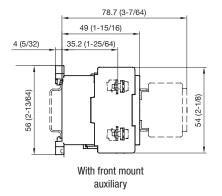


Mounting Position with Accessories



* Minimum distance to grounded parts or walls

| Contactor with | | Dim. [mm] | Dim. [inches] |
|-------------------------|----------------------|-----------|------------------|
| with aux. contact block | | 78.7 | 3.1 |
| with timer | on contactor | 81.7 | 3.25 |
| | at side of contactor | 66.9 | 2.63 |
| with neutral terminal | at side of contactor | 64.9 | 2.56 |
| with nameplate | | 51 | 2 |



RH Series Compact Power Relays

Key features

- SPDT through 4PDT, 10A contacts
- Compact power type relays
- Miniature power relays with a large capacity
- 10A contact capacity
- Compact size saves space











Part Number Selection

| | | Part I | Number | | | |
|--|---|-------------------|--------------|--|--|--|
| Contact | Model | Blade Terminal | PCB Terminal | Coil Voltage Code (Standard Stock in bold) | | |
| | Standard | RH1B-U □ | RH1V2-U □ | | | |
| SPDT | With Indicator | RH1B-UL □ | _ | AC6V, AC12V, AC24V , AC110V, AC120V , | | |
| VEND | With Check Button | RH1B-UC □ | _ | AC220V, AC240V DC6V, DC12V, DC24V, | | |
| | With Indicator and Check Button | RH1B-ULC □ | _ | DC48V, DC110V | | |
| | Top Bracket Mounting | RH1B-UT □ | _ | | | |
| ()00 | With Diode (DC coil only) | RH1B-UD □ | RH1V2-UD □ | DC6V, DC12V , DC24V , DC48V, DC110V | | |
| | With Indicator and Diode (DC coil only) | RH1B-ULD □ | _ | DC12V, DC24V, DC48V, DC110V | | |
| DPDT | Standard | RH2B-U □ | RH2V2-U □ | | | |
| DPD1 | With Indicator | RH2B-UL □ | RH2V2-UL □ | AC6V, AC12V, AC24V , AC110-120V , | | |
| | With Check Button | RH2B-UC □ | _ | AC220-240V | | |
| | With Indicator and Check Button | RH2B-ULC □ | _ | DC6V, DC12V , DC24V , DC48V, DC100-110V | | |
| | Top Bracket Mounting | RH2B-UT □ | _ | | | |
| | With Diode (DC coil only) | RH2B-UD □ | RH2V2-UD □ | DC6V, DC12V , DC24V , DC48V, DC100-110V | | |
| | With Indicator and Diode (DC coil only) | RH2B-ULD □ | RH2V2-ULD □ | DC6V, DC12V, DC24V, DC46V, DC100-110V | | |
| 3PDT | Standard | RH3B-U □ | RH3V2-U □ | | | |
| ארטו | With Indicator | RH3B-UL □ | RH3V2-UL □ | AC6V, AC12V, AC24V , AC1 QV, AC120V , | | |
| W. There are the same of the s | With Check Button | RH3B-UC □ | _ | AC220V, AC240V DC6V, DC12V, DG24V, | | |
| The Park | With Indicator and Check Button | RH3B-ULC □ | _ | DC48V, DC110V | | |
| THE STATE OF THE S | Top Bracket Mounting | RH3B-UT □ | _ | | | |
| and the same of th | With Diode (DC coil only) | RH3B-UD □ | _ | DC6V, DC12V, DC24V, DC48V, DC110V | | |
| | With Indicator and Diode (DC coil only) | RH3B-ULD □ | _ | DC0V, DC12V, DC24V, DC46V, DC110V | | |
| 4PDT | Standard | RH4B-U □ | RH4V2-U □ | | | |
| 4601 | With Indicator | RH4B-UL □ | RH4V2-UL □ | AC6V, AC12V, AC24V , AC110V, AC120V , | | |
| Value Contract | With Check Button | RH4B-UC □ | _ | AC220V, AC240V DC6V, DC12V , DC24V , DC48V, | | |
| | With Indicator and Check Button | RH4B-ULC □ | _ | DC110V | | |
| A CONTRACTOR OF THE PARTY OF TH | Top Bracket Mounting | RH4B-UT □ | _ | | | |
| Dest | With Diode (DC coil only) | RH4B-UD □ | RH4V2-UD □ | DCCV DC12V DC2AV DC40V DC410V | | |
| | With Indicator and Diode (DC coil only) | RH4B-ULD □ | _ | DC6V, DC12V, DC24V, DC48V, DC110V | | |



PCB terminal relays are designed to mount directly to a circuit board without any socket.

Ordering Information

When ordering, specify the Part No. and coil voltage code:

(example) RH3B-U

RH3B-U AC120V
Part No. Coil Voltage Code



Sockets (for Blade Terminal Models)

| Relays | Standard DIN Rail Mount 1 | Finger-safe DIN Rail Mount ¹ | Through Panel Mount | PCB Mount | |
|--------|---------------------------|---|---------------------|-----------|----|
| RH1B | SH1B-05 | SH1B-05C | SH1B-51 | SH1B-62 | |
| RH2B | SH2B-05 | SH2B-05C | SH2B-51 | SH2B-62 | ١, |
| RH3B | SH3B-05 | SH3B-05C | SH3B-51 | SH3B-62 | |
| RH4B | SH4B-05 | SH4B-05C | SH4B-51 | SH4B-62 | |
| | | 170 | Ly do | | |

Relays & Sockets

1. DIN Rail mount socket

comes with two horseshoe clips. Do not use unless you plan to insert pullover wire spring. Replacement horseshoe clip part number is Y778-011.

Hold Down Springs & Clips

| Appearance | Item | Relay | For DIN Mount Socket | For Through Panel & PCB Mount Socket | | |
|------------|--------------------------|------------------------|-------------------------|--------------------------------------|---|--|
| \wedge | | RH1B | SY2S-02F1 ² | | | |
| | Dullovar Mira Carina | RH2B | SY4S-02F1 ² | CV4C E1F1 | 4 | |
| , | Pullover Wire Spring | RH3B | SH3B-05F1 ² | SY4S-51F1 | | |
| | | RH4B | SH4B-02F1 ² | | | |
| Ales. | Leaf Spring (side latch) | RH1B, RH2B, RH3B, RH4B | SFA-202 ³ | SFA-302 ³ | | |
| - | Leaf Spring (top latch) | RH1B, RH2B, RH3B, RH4B | SFA-101 ³ | SFA-301 ³ | | |

2. Must use horseshoe clip when mounting in DIN mount socket. Replacement horseshoe clip

part number is Y778-011.

3. Two required per relay.

AC Coil Ratings

| | Rated Current (mA) ±15% at 20°C | | | | | | | | | Coil Resis | stance (Ω) | | Operation Characteristics | | | |
|---------|---------------------------------|--------------|------|------|------|---------|------|------|------|------------|------------|-------|------------------------------------|-----------------------|--------------------|--|
| Voltage | | AC 5 | 0Hz | | | AC 6 | 0Hz | | | ±10% a | at 20°C | | (against ra | rated values at 20°C) | | |
| (V) | SPDT | DPDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | Max. Continuous Applied Voltage | Pickup Voltage | Dropout Voltage | |
| 6 | 170 | 240 | 330 | 387 | 150 | 200 | 280 | 330 | 330 | 9.4 | 6.4 | 5.4 | | | | |
| 12 | 86 | 121 | 165 | 196 | 75 | 100 | 140 | 165 | 165 | 39.3 | 25.3 | 21.2 | | | | |
| 24 | 42 | 60.5 | 81 | 98 | 37 | 50 | 70 | 83 | 83 | 153 | 103 | 84.5 | | | | |
| 110 | 9.6 | _ | 18.1 | 21.6 | 8.4 | _ | 15.5 | 18.2 | 18.2 | _ | 2,200 | 1,800 | | | | |
| 110-120 | _ | 9.4- 10.8 | _ | _ | _ | 8.0-9.2 | _ | _ | _ | _ | _ | _ | 110% | 80% maximum | 30% minimum | |
| 120 | 8.6 | _ | 16.4 | 19.5 | 7.5 | _ | 14.2 | 16.5 | 16.5 | _ | 10,800 | 7,360 | | | | |
| 220 | 4.7 | _ | 8.8 | 10.7 | 4.1 | _ | 7.7 | 9.1 | 9.1 | _ | 10,800 | 7,360 | | | | |
| 220-240 | _ | 4.7-5.4 | _ | _ | _ | 4.0-4.6 | _ | | _ | 18,820 | _ | _ | | | | |
| 240 | 4.9 | _ | 8.2 | 9.8 | 4.3 | _ | 7.1 | 8.3 | 8.3 | _ | 12,100 | 9,120 | | | | |

DC Coil Ratings

| · · · · · · · · · · · · · · · · · · · | | | | | | | | | | | | | |
|---------------------------------------|---------------------------------|---------|------|-------------------------------------|--------|--------|-------|--|------------------------------------|-------------------|--------------------|--|--|
| Voltage | Rated Current (mA) ±15% at 20°C | | | Coil Resistance (Ω) ±10% at 20°C | | | | Operation Characteristics (against rated values at 20°C) | | | | | |
| (V) | SPDT | DPDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | Max. Continuous Applied Voltage | Pickup Voltage | Dropout Voltage | | |
| 6 | 128 | 150 | 240 | 250 | 47 | 40 | 25 | 24 | | | | | |
| 12 | 64 | 75 | 120 | 125 | 188 | 160 | 100 | 96 | | 80% maximum | 10% minimum | | |
| 24 | 32 | 36.9 | 60 | 62 | 750 | 650 | 400 | 388 | 1100/ | | | | |
| 48 | 18 | 18.5 | 30 | 31 | 2,660 | 2,600 | 1,600 | 1,550 | 110% | | | | |
| 100-110 | _ | 8.2-9.0 | _ | _ | _ | 12,250 | _ | _ | | | | | |
| 110 | 8 | _ | 12.8 | 15 | 13,800 | _ | 8,600 | 7,340 | | | | | |

Standard coil voltages are in **BOLD**. Signaling Lights

Contact Ratings

| | Maximum Contact Capacity | | | | | | | | | | | |
|-------|--------------------------|----------------------|----------------------|----------------|--------------|--------------|--|--|--|--|--|--|
| | Continuous | Allowable Co | ontact Power | Rated Load | | | | | | | | |
| Model | Current | Resistive Load | Inductive Load | Voltage (V) | Res. Load | Ind. Load | | | | | | |
| | | | | 110 AC | 10A | 7A | | | | | | |
| SPDT | 10A | 1540VA 300W | 990VA 210W | 220 AC | 7A | 4.5A | | | | | | |
| | | 00011 | 21011 | 30 DC | 10A | 7A | | | | | | |
| DPDT | | | | 110 AC | 10A | 7.5A | | | | | | |
| 3PDT | 10A | 1650VA 300W | 1100VA 225W | 220 AC | 7.5A | 5A | | | | | | |
| 4PDT | | 00011 | 22011 | 30 DC | 10A | 7.5A | | | | | | |
| A No | te: Inductive load | for the rated load - | — cos ø = 0.3, L/R : | = 7 ms | | | | | | | | |

Note: made no read for the n

TÜV Ratings

| • | | | | |
|---------|-----|-----|------|------|
| Voltage | RH1 | RH2 | RH3 | RH4 |
| 240V AC | 10A | 10A | 7.5A | 7.5A |
| 30V DC | 10A | 10A | 10A | 10A |

A '

AC: cos ø = 1.0, DC: L/R = 0 ms

UL Ratings

| | Resistive | | | Ge | neral Us | e | Horsepower Rating | | | |
|---------|------------|------|------|------------|----------|------|-------------------|--------|-----|--|
| Voltage | RH1 RH2 | RH3 | RH4 | RH1 RH2 | RH3 | RH4 | RH1 RH2 | RH3 | RH4 | |
| 240V AC | 10A | 7.5A | 7.5A | 7A | 6.5A | 5A | 1/3 HP | 1/3 HP | _ | |
| 120V AC | _ | 10A | 10A | _ | 7.5A | 7.5A | 1/6 HP | 1/6 HP | _ | |
| 30V DC | 10A | 10A | _ | 7A | _ | _ | _ | _ | _ | |
| 28V DC | _ | _ | 10A | _ | _ | _ | _ | _ | — | |

CSA Ratings

| Voltage Resistive | | | | | | | Horse- power Rating | | |
|-------------------|-----|-----|-----|------|------|------|---------------------------|------|-----------|
| | RH1 | RH2 | RH3 | RH4 | RH1 | RH2 | RH3 | RH4 | RH1, 2, 3 |
| 240V AC | 10A | 10A | _ | 7.5A | 7A | 7A | 7A | 5A | 1/3 HP |
| 120V AC | 10A | 10A | 10A | 10A | 7.5A | 7.5A | _ | 7.5A | 1/6 HP |
| 30V DC | 10A | 10A | 10A | 10A | 7A | 7.5A | _ | _ | _ |

Socket Specifications

| | Sockets | Terminal | Electrical Rating | Wire Size | Torque |
|-------------------------------------|--|---|-------------------|------------------------|---------------------------------------|
| DIN Rail | SH1B-05 | (Coil) M3 screws (contact) M3.5 screws with captive wire clamp | 250V, 10A | Maximum up to 2—#12AWG | 5.5 - 9 in • lbs 9 - 11.5 in • lbs |
| Mount Sockets | SH2B-05 SH3B-05 SH4B-05 | M3.5 screws with captive wire clamp | 300V, 10A | Maximum up to 2—#12AWG | 9 - 11.5 in • lbs |
| Finger-safe | SH1B-05C | (coil) M3 screws (contact) M3.5 screws with captive wire clamp, fingersafe | 250V, 10A | Maximum up to 2—#12AWG | 5.5 - 9 in • lbs 9 - 11.5 in • lbs |
| DIN Rail Mount | SH2B-05C SH3B-05C SH4B-05C | M3.5 screws with captive wire clamp, fingersafe | 300V, 10A | Maximum up to 2—#12AWG | 9 - 11.5 in • lbs |
| Through Panel Mount Socket | SH1B-51 SH2B-51 SH3B-51 SH4B-51 | Solder | 300V, 10A | _ | _ |
| | SH1B-62 | PCB mount | 250V, 10A | _ | _ |
| PCB Mount Socket | SH2B-62 SH3B-62 SH4B-62 | PCB mount | 300V, 10A | _ | _ |

Accessories

| Item | Appearance | Use with | Part No. | Remarks |
|---|--|--|----------|---|
| Aluminum DIN Rail (1 meter length) | | All DIN rail sockets | BNDN1000 | The BNDN1000 is designed to accommodate DIN mount sockets. Made of durable extruded aluminum, the BNDN1000 measures 0.413 (10.5mm) in height and 1.37 (35mm) in width (DIN standard). Standard length is 39" (1,000mm). |
| DIN Rail End Stop | A COLUMN TO A COLU | DIN rail | BNL5 | 9.1 mm wide. |
| Replacement Hold-Down Spring Anchor | | DIN mount sockets and hold down springs. | Y778-011 | For use on DIN rail mount socket when using pullover wire hold down spring. 2 pieces included with each socket. |



Switches & Pilot Lights

Specifications

| Specifications | | | | | |
|---------------------------------------|------------------------------|--|---------------------|---|--|
| Contact Material | | Silver cadmium oxide | | | |
| Contact Resistance 1 | | 50mΩ maximum | | | |
| Minimum Applicable Load | | 24V DC, 30 mA; 5V DC, 100 mA (reference value) | | | |
| Operating Time ² | SPDT DPDT | 20ms maximum | | | |
| operating fillie | 3PDT 4PDT | 25ms maximum | | | |
| Release Time ² | SPDT DPDT | 20ms maximum | | | |
| Tielease fillie | 3PDT 4PDT | 25ms maximum | | | |
| | SPDT | AC: 1.1VA (50Hz), 1VA (6 | OHz) | DC: 0.8W | |
| Power Consumption | DPDT | AC: 1.4VA (50Hz), 1.2VA | (60Hz) | DC: 0.9W | |
| (approx.) | 3PDT | AC: 2VA (50Hz), 1.7VA (6 | OHz) | DC: 1.5W | |
| | 4PDT | AC: 2.5VA (50Hz), 2VA (6 | OHz) | DC: 1.5W | |
| Insulation Resistance | | 100MΩ minimum (500V DC megger) | | | |
| | SPDT | Between live and dead p Between contact and co Between contacts of the | il: | 2,000V AC, 1 minute 2,000V AC, 1 minute 1,000V AC, 1 minute | |
| Dielectric Strength ³ | DPDT 3PDT 4PDT | Between live and dead p Between contact and co Between contacts of diff Between contacts of the | il: erent poles: | | |
| Operating Frequency | | Electrical: Mechanical: | | ations/hour maximum rations/hour maximum | |
| Vibration Resistance | | Damage limits: Operating extremes: | | amplitude 0.5 mm amplitude 0.5 mm | |
| Shock Resistance | | Damage limits: Operating extremes: | , , | (100G) OG - SPDT, DPDT) OG - 3PDT, 4PDT) | |
| Mechanical Life | | 50,000,000 operations minimum | | | |
| | DPDT | 500,000 operations minimum (120V AC, 10A) | | | |
| Electrical Life SPDT 3PDT 4PDT | | 200,000 operations minimum (120V AC, 10A) | | | |
| Operating Temperature ⁴ | SPDT DPDT 3PDT 4PDT | −25 to +70°C (no freezing) | | | |
| Operating Humidity | | 45 to 85% RH (no condensation) | | | |
| Weight (approx.) | | SPDT: 24g, DPDT: 37g, 3PDT: 50g, 4PDT: 74g | | | |
| | | | | | |

Relays & Sockets



Note: Above values are initial values.

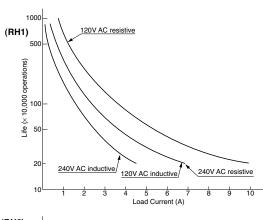
- 1. Measured using 5V DC, 1A voltage drop method
- 2. Measured at the rated voltage (at 20°C), excluding contact bouncing Release time of relays with diode: 40 ms maximum
- 3. Relays with indicator or diode: 1000V AC, 1 minute
- 4. For use under different temperature conditions, refer to Continuous Load Current vs. Operating Temperature Curve. The operating temperature range of relays with indicator or diode is -25 to +40 °C.

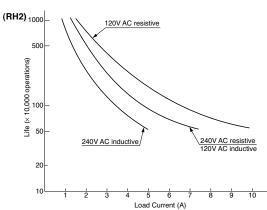
Signaling Lights

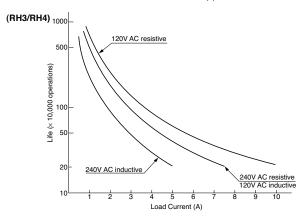
Characteristics (Reference Data)

Electrical Life Curves

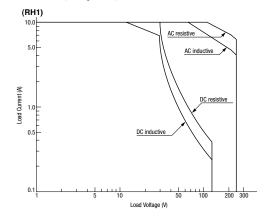




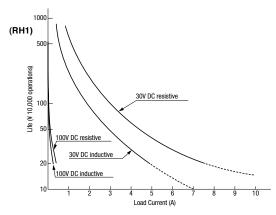


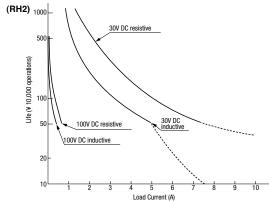


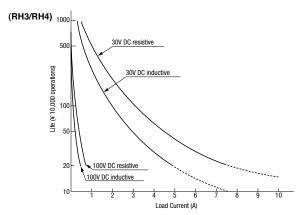
Maximum Switching Capacity

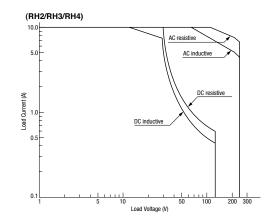




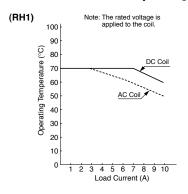


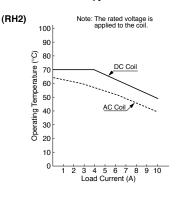


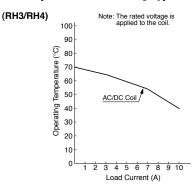




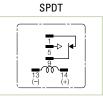
Continuous Load Current vs. Operating Temperature Curve (Basic Type, With Check Button, and Top Bracket Mounting Type)

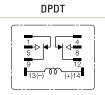


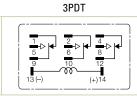


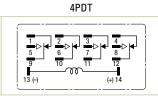


Internal Connection (View from Bottom) Basic Type







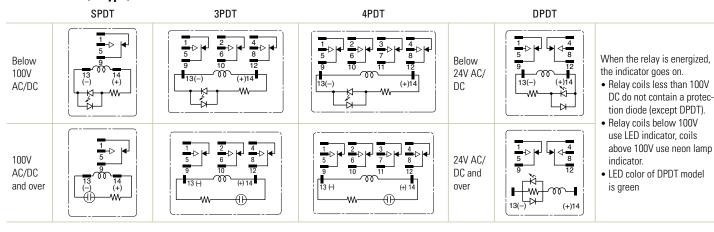


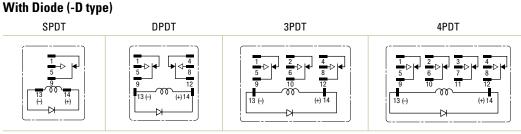
With Check Button



Contacts can be operated by pressing the check button.

With Indicator (-L type)



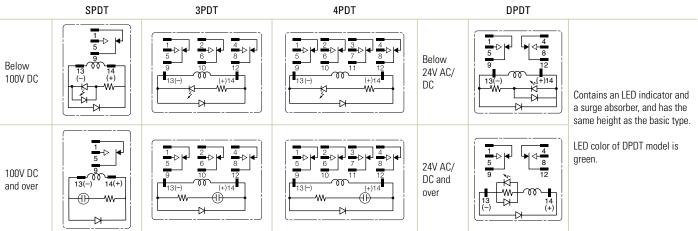


Contains a diode to absorb the back emf generated when the coil is de-energized. The release time is slightly longer. Available for DC

coil only. • Diode Characteristics Reverse withstand voltage: 1,000V Forward current: 1A

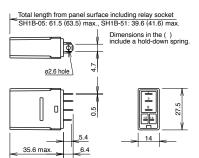
Signaling Lights

With Indicator LED & Diode (-LD type)

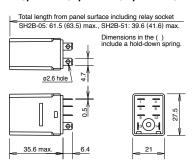


Dimensions (mm)

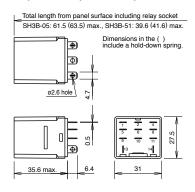
RH1B-U/RH1B-UL/RH1B-UD/RH1B-ULD



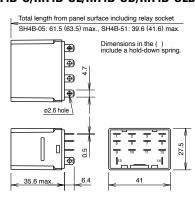
RH2B-U/RH2B-UL/RH2B-UD/RH2B-ULD



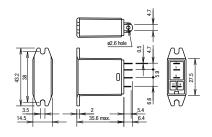
RH3B-U/RH3B-UL/RH3B-UD/RH3B-ULD



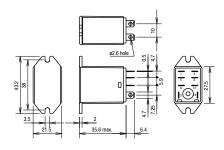
RH4B-U/RH4B-UL/RH4B-UD/RH4B-ULD



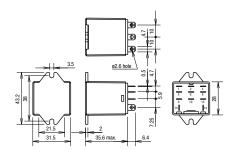
RH1B-UT



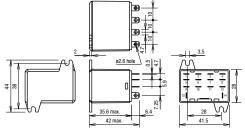
RH2B-UT



RH3B-UT

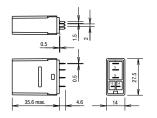


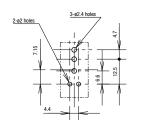
RH4B-UT



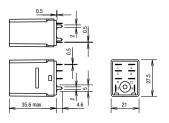
Dimensions con't (mm)

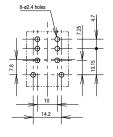
RH1V2-U/RH1V2-UD



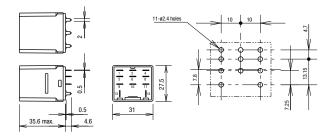


RH2V2-U/RH2V2-UL/RH2V2-UD

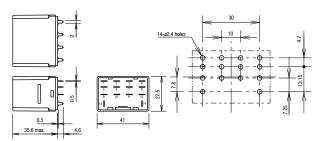




RH3V2-U/RH3V2-UL/RH3V2-D

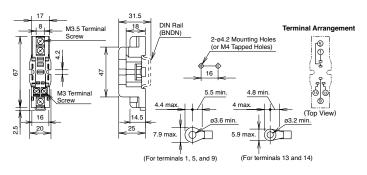


RH4V2-U/RH4V2-UL/RH4V2-UD

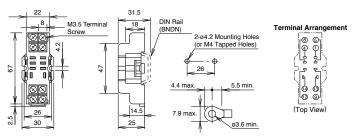


Standard DIN Rail Mount Sockets

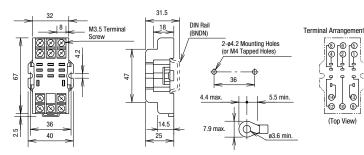
SH1B-05



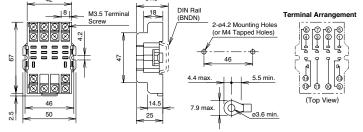
SH2B-05



SH3B-05



SH4B-05

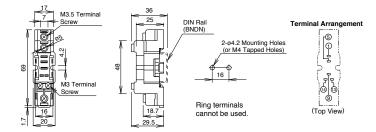


Timers

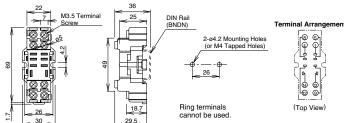
Dimensions con't (mm)

Finger-safe DIN Rail Mount Sockets

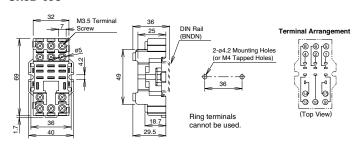
SH1B-05C



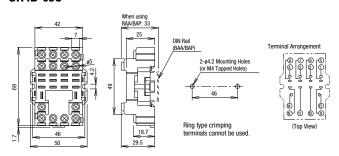
SH2B-05C



SH3B-05C

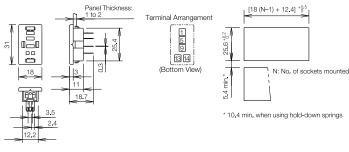


SH4B-05C

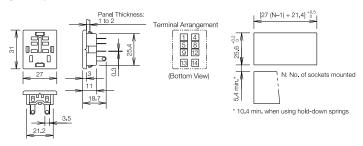


Through Panel Mount Socket

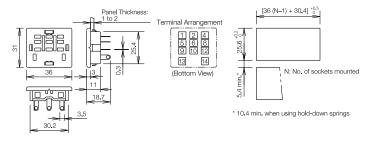
SH1B-51



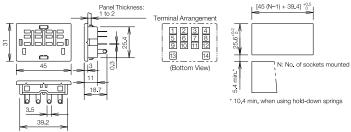
SH2B-51



SH3B-51



SH4B-51





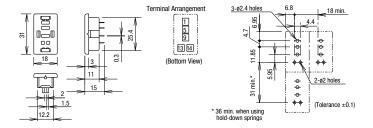
Timers

Dimensions con't (mm)

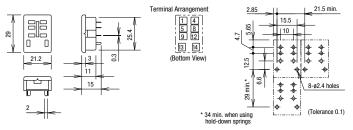
Relays & Sockets

PCB Mount Sockets

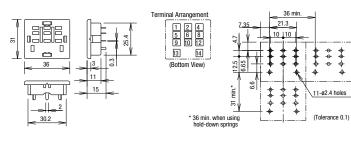
SH1B-62



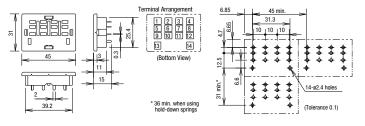
SH2B-62



SH3B-62



SH4B-62





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Pluggable device protection, according to type 3/class III, for 1-phase power supply networks with separate N and PE (3-conductor system: L1, N, PE), with integrated surge-proof fuse and remote indication contact. Also suitable for DC applications.

Your advantages

- ✓ Varistor-based device protection
- ☑ Can be used without separate backup fuse thanks to integrated overcurrent protection
- For 1-phase power supply units (AC/DC)
- ✓ Pluggable
- Optical status indicator via LED
- With floating remote indication contact
- ✓ Plugs can be checked with CHECKMASTER 2



Key Commercial Data

| Packing unit | 1 pc |
|--------------------------------------|-----------------|
| GTIN | 4 046356 939690 |
| GTIN | 4046356939690 |
| Weight per Piece (excluding packing) | 91.600 g |
| Custom tariff number | 85363030 |
| Country of origin | Germany |

Technical data

Dimensions

| Height | 90 mm |
|--------|---------------------------------|
| Width | 17.7 mm |
| Depth | 74.5 mm (incl. DIN rail 7.5 mm) |



Technical data

Dimensions

| Horizontal pitch | 1 Div. |
|------------------|--------|

Ambient conditions

| Degree of protection | IP20 |
|---|---|
| Ambient temperature (operation) | -40 °C 70 °C |
| Ambient temperature (storage/transport) | -40 °C 70 °C |
| Altitude | ≤ 2000 m (amsl (above mean sea level)) |
| Permissible humidity (operation) | 5 % 95 % |
| Shock (operation) | 30g (Half-sine / 11 ms / 3x ±X, ±Y, ±Z) |
| Vibration (operation) | 5g (10 150 Hz/20 cycles/axis/X, Y, Z) |

General

| EN type | Т3 |
|--|---|
| Number of ports | One |
| Mode of protection | L-N |
| | L-PE |
| | N-PE |
| | (L+) - (L-) |
| | (L+/L-) - PE |
| Mounting type | DIN rail: 35 mm |
| Color | light grey RAL 7035 |
| | traffic grey A RAL 7042 |
| Housing material | PA 6.6-FR 20% GF |
| | PA 6.6-FR |
| Degree of pollution | 2 |
| Flammability rating according to UL 94 | V-0 |
| Туре | DIN rail module, two-section, divisible |
| Number of positions | 2 |
| Surge protection fault message | Optical, remote indicator contact |

Protective circuit

| Nominal voltage U _N | 120 V AC (TN-S) |
|--|--------------------------------------|
| | 120 V AC (TT - only in use with RCD) |
| Nominal frequency f _N | 50 Hz (60 Hz) |
| Maximum continuous voltage U _C | 150 V AC |
| | 150 V DC |
| Rated load current I _L | 26 A (30 °C) |
| Residual current I _{PE} | ≤ 5 μA |
| Nominal discharge current I _n (8/20) µs | 3 kA |

11/04/2019 Page 2 / 9



Technical data

Protective circuit

| Standby power consumption P _C | ≤ 150 mVA (at U _{REF}) |
|--|--|
| | ≤ 175 mVA (at U _C) |
| Reference test voltage U _{REF} | 132 V AC |
| Combination wave U _{oc} | 6 kV |
| Voltage protection level U _p (L-N) | ≤ 0.85 kV |
| Voltage protection level U _p (L-PE) | ≤ 0.95 kV |
| Voltage protection level U _p (N-PE) | ≤ 0.95 kV |
| TOV behavior at U _T (L-N) | 240 V AC (5 s / withstand mode) |
| | 240 V AC (120 min / withstand mode) |
| TOV behavior at U _T (L-PE) | 240 V AC (5 s / withstand mode) |
| | 240 V AC (120 min / withstand mode) |
| | 1332 V AC (200 ms / safe failure mode) |
| TOV behavior at U _T (N-PE) | 1200 V AC (200 ms / safe failure mode) |
| Response time t _A (L-N) | ≤ 25 ns |
| Response time t _A (L-PE) | ≤ 100 ns |
| Response time t _A (N-PE) | ≤ 100 ns |
| Short-circuit current rating I _{SCCR} | 1.5 kA AC |
| | 0.25 kA DC |
| Max. backup fuse with branch wiring | not required |
| Maximum backup fuse for through wiring | 25 A (gG / B / C) |

Indicator/remote signaling

| Switching function | N/C contact |
|----------------------------------|----------------------|
| Operating voltage | 250 V AC |
| | 125 V DC (200 mA DC) |
| Operating current | 3 A AC |
| | 1 A DC (30 V DC) |
| Connection method | Screw connection |
| Conductor cross section flexible | 0.2 mm² 2.5 mm² |
| Conductor cross section solid | 0.2 mm² 4 mm² |
| Conductor cross section AWG | 24 12 |
| Screw thread | M3 |
| Tightening torque | 0.8 Nm |
| Stripping length | 8 mm |

Connection data

| Connection method | Screw connection |
|----------------------------------|------------------|
| Conductor cross section flexible | 0.2 mm² 2.5 mm² |



Technical data

Connection data

| Conductor cross section solid | 0.2 mm² 4 mm² | |
|-------------------------------|---------------|--|
| Conductor cross section AWG | 24 12 | |
| Screw thread | M3 | |
| Tightening torque | 0.8 Nm | |
| Stripping length | 8 mm | |

UL specifications

| SPD Type | 4CA | | |
|---|--------------|--|--|
| Maximum continuous operating voltage MCOV | 150 V AC | | |
| | 150 V DC | | |
| Nominal voltage | 120 V DC | | |
| Rated load current I _L | 25 A | | |
| Mode of protection | L-N | | |
| | L-G | | |
| | N-G | | |
| | (L+) - (L-) | | |
| | (L+) - G | | |
| | (L-) - G | | |
| Power distribution system | Single phase | | |
| Nominal frequency | 50/60 Hz | | |
| Measured limiting voltage MLV (L-N) | 780 V | | |
| Measured limiting voltage MLV (L-G) | 760 V | | |
| Measured limiting voltage MLV (N-G) | 760 V | | |
| Measured limiting voltage MLV (L+) - (L-) | 780 V | | |
| Measured limiting voltage MLV (L+) - G | 760 V | | |
| Measured limiting voltage MLV (L-) - G | 760 V | | |
| Nominal discharge current I _n | 3 kA | | |

UL indicator/remote signaling

| Tightening torque | 5 lb _r in 7 lb _r in. | | | |
|-----------------------------|--|--|--|--|
| Conductor cross section AWG | 14 12 | | | |

UL connection data

| Conductor cross section AWG | 14 12 | | |
|-----------------------------|--|--|--|
| Tightening torque | 5 lb _r in 7 lb _r in. | | |

Standards and Regulations

| Standards/specifications | EN 61643-11 2012 |
|--------------------------|------------------|

Environmental Product Compliance



Technical data

Environmental Product Compliance

| | Lead 7439-92-1 | | |
|------------|---|--|--|
| China RoHS | Environmentally Friendly Use Period = 50 | | |
| | For details about hazardous substances go to tab "Downloads", Category "Manufacturer's declaration" | | |

Drawings

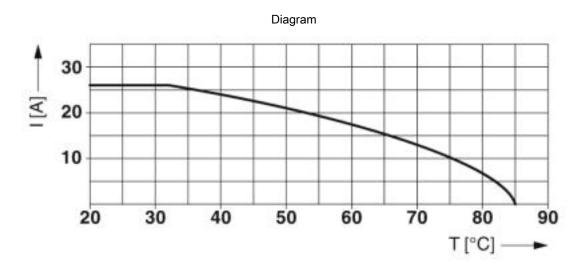
Product drawing





17,7

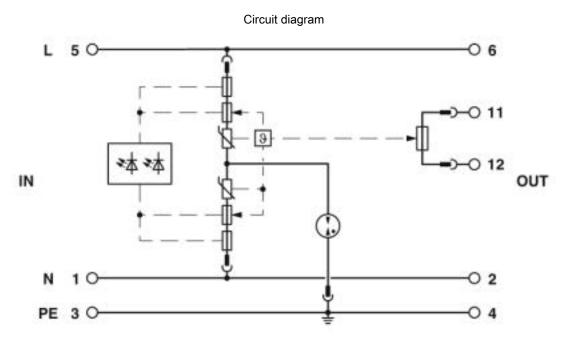
Type 3 surge protection device - PLT-SEC-T3-120-FM - 2905228



Nominal current depending on ambient temperature

Dimensional drawing





Classifications

eCl@ss

| eCl@ss 5.1 | 27130800 |
|------------|----------|
| eCl@ss 6.0 | 27130800 |
| eCl@ss 7.0 | 27130806 |
| eCl@ss 8.0 | 27130806 |
| eCl@ss 9.0 | 27130806 |

ETIM

| ETIM 5.0 | EC000942 |
|----------|----------|
| ETIM 6.0 | EC000942 |
| ETIM 7.0 | EC000942 |

UNSPSC

| UNSPSC 13.2 | 39121620 |
|-------------|----------|
|-------------|----------|

Approvals

Approvals

Approvals

CSA / GL / CCA / KEMA-KEUR / EAC



Approvals Ex Approvals cULus Recognized Approval details **(I)** CSA http://www.csagroup.org/services-industries/product-listing/ 70056020 GL https://approvalfinder.dnvgl.com/ 14588-15 HH GL CCA NTR-NL 7399 KEMA **KEMA-KEUR** 2173868.01 http://www.dekra-certification.com RU C-EHE

Accessories

EAC

Accessories

Device marking

Label - EML (20XE)R - 0803452



Label, Roll, white, unlabeled, can be labeled with: THERMOMARK ROLLMASTER 300/600, THERMOMARK X1.2, THERMOMARK ROLL X1, THERMOMARK ROLL 2.0, THERMOMARK ROLL, mounting type: adhesive, lettering field size: continuous x 20 mm

DE.A*30.B01561



Accessories

Label - EML (20XE)R YE - 0803453



Label, Roll, yellow, unlabeled, can be labeled with: THERMOMARK ROLLMASTER 300/600, THERMOMARK X1.2, THERMOMARK ROLL X1, THERMOMARK ROLL 2.0, THERMOMARK ROLL, mounting type: adhesive, lettering field size: continuous x 20 mm

End block

End clamp - CLIPFIX 35 - 3022218



Quick mounting end clamp for NS 35/7,5 DIN rail or NS 35/15 DIN rail, with marking option, width: 9.5 mm, color: gray

Marker pen

Marker pen - X-PEN 0,35 - 0811228



Marker pen without ink cartridge, for manual labeling of markers, labeling extremely wipe-proof, line thickness 0.35 mm

Spare parts

Type 3 surge protection plug - PLT-SEC-T3-120-P - 2905234



Replacement plug for type 3 device protection from the PLUGTRAB SEC T3 product range. 120 V nominal voltage.

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Switch Mode Power Supply

VK-G (15/30/60/120/240/480-W Models)

Reliable and Easy Operation-Worldwide Power Supply Resistant in tough environments Easy and fast installation

The most compact class on the market

- Universal input for worldwide applications: 100 to 240 VAC (85 to 264 VAC)
- DC input can be available: 90 to 350 VDC
- Possible for 2 phases input usage.
- Wide operation temperature range: -40 to 70 °C
- Power Boost function at 120%
- · Safety standards:

UL508/60950-1, CSA C22.2 No. 107.1/60950-1 EN50178, EN60950-1.

Lloyd's standards, EN60204-1 PELV Safety of Power Transformers: EN61558-2-16

- ANSI/ISA 12.12.01 (excluding 480-W models)
- CSA C22.2 No.213 (excluding 480-W models)
- 15-W,30-W, and 60-W models conform to **UL Class 2 output Standards**

 EMS: EN 61204-3 EMI: EN61204-3 Class B

Five years Warranty















Refer to Safety Precautions for All Power Supplies and Safety Precautions on page 17.

S8VK-G

Model Number Structure

Model Number Legend

Note: Not all combinations are possible. Refer to List of Models in Ordering Information, below.

S8VK- _______

1. Input voltage types

G: Single phase

2. Power Ratings

015: 15 W 030: 30 W 060: 60 W 120: 120 W

240: 240 W 480: 480 W 3. Output voltage

05: 5 V 12: 12 V

24: 24 V

48: 48 V

Ordering Information

Note: For details on normal stock models, contact your nearest OMRON representative.

| Power ratings | Input voltage | Output Voltage | Output current | Boost Current | Model number |
|---------------|----------------|----------------|----------------|---------------|--------------|
| | | 5 V | 3 A | 3.6 A | S8VK-G01505 |
| 15 W | | 12 V | 1.2 A | 1.44 A | S8VK-G01512 |
| | | 24 V | 0.65 A | 0.78 A | S8VK-G01524 |
| | | 5 V | 5 A | 6 A | S8VK-G03005 |
| 30 W | | 12 V | 2.5 A | 3 A | S8VK-G03012 |
| Oin-sta | Single phase | 24 V | 1.3 A | 1.56 A | S8VK-G03024 |
| 100 to 24 | 100 to 240 VAC | 12 V | 4.5 A | 5.4 A | S8VK-G06012 |
| | 90 to 350 VDC | 24 V | 2.5 A | 3 A | S8VK-G06024 |
| 120 W | | 24 V | 5 A | 6 A | S8VK-G12024 |
| 240.144 | | 24 V | 10 A | 12 A | S8VK-G24024 |
| 240 W | | 48 V | 5 A | 6 A | S8VK-G24048 |
| 100 14/ | | 24 V | 20 A | 24 A | S8VK-G48024 |
| 480 W | | 48 V | 10 A | 12 A | S8VK-G48048 |

Specifications

Ratings, Characteristics, and Functions

| Power ratings | | 15 W | | | 30 W | | | |
|---------------------|---|---------------------|---|---------------------|-------------------|----------------------|----------------------|----------|
| Item Output voltage | | | 5 V | 12 V | 24 V | 5 V | 12 V | 24 V |
| Efficiency | (Typical) | 230 VAC input | 77% | * | 80% | 79% | 82% | 86% |
| | Voltage *1 | | 100 to 240 VAC, | , 90 to 350 VDC (| allowable range | : 85 to 264 VAC) : | * 6 | |
| | Frequency *1 | | 50/60 Hz (47 to | 450 Hz) | | | | |
| | 0 | 115 VAC input | 0.32 A | 0.3 A | 0.31 A | 0.5 A | 0.57 A | 0.58 A |
| | Current (Typical) | 230 VAC input | 0.2 A | 0.21 A | 0.2 A | 0.32 A | 0.37 A | 0.36 A |
| nput | Power factor (Typical) | 230 VAC input | 0.42 | | | 0.43 | 0.42 | 0.43 |
| | Harmonic current emissions | | Conforms to EN | 61000-3-2 | | | | |
| | Leakage current | 115 VAC input | 0.14 mA | | | 0.13 mA | | |
| | (Typical) | 230 VAC input | 0.25 mA | | | 0.24 mA | | |
| | Inrush current | 115 VAC input | 16 A | | | | | |
| | (Typical) *2 | 230 VAC input | 32 A | | | | | |
| | Voltage adjustme | nt range *3 | -10% to 15% (w | rith V.ADJ) (guara | nteed) | | | |
| | Ripple *4 | at 20 MHz (Typical) | 60 mV | 50 mV | 30 mV | 30 mV | 30 mV | 30 mV |
| | Input variation inf | luence | 0.5% max. (at 85 | 5 to 264 VAC inpu | ıt, 100% load) | | | |
| 0 | Load variation Inf (Rated Input volta | | 3.0% max. (5 V) | , 2.0% max. (12 \ | /), 1.5% max. (2 | 24 V), at 0% to 100 |)% load | |
| Output | Temperature varia | ation influence | 0.05%/°C max. | | | | | |
| | Start up time | 115 VAC input | 530 ms | 520 ms | 580 ms | 550 ms | 550 ms | 600 ms |
| | (Typical) *2 | 230 VAC input | 330 ms | 400 ms | 400 ms | 430 ms | 490 ms | 480 ms |
| | Hold time | 115 VAC input | 28 ms | 29 ms | 32 ms | 33 ms | 36 ms | 23 ms |
| | (Typical) *2 | 230 VAC input | 134 ms | 138 ms | 134 ms | 177 ms | 170 ms | 154 ms |
| | Overload protection *2 | | 121% to 160% of rated load current (130% typ value) | | | | | |
| | Overvoltage protection *2 | | Yes *5 | | | | | |
| Additional unctions | Power Boost | | 120% of rated current (Refer to Engineering Data) | | | | | |
| u | Parallel operation | | Yes (Refer to Engineering Data) | | | | | |
| | Series operation | | Possible for up to two Power Supplies (with external diode) | | | | | |
| | Ambient operating | g temperature | −40 to 70°C (Refer to Engineering Data) | | | | | |
| | Storage temperate | ure | -40 to 85°C | | | | | |
| | Ambient operating | g humidity | 0% to 95% (Storage humidity: 0% to 95%) | | | | | |
| | Dielectric strengtl (detection current | | 3.0 kVAC for 1 min. (between all inputs and outputs) 2.0 kVAC for 1 min. (between all inputs and PE terminal) 1.0 kVAC for 1 min. (between all outputs and PE terminal) | | | | | |
| | Insulation resista | nce | 100 M Ω min. (between all outputs and all inputs/ PE terminals) at 500 VDC | | | | | |
| | Vibratias | | 10 to 55 Hz, 0.3 | 75-mm single am | olitude for 2 h e | ach in X, Y, and Z | directions | |
| | Vibration resistan | ce | 10 to 150 Hz, 0.3 | 35-mm single am | olitude (5 G ma | x.) for 80 min. eac | h in X, Y, and Z dir | rections |
| | Shock resistance | | 150 m/s ² , 3 time | s each in ±X, ±Y, | and ±Z direction | ins | | |
| | Output indication | | Yes (color: greei | n), lighting from 8 | 0% to 90% or m | nore of rated voltag | је | |
| | ЕМІ | Conducted Emission | Conforms to EN | 61204-3 EN5501 | 1 Class B and b | ased on FCC Clas | ss A | |
| N41 | E1VII | Radiated Emission | Conforms to EN61204-3 EN55011 Class B | | | | | |
| Others | EMS | | | 61204-3 high sev | | | | |
| | Approved Standards | | UL Listed: UL508 (Listing, Class2 Output: Per UL1310) UL UR: UL60950-1 (Recognition) cUL: CSA C22.2 No.107.1 (Class2 Output: Per CSA C22.2 No.223) cUR: CSA C22.2 No.60950-1 EN/VDE: EN50178, EN60950-1 Lloyd's standards *7 ANSI/ISA 12.12.01 CSA C22.2 No.213 | | | | | |
| | Fulfilled Standard | | SELV (EN60950-1/EN50178/UL60950-1), PELV (EN60204-1, EN50178), Safety of Power Transformers (EN61558-2-16) EN50274 for Terminal parts | | | | | |
| | Degree of protect | ion | IP20 by EN / IEC | | | | | |
| | SEMI | | | 7-0706 (200 to 24 | 0 VAC) | | | |
| | Weight | | 150 g | | | 195 g | | |

- ***1.** Do not use an inverter output for the Power Supply. Inverters with an output frequency of 50/60 Hz are available, but the rise in the internal temperature of the Power Supply may result in ignition or burning.
- *2. For a cold start at 25°C. Refer to Engineering Data on page 11 for details.
- *3. If the output voltage adjuster (V. ADJ) is turned, the voltage will increase by more than +15% of the voltage adjustment range. When adjusting the output voltage, confirm the actual output voltage from the Power Supply and be sure that the load is not damaged.
- *4. A characteristic when the ambient operating temperature is between -25 to 70°C.
- ***5.** To reset the protection, turn OFF the input power for three minutes or longer and then turn it back ON.

- *6. Safety Standards for a DC Input
 - The following safety standards apply to a DC input: UL 60950-1, cUR (CSA C22.2 No. 60950-1), EN 50178, EN 60950-1, and

For a DC input, safety is ensured by an external fuse. Select an external fuse the meets the following conditions. S8VK-G015□□: 350 VDC min, 3 A

S8VK-G030□□: 350 VDC min, 4 A

*7. Clamp filter "ZCAT2035-0930" manufactured by TDK Corporation. or equivalent should be installed in the cable connected to the input - output terminals of S8VK-G series. Noise filter "FN2080-10-06" manufactured by SCHAFFNER Corporation. or equivalent should be connected to the Input terminals of S8VK-G series.

| | | Power ratings | 60 | W | 120 W | | | |
|---------------------|--|---------------------|---|--|------------------------|--|--|--|
| Item Output voltage | | | 12 V | 24 V | 24 V | | | |
| Efficiency (| (Typical) | 230 VAC input | 85% | 88% | 89% | | | |
| _ | Voltage *1 | | 100 to 240 VAC, 90 to 350 VDC (allowable range: 85 to 264 VAC) * 6 | | | | | |
| | Frequency *1 | | 50/60 Hz (47 to 450 Hz) | | 50/60 Hz (47 to 63 Hz) | | | |
| | 115 VAC input | | 1.0 A | 1.1 A | 1.3 A | | | |
| | Current (Typical) | 230 VAC input | 0.6 A | 0.7 A | | | | |
| Input | Power factor (Typical) 230 VAC input | | 0.46 | 0.45 | 0.94 | | | |
| | Harmonic current | emissions | Conforms to EN61000-3-2 | | | | | |
| | Leakage current | 115 VAC input | 0.16 mA | 0.24 mA | | | | |
| | (Typical) | 230 VAC input | 0.30 mA 0.38 mA | | | | | |
| | Inrush current | 115 VAC input | 16 A | | | | | |
| | (Typical) *2 | 230 VAC input | 32 A | | | | | |
| | Voltage adjustmen | nt range *3 | -10% to 15% (with V.ADJ) (guarar | nteed) | | | | |
| | Ripple *4 | at 20 MHz (Typical) | 150 mV | 50 mV | 150 mV | | | |
| | Input variation inf | | 0.5% max. (at 85 to 264 VAC inpu | t, 100% load) | | | | |
| | Load variation Inf (Rated Input volta | | 2.0% max. (12 V), 1.5% max. (24 V | V), at 0% to 100% load | | | | |
| Output | Temperature varia | | 0.05%/°C max. | | | | | |
| | Start up time | 115 VAC input | 570 ms | 650 ms | 790 ms | | | |
| | (Typical) *2 | 230 VAC input | 430 ms | 500 ms | 750 ms | | | |
| | Hold time | 115 VAC input | 26 ms | 25 ms | 42 ms | | | |
| | (Typical) *2 | 230 VAC input | 139 ms | 129 ms | 42 ms | | | |
| | Overload protection *2 | | 121% to 160% of rated load currer | 121% to160% of rated load curren (125% typ value) | | | | |
| Additional | Overvoltage prote | ection *2 | Yes * 5 | | | | | |
| functions | Power Boost | | 120% of rated current (Refer to Engineering Data) | | | | | |
| | Parallel operation | | Yes (Refer to Engineering Data) | | | | | |
| | Series operation | | Possible for up to two Power Supplies (with external diode) | | | | | |
| | Ambient operating | g temperature | -40 to 70°C (Refer to Engineering | Data) | | | | |
| | Storage temperati | ure | -40 to 85°C | | | | | |
| | Ambient operating | g humidity | 0% to 95% (Storage humidity: 0% to 95%) | | | | | |
| | Dielectric strength (detection current: 20 mA) | | 3.0 kVAC for 1 min. (between all inputs and outputs) 2.0 kVAC for 1 min. (between all inputs and PE terminal) 1.0 kVAC for 1 min. (between all outputs and PE terminal) | | | | | |
| | Insulation resistar | nce | 100 MΩ min. (between all outputs and all inputs/ PE terminals) at 500 VDC | | | | | |
| | VIII | | 10 to 55 Hz, 0.375-mm single amplitude for 2 h each in X, Y, and Z directions | | | | | |
| | Vibration resistan | ce | 10 to 150 Hz, 0.35-mm single amplitude (5 G max.) for 80 min. each in X, Y, and Z directions | | | | | |
| | Shock resistance | | 150 m/s², 3 times each in ±X, ±Y, and ±Z directions | | | | | |
| | Output indication | | Yes (color: green), lighting from 80% to 90% or more of rated voltage | | | | | |
| | EMI | Conducted Emission | Conforms to EN61204-3 EN55011 | Class B and based on FCC Class | A | | | |
| | EMI | Radiated Emission | Conforms to EN61204-3 EN55011 | Class B | | | | |
| Others | EMS | | Conforms to EN61204-3 high severity levels | | | | | |
| | Approved Standards | | UL Listed: UL508 (Listing, For 60 W only Class2 Output: Per UL1310) UL UR: UL60950-1 (Recognition) cUL: CSA C22.2 No.107.1 (For 60 W only Class2 Output: Per CSA C22.2 No.223) cUR: CSA C22.2 No.60950-1 EN/VDE: EN50178, EN60950-1 Lloyd's standards *7 ANSI/ISA 12.12.01 CSA C22.2 No.213 | | | | | |
| | Fulfilled Standards | | SELV (EN60950-1/EN50178/UL60950-1), PELV(EN60204-1, EN50178), Safety of Power Transformers (EN61558-2-16) EN50274 for Terminal parts | | | | | |
| | Degree of protecti | ion | IP20 by EN / IEC60529 | | | | | |
| | SEMI | | Conforms to F47-0706 (200 to 240 VAC) | | | | | |
| | Weight | | 260 g 620 g | | | | | |

- *1. Do not use an inverter output for the Power Supply. Inverters with an output frequency of 50/60 Hz are available, but the rise in the internal temperature of the Power Supply may result in ignition or burning.
- *2. For a cold start at 25°C. Refer to Engineering Data on page 11 for details.
- *3. If the output voltage adjuster (V. ADJ) is turned, the voltage will increase by more than +15% of the voltage adjustment range. When adjusting the output voltage, confirm the actual output voltage from the Power Supply and be sure that the load is not damaged.
- ***4.** A characteristic when the ambient operating temperature is between –25 to 70°C.
- ***5.** To reset the protection, turn OFF the input power for three minutes or longer and then turn it back ON.

- *6. Safety Standards for a DC Input
 - The following safety standards apply to a DC input: UL 60950-1, cUR (CSA C22.2 No. 60950-1), EN 50178, EN 60950-1, and Lloyd's.
- For a DC input, safety is ensured by an external fuse. Select an external fuse the meets the following conditions. S8VK-G060□□: 350 VDC min, 6 A S8VK-G12024: 350 VDC min, 5 A *7. Clamp filter "ZCAT2035-0930" manufactured by TDK
- *7. Clamp filter "ZCAT2035-0930" manufactured by TDK Corporation. or equivalent should be installed in the cable connected to the input - output terminals of S8VK-G series. Noise filter "FN2080-10-06" manufactured by SCHAFFNER Corporation. or equivalent should be connected to the Input terminals of S8VK-G series.

| | | Power ratings | 24 | 0 W | 480 | W |
|--------------|---|---------------------|--|---------------------------------------|-----------------------------|--------|
| Item | | Output voltage | 24 V | 48 V | 24 V | 48 V |
| Efficiency (| (Typical) | 230 VAC input | 92% | 10 (| 93% | 10 1 |
| | Voltage *1 | | | 0 VDC (allowable range: 8 | | |
| | Frequency *1 | | 50/60 Hz (47 to 63 Hz) | o voo (anomabio iango, o | | |
| | | 115 VAC input | 2.4 A | | 4.7 A | |
| | Current (Typical) | 230 VAC input | 1.3 A 2.3 A | | | |
| | Power factor | | | | | |
| Input | (Typical) 230 VAC input | | 0.97 | | | |
| | Harmonic current | emissions | Conforms to EN61000-3-2 | 2 | | |
| | Leakage current | 115 VAC input | 0.23 mA | | 0.3 mA | |
| | (Typical) | 230 VAC input | 0.33 mA | | 0.49 mA | |
| | Inrush current | 115 VAC input | 16 A | | | |
| | (Typical) *2 230 VAC input | | 32 A | | | |
| | Voltage adjustmen | | -10% to 15% (with V.AD. | , , , | T | |
| | Ripple *4 | at 20 MHz (Typical) | 180 mV | 350 mV | 230 mV | 470 mV |
| | Input variation inf | | 0.5% max. (at 85 to 264 \ | /AC input, 100% load) | | |
| Output | Load variation Influence (Rated Input voltage) | | 1.5% max. (24 V, 48 V), a | at 0% to 100% load | | |
| Output | Temperature varia | | 0.05%/°C max. | 1 | + | |
| | Start up time | 115 VAC input | 250 ms | 290 ms | 380 ms | |
| | (Typical) *2 | 230 VAC input | 250 ms | 290 ms | 260 ms | |
| | Hold time | 115 VAC input | 44 ms | 43 ms | 40 ms | |
| | (Typical) *2 | 230 VAC input | 44 ms | | 50 ms | |
| | Overload protection *2 | | 121% to 160% of rated load current (130% typ value) | | | |
| Additional | Overvoltage protection *2 | | Yes *5 | | | |
| functions | Power Boost | | 120% of rated current (Re | | | |
| | Parallel operation | | Yes (Refer to Engineering | · · · · · · · · · · · · · · · · · · · | 1 4:- 4-) | |
| | Series operation | . tammavatuus | | wer Supplies (with externa | i diode) | |
| | Ambient operating temperature | | -40 to 70°C (Refer to Eng -40 to 85°C | gineering Data) | | |
| | Storage temperature Ambient operating humidity | | 0% to 95% (Storage hum | idity: 09/ to 059/) | | |
| | Dielectric strength (detection current: 20 mA) | | 3.0 kVAC for 1 min. (between all inputs and outputs) 2.0 kVAC for 1 min. (between all inputs and PE terminal) 1.0 kVAC for 1 min. (between all outputs and PE terminal) | | | |
| | Insulation resistance | | 100 MΩ min. (between al | l outputs and all inputs/ PE | terminals) at 500 VDC | |
| | | | 10 to 55 Hz, 0.375-mm si | ngle amplitude for 2 h eac | h in X, Y, and Z directions | |
| | Vibration resistance | | 10 to 150 Hz, 0.35-mm single amplitude (5 G max for 240 W, 3 G max for 480 W) for 80 min. each in X, Y, and Z directions | | | |
| | Shock resistance | | 150 m/s², 3 times each in ±X, ±Y, and ±Z directions | | | |
| | Output indication | | Yes (color: green), lighting from 80% to 90% or more of rated voltage | | | |
| | ЕМІ | Conducted Emission | | EN55011 Class B and bas | ed on FCC Class A | |
| Others | | Radiated Emission | Conforms to EN61204-3 I | | | |
| | EMS | | Conforms to EN61204-3 I | · , | | |
| | Approved Standards | | UL Listed: UL508 (Listing) UL UR: UL60950-1 (Recognition) cUL: CSA C22.2 No.107.1 cUR: CSA C22.2 No.60950-1 EN/VDE: EN50178, EN60950-1 Lloyd's standards *7 ANSI/ISA 12.12.01 (excluding 480-W models) CSA C22.2 No.213 (excluding 480-W models) | | | |
| | Fulfilled Standards | | SELV (EN60950-1/EN50178/UL60950-1), PELV(EN60204-1, EN50178), Safety of Power Transformers (EN61558-2-16) EN50274 for Terminal parts | | | |
| | Degree of protecti | on | IP20 by EN / IEC60529 | | | |
| | SEMI | | Conforms to F47-0706 (200 to 240 VAC) | | | |
| | Weight | | 900 g 1,500 g | | | |

- *1. Do not use an inverter output for the Power Supply. Inverters with an output frequency of 50/60 Hz are available, but the rise in the internal temperature of the Power Supply may result in ignition or burning.
- *2. For a cold start at 25°C. Refer to Engineering Data on page 11 for details.
- *3. If the output voltage adjuster (V. ADJ) is turned, the voltage will increase by more than +15% of the voltage adjustment range. When adjusting the output voltage, confirm the actual output voltage from the Power Supply and be sure that the load is not damaged.
- ***4.** A characteristic when the ambient operating temperature is between –25 to 70°C.
- ***5.** To reset the protection, turn OFF the input power for three minutes or longer and then turn it back ON.

- *6. Safety Standards for a DC Input
 - The following safety standards apply to a DC input: UL 60950-1, cUR (CSA C22.2 No. 60950-1), EN 50178, EN 60950-1, and Lloyd's.

For a DC input, safety is ensured by an external fuse. Select an external fuse the meets the following conditions. S8VK-G240 : 350 VDC min, 8 A S8VK-G480 : 350 VDC min, 12 A

***7.** Shipping Standards

Clamp filter "ZCAT2035-0930" manufactured by TDK Corporation. or equivalent should be installed in the cable connected to the input - output terminals of S8VK-G series. Noise filter "FN2080-10-06" manufactured by SCHAFFNER Corporation. or equivalent should be connected to the Input terminals of S8VK-G series.

IES-150B



Industrial 5-port mini type unmanaged Ethernet switch with 5x10/100Base-T(X)

Features

- Supports 5 ports 10/100 Base-T(X)
- Supports auto-negotiation and auto-MDI/MDI-X
- Supports store-and-forward transmission
- Supports flow control
- Compact size for easily installation
- Rigid IP-30 housing design
- DIN-Rail and wall mounting enabled















Introduction

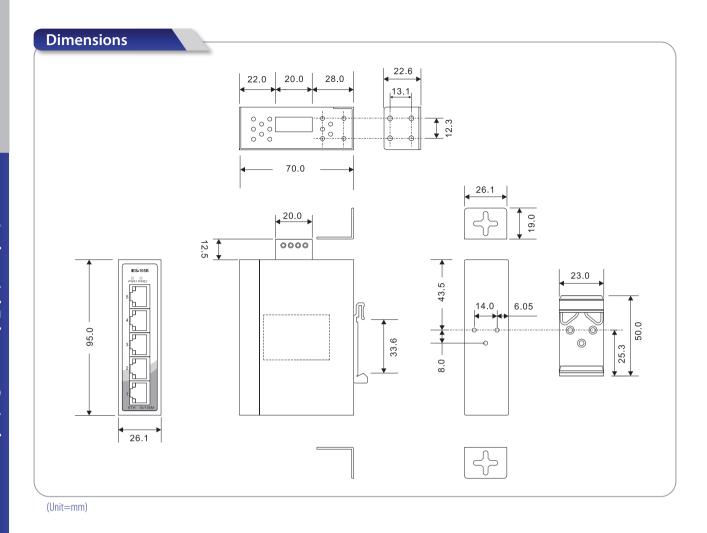
IES-150B is an unmanaged Ethernet switch with 5x10/100Base-T(X) ports. With very mini size of housing, you can install IES-150B easily. In addition, IES-150B is with rigid IP-30 housing design and can operate under harsh environment. The extended operating temperature range from -40 to 70°C is ready and can satisfy most requirement of operation.

Practical Operation

IES-150B can be used in connecting several Ethernet devices like Ethernet I/O, IP-Camera or other Ethernet switches. In addition, its mini size enables easily installation and minimize space requirement.



Connections of Ethernet devices



Specifications

| ORing Switch Model | IES-150B |
|---|---|
| Physical Ports | |
| 10/100Base-T(X) Ports in RJ45 Auto MDI/MDIX | 5 |
| Technology | |
| Ethernet Standards | IEEE 802.3 for 10Base-T IEEE 802.3u for 100Base-TX IEEE 802.3x for Flow control |
| MAC Table | 2048 MAC addresses |
| Processing | Store-and-Forward |
| LED Indicators | |
| Power indicator | Green: Power LED x 2 |
| 10/100Base-T(X) RJ45 port Indicator | Green for port Link/Act. Amber for Duplex/Collision |
| Power | |
| Input Power | Dual 12~48 VDC power input on 4-pin terminal block |
| Power Consumption (Typ.) | 3 Watts |
| Overload Current Protection | Present |

| Reverse Polarity Protection | Present |
|-----------------------------|--|
| Physical Characteristics | |
| Enclosure | IP-30 |
| Dimensions (W x D x H) | 26.1 (W) x 70 (D) x 95 (H)mm (1.03 x 2.76 x 3.74 inch) |
| Weight (g) | 205 g |
| Environmental | |
| Storage Temperature | -40 to 85°C (-40 to 185°F) |
| Operating Temperature | -40 to 70°C (-40 to 158°F) |
| Operating Humidity | 5% to 95% Non-condensing |
| Regulatory Approvals | |
| EMI | FCC Part 15, CISPR (EN55022) class A |
| EMS | EN61000-4-2 (ESD), EN61000-4-3 (RS), EN61000-4-4 (EFT), EN61000-4-5 (Surge), EN61000-4-6 (CS), EN61000-4-8, EN61000-4-11 |
| Shock | IEC60068-2-27 |
| Free Fall | IEC60068-2-32 |
| Vibration | IEC60068-2-6 |
| Safety | EN60950-1 |
| Warranty | 5 years |

Ordering Information

IES-1 ABB

| Code efinition | 10/100Base-T(X) Port Number | Additional Port Number | |
|----------------|-----------------------------|------------------------|--|
| Option | - 5: 5 ports | - 0: 0 port | |

| Available | Model Name | Descripn |
|--|------------|---|
| Model | IES-150B | Industrial 5-port mini type unmanaged Ethernet switch with 5x10/100Base-T(X) |
| Packing List • IES-150B • DIN-Rail Kit • Wall-mount Kit • Quick Installation Guide | | Optional Accessories (Can be purchased separately) • DR-45 series, 45W DIN-Rail power supply • DR-75 series, 75W DIN-Rail power supply • DR-120 series, 120W DIN-Rail power supply • PAA-121000, 12VDC/1000mA 12W Power Adapter with universal 100 to 240VAC input, US plug • PAE-121000, 12VDC/1000mA 12W Power Adapter with universal 100 to 240VAC input, EU plug • SDR-240-48, 240W DIN-Rail power supply • SDR-480-48, 480W DIN-Rail power supply |



876 And 877 Grille Type Adaptahorn Installation Sheet

Description

The 876 and 877 series are UL listed, FM approved, vibrating horns in a NEMA Type 4X, 12, 12K rated enclosure. They are low current, high decibel horns designed for heavy-duty use either indoors or outdoors. The die-cast weatherproof box has a durable, corrosion resistant, electrostatic heat flowed powder epoxy gray finish. The horns are intended for general signaling applications.

PLC Compatibility

The electrical input load requirements for PLC compatible signaling devices are listed in Table 1. Signaling devices may be directly connected to output cards that meet these load requirements.

24V DC electromechanical horns such as the 877-G1 can produce transient spikes and should only be used on PLC output cards that have inherent transient spike suppression. The Process Control Engineer should consult the PLC manufacturer when connecting 24V DC electromechanical devices to PLCs.

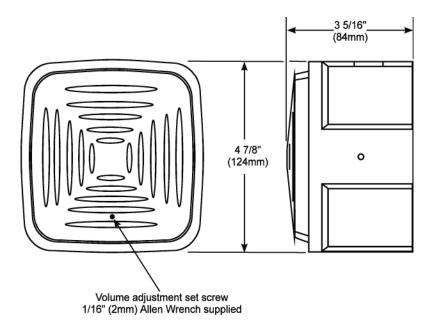
Installation

 Using a 5/64" allen wrench (supplied), loosen both set screws (located on either side of backbox) and remove horn from backbox.

- 2. Fasten backbox to wall or partition as follows:
 - a. Remove the screw hole knockouts in the backbox.
 - b. Insert caplugs (supplied) in screw holes in backbox.
 - c. Drive #8 wood screws (supplied) through caplugs into mounting surface.
 - d. Secure conduit at entrance hole.
- Ground the unit using the terminal screw in the box or by other appropriate means.
- Connect one wire to each terminal in backbox.
- 5. Orient the horn so that the "E" is at the top and plug horn on backbox. Tighten set screws.
- 6. The volume is factory set at the maximum level. To reduce volume level, turn set screw (located on grille front) clockwise using a 1/16" allen wrench (supplied).

Table 1: PLC Compatibility

| Catalog number | 876-N5 | 877-G1 |
|-----------------------------------|--------------------|-------------------|
| Operating voltage | 120 VAC | 24 VDC |
| Maximum off state leakage current | 25 mA | 25 mA |
| Continuous on current | 125 mA | 160 mA |
| Surge (inrush/duration) | 1.02 A/0.000026 ms | 1.7 A/0.000042 ms |



Specifications

| | Voltage | Current | |
|--------|---------|---------|--|
| 876-E5 | 12 VAC | 1.25 A | |
| 876-G5 | 24 VAC | 0.63 A | |
| 876-N5 | 120 VAC | 0.13 A | |
| 876-R5 | 240 VAC | 0.07 A | |
| 877-E1 | 12 VDC | 0.27 A | |
| 877-G1 | 24 VDC | 0.16 A | |
| 877-J1 | 32 VDC | 0.13 A | |
| 877-K1 | 48 VDC | 0.07 A | |
| 877-P1 | 125 VDC | 0.025 A | |

Regulatory information

| Manufacturer | Edwards, A Division of UTC Fire & Security Americas Corporation, Inc. 8985 Town Center Parkway, Bradenton, FL 34202, USA |
|--------------------------|---|
| Year of manufacture | The first two digits of the date code (located on the product identification label) are the year of manufacture. |
| North American standards | Meets: UL 464 |

Contact information

For contact information, see www.edwardssignaling.com.



PASS & SEYMOUR®

radiant® Specification Grade Self-Test GFCIs 15 & 20A, 125VAC



Reinventing Safety All Around

1597, 2097, 1597TR, 2097TR, 1597TRWR, 2097TRWR

The radiant® Self-Test GFCI receptacle with SafeLock® Protection conducts an automatic test every three seconds, ensuring it's always ready to protect. If the device fails the test, the indicator light flashes to signal that the GFCI should be replaced. It also has our proven SafeLock Protection feature: if critical components are damaged and protection is lost, power to the receptacle is disconnected.

Features & Benefits

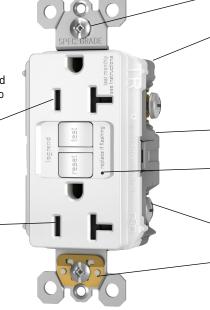
New external back wire pressure plates with posted terminal screws for faster installation.

Patented SafeLock® Protection:

if critical components are damaged and ground fault protection is lost, power to the receptacle is disconnected.

Enhanced tamper-resistant automatic shutter system allows for easier plug insertion while preventing young children from inserting common household objects.

Now with black "invisi-shutters" for an invisible effect preferred by end users



2097TRW

Captive screws make for easier installation.

Ground terminal clamp allows for fast installation.

Prevents line-load reversal miswire:

No power to the face or downstream receptacles if wired incorrectly.

High-impact-resistant, thermoplastic construction for superior strength and durability.

The indicator light flashes if the device fails the self-test, signalling that the GFCI should be replaced.

Redesigned side wire cavity improves speed of side wire installation.

Auto-ground clip assures a positive ground to metal box.

Meets latest UL Requirements



3rd Party Compliance



cULus Listed File Number E42190, Standard UL498 Attachment Plugs and Receptacles, UL943 GFCIs. Federal Specification WC596, Hospital Grade. Standard CSA C22.2 No. 42 General Use Receptacles, CSA C22.2 No. 144 GFCIs. Conforms to NEMA WD-1 and WD-6. RoHS compliant.



Technical Information

Performance

| 1 Ollotimanoo | |
|------------------------------|---|
| Electrical | |
| Dielectric Withstand Voltage | Withstands 1500V minimum |
| Trip Level | 4 to 6 mA |
| Trip Time | .025 Second Nominal |
| Frequency | 60 Hz |
| Maximum Working Voltage | 125VAC |
| Voltage Range | 102-132VAC |
| Mechanical | |
| Terminal Identification | Terminals identified in accordance with UL498 (Hot, White, Green) |
| Terminal Accommodation | #14 AWG – #10 AWG solid or stranded copper conductor only |
| Product Identification | Ratings are a permanent part of device |
| Environmental | |
| Operating Temperature | -35°C to +66°C |
| Maximum Humidity | 95% |
| Flammability | UL94 V2 |
| Certification | RoHS Compliant |
| | |



Dimensions for 15 & 20 Amp

Material Specs

| Face | Nylon | | |
|---------------------------|-----------------------------|--|--|
| Body | Nylon | | |
| Contacts | .03" Brass (.8) | | |
| Mounting Strap | Galvanized Steel | | |
| Terminal Screws | Nickel-Plated Steel #8 - 32 | | |
| Hex Head Grounding Screw | Steel (Green) | | |
| Flat Head Mounting Screws | Zinc-Plated Steel | | |
| Test/Reset Buttons | Nylon | | |
| Auto-Ground Clip | Brass Alloy | | |
| Tamper-Resistant Shutter* | Thermoplastic | | |

^{*}For 1597TR, 1597TRWR, 2097TR and 2097TRWR

Warranty

1 year



Ordering Information

| Catalog Number | Description | Ratings | Colors | NEMA Config |
|----------------|--|----------|----------------------------|----------------|
| 1597TR* | radiant®/Spec Grade Tamper-Resistant 15 Amp Duplex GFCI | 15A 125V | I, W, -, BK, LA, NI, DB, G | 5-15R |
| 1597* | radiant®/Spec Grade 15 Amp Duplex GFCI | 15A 125V | I, W, –, GRY, BK, RED, LA | 5-15R |
| 1597TRWR* | radiant®/Spec Grade Weather-Resistant 15 Amp Duplex GFCI | 15A 125V | I, W, –, GRY, BK, LA | 5-15R |
| 2097TR* | Spec Grade Tamper-Resistant 20 Amp Duplex GFCI | 20A 125V | I, W, –, GRY, BK, RED, LA | 5-20R |
| 2097* | Spec Grade 20 Amp Duplex GFCI | 20A 125V | I, W, –, GRY, BK, RED, LA | 5-20R |
| 2097TRWR* | radiant®/Spec Grade Weather-Resistant 20 Amp Duplex GFCI | 20A 125V | I, W, –, GRY, BK, LA | 5-20R |

^{*}For 1597TR, 1597TRWR, 2097TR and 2097TRWR





*Color Designation

Bronze

 I
 Ivory
 Brown
 BK
 Black
 LA
 Light Almond

 W
 White
 GRY
 Gray
 RED
 Red
 NI
 NIckel

 DB
 Dark
 G
 Graphite

For more information on these and other Legrand products refer to our web site.



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- IEC 309 Industrial Products
- Flexcor® Wire Mesh Grips
- Night Lights



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.5 IN FSE 1-GANG WP BOX - NEW STYLE

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General Information

| Extended Product Type | E980DFN |
|-----------------------|---|
| Product ID | 7TAA232420R0004 |
| EAN | 0034481048923 |
| Catalog Description | .5 IN FSE 1-GANG WP BOX - NEW STYLE |
| Long Description | Single Gang FS Box, Volume 18 Cubic Inches, Length 4.54 Inches, Width 2.80 Inches, Depth 2.30 Inches, Conduit Size 1/2 Inch, Material PVC, Color Gray |

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Ordering

| EAN | 0034481048923 |
|-----------------------|---------------|
| Customs Tariff Number | 3926909990 |

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Dimensions

| Product Net Weight | .39 lb |
|--------------------|-----------|
| | 176.871 g |

Container Information

| Package Level 2 Units | 10 piece |
|--------------------------------|-------------------|
| Package Level 2 Width | 7.6 in 193 mm |
| Package Level 2 Height | 5.8 in 147 mm |
| Package Level 2 Depth / Length | 11.4 in 290 mm |

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Additional Information

| Application | For dead-end terminations. |
|---------------------|---|
| Brand / Label | Carlon |
| Color | Gray |
| Material | PVC |
| Number of Batteries | 0 |
| Product Name | PLASTIC ELEC BOX W/O CONDUCTOR |
| Product Type | Rigid Non-Metallic FS & FD Boxes & Covers |
| Size | 4.54 Inches x 2.80 Inches x 2.30 Inches |

E980DFN 2

| Special Functions | All sizes take standard covers and accessories or devices. |
|-------------------|--|
| Standards | UL E11461 |
| UPC | 034481048923 |
| Volume | 18 in ³ |

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Certificates and Declarations (Document Number)

| Data Sheet, Technical Information | E980DFN |
|-----------------------------------|---------|
| Instructions and Manuals | E980DFN |

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Classifications

| ETIM 6 | EC002600 - Box/housing for surface mounting on the wall/ceiling |
|------------------------------------|---|
| ETIM 7 | EC002600 - Box/housing for surface mounting on the wall/ceiling |
| UNSPSC | 39121332 |
| WEEE Category | Product Not in WEEE Scope |
| IDEA Granular Category Code (IGCC) | 4486 >> Electrical junction box |

Categories

 $Low\ Voltage\ Products\ and\ Systems\ \rightarrow\ Installation\ Products\ \rightarrow\ Wire\ Management\ and\ Connectivity\ \rightarrow\ Commercial\ Fittings$



MPDB Series Open-Style Power Distribution Blocks

The Next Generation Power Distribution Block (PDB)

Mersen power distribution blocks provide a safe and easy method of splicing cables, splitting primary power into secondary circuits and fulfilling requirements for fixed junction tap-off points. All blocks are UL and CSA approved while meeting spacing requirements for feeder and branch circuits in conjunction with UL508A and the National Electrical Code®. PDB options include single or dual conductor primary inputs and up to 30 secondary outputs. Specialty blocks are available allowing for up to 7 primary inputs. The MPDB series is offered in three size categories: miniature (MPDB62 and MPDB63 series), intermediate (MPDB66 and MPDB67 series), and large (MPDB68 and MPDB69 series), in both aluminum and copper.

Features/Benefits:

Adder Poles

All sizes have optional adder poles for increased flexibility and ease-of-use. Adder poles can be stacked to form multi-pole units in the field without the use of tools. Adder poles allow for customization of primary and secondary wire combinations. End barriers are also available for sale, catalog numbers can be found in the catalog number selection tables for each size block.

• Wire Connectors

Standard aluminum and copper wire connectors are available. Aluminum connectors accept both AL or CU wire while copper connectors accept CU wire only. Connectors are all 1-piece tin-plated.

Insulators

Insulators are virtually unbreakable, made of glass-filled polycarbonate. "Seethrough," hinged safety covers are optional and provide a greater degree of safety and shock resistance where required. Hinged covers can be installed without tools.

1 inch through air and 2 inches over surface between uninsulated live parts of opposite polarity meets requirements for feeder and branch circuit applications of UL508A.

Safety Covers

Polycarbonate safety covers provide dead-front protection. One cover is needed for each pole. Each cover has a test probe hole in the center for circuit checking. Covers are optional accessories and catalog numbers can be found in the catalog selection tables for each size block.

Additional Specifications:

Wire Type: Copper Blocks: 60/75°C Solid/Stranded CU

Aluminum Blocks: 60/75/90°C Solid/Stranded AL and CU

Connector: Copper Blocks: Highly conductive tin-plated copper

Aluminum Blocks: Highly conductive tin-plated aluminum

Insulating Material: Glass-filled polycarbonate with verified dielectric strength

in excess of 2500V

Flammability: UL94-V0

Mounting: Direct panel mount

Environmental: RoHS compliant, Lead Free



Ratings:

: 600VAC/DC Volts Amps : 65 to 2260A

> based on NEC table 310.15(B)(16) 75°C ampacities

SCCR: 100kA with properly

sized fuse

(See Mersen's PDB SCCR guide at ep-us.mersen.com or contact Mersen technical services)

Approvals:

- UL Listed to subject 1953, File E352417
- CSA Certified Class 6228 01





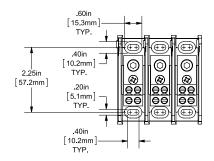


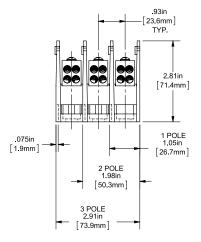


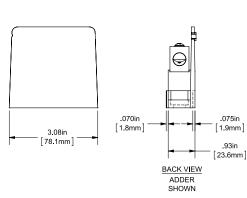
MPDB Series Open-Style Power Distribution Blocks

Dimensions

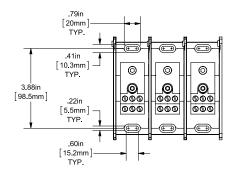
Miniature (MPDB63133 shown for reference)

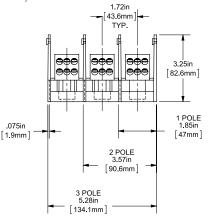


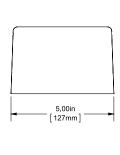


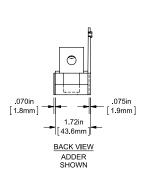


Intermediate (MPDB67563 shown for reference)

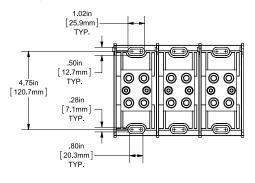


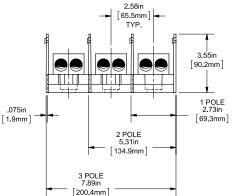


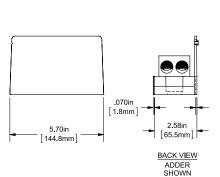




Large (MPDB69123 shown for reference)









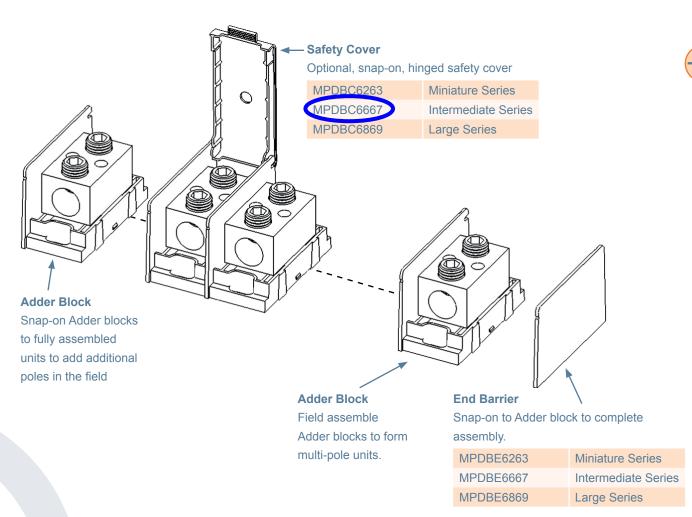
MPDB62 and MPDB63 Open-Style PDBs

Catalog Numbers (Miniature)

| Li | ne | Loa | id | Ca | atalog Numbe | ers - Aluminı | ım | (| atalog Num | bers - Coppe | r | Amp Rating | | | | | | | |
|--------------|------------------|--------------|------------------|-----------|--------------|---------------|-----------|-----------|------------|--------------|-----------|------------|-----|----|--------|----------|--|-----|------|
| Open- | | Wire | Wire | Wire | Wire | Wire | Wire | l Wire | Open- | | Number | of Poles | | | Number | of Poles | | per | Pole |
| Range | ings per Pole | Range | ings per Pole | ADDER | 1-P | 2-P | 3-P | ADDER | 1-P | 2-P | 3-P | Al | Cu | | | | | | |
| Box-Bo | x Configu | ration | | | | | | | | | | | | | | | | | |
| 4 44 | 4 | 4 44 | 1 | MPDB63100 | MPDB63101 | MPDB63102 | MPDB63103 | MPDB62100 | MPDB62101 | MPDB62102 | MPDB62103 | 05 | 0.5 | | | | | | |
| 4 - 14 | 1 4 - 14 | 4 - 14 | 1 4-14 | 4 | MPDB63160 | MPDB63161 | MPDB63162 | MPDB63163 | MPDB62160 | MPDB62161 | MPDB62162 | MPDB62163 | 65 | 85 | | | | | |
| | | 2/0 - 14 | 1 | MPDB63150 | MPDB63151 | MPDB63152 | MPDB63153 | MPDB62150 | MPDB62151 | MPDB62152 | MPDB62153 | | | | | | | | |
| 2/0 - 14 | 1 | 2 - 14 | 2 | MPDB63190 | MPDB63191 | MPDB63192 | MPDB63193 | MPDB62190 | MPDB62191 | MPDB62192 | MPDB62193 | 135 | 175 | | | | | | |
| | | 4 - 14 | 4 | MPDB63130 | MPDB63131 | MPDB63132 | MPDB63133 | MPDB62130 | MPDB62131 | MPDB62132 | MPDB62133 | | | | | | | | |
| Box-St | ud Configเ | ıration | | | | | | | | | | | | | | | | | |
| 2/0 - 14 | 1 | 1/4-20 x 5/8 | 1 | MPDB63140 | MPDB63141 | MPDB63142 | MPDB63143 | - | - | - | - | 135 | 175 | | | | | | |
| Stud-St | tud Config | uration | | | | | | | | | | | | | | | | | |
| 1/4-20 x 5/8 | 1 | 1/4-20 x 5/8 | 1 | - | - | - | - | MPDB62200 | MPDB62201 | MPDB62202 | MPDB62203 | 240 | 240 | | | | | | |

Hinged Safety Cover for MPDB62 and MPDB63 series: Catalog number **MPDBC6263** End Barrier for MPDB62 and MPDB63 series: Catalog Number **MPDBE6263**

Adder Pole Installation Instructions







Catalog Numbers (Intermediate)

| Li | ne | Loa | ıd | Ca | talog Numb | ers - Alumin | um | C | atalog Num | bers - Coppe | er | Amp I | Rating | |
|-----------------|------------------|-----------------|------------------|-----------|------------|--------------|-----------|-----------|------------|--------------|-----------|-----------|--------|--|
| Wire | Open- | Wire | Open- | | Number | of Poles | | | Number | of Poles | | per | Pole | |
| Range | ings per Pole | Range | ings per Pole | ADDER | 1-P | 2-P | 3-P | ADDER | 1-P | 2-P | 3-P | Al | Cu | |
| Box-Bo | ox Configu | ration | | | | • | | | | | • | | | |
| | | 2/0 - 14 | 1 | MPDB67050 | MPDB67051 | MPDB67052 | MPDB67053 | MPDB66050 | MPDB66051 | MPDB66052 | MPDB66053 | | | |
| | | 2 - 14 | 4 | MPDB67570 | MPDB67571 | MPDB67572 | MPDB67573 | MPDB66570 | MPDB66571 | MPDB66572 | MPDB66573 | | | |
| 0/0 44 | 4 | 2 - 14 | 6 | MPDB67560 | MPDB67561 | MPDB67562 | MPDB67563 | MPDB66560 | MPDB66561 | MPDB66562 | MPDB66563 | 125 | 475 | |
| 2/0 - 14 | 1 | 2 - 14 | 8 | MPDB67580 | MPDB67581 | MPDB67582 | MPDB67583 | MPDB66580 | MPDB66581 | MPDB66582 | MPDB66583 | 135 | 175 | |
| | | 6 - 14 | 10 | MPDB67590 | MPDB67591 | MPDB67592 | MPDB67593 | MPDB66590 | MPDB66591 | MPDB66592 | MPDB66593 | | | |
| | | 10 - 14 | 12 | MPDB67110 | MPDB67111 | MPDB67112 | MPDB67113 | MPDB66110 | MPDB66111 | MPDB66112 | MPDB66113 | | | |
| | | 350 - 6 | 1 | MPDB67000 | MPDB67001 | MPDB67002 | MPDB67003 | MPDB66000 | MPDB66001 | MPDB66002 | MPDB66003 | | | |
| | | 2/0 - 14 | 2 | MPDB67010 | MPDB67011 | MPDB67012 | MPDB67013 | MPDB66010 | MPDB66011 | MPDB66012 | MPDB66013 | | | |
| | 1 | 2 - 14 | 4 | MPDB67670 | MPDB67671 | MPDB67672 | MPDB67673 | MPDB66670 | MPDB66671 | MPDB66672 | MPDB66673 | | | |
| 350 - 6 | | 2 - 14 | 6 | MPDB67660 | MPDB67661 | MPDB67662 | MPDB67663 | MPDB66660 | MPDB66661 | MPDB66662 | MPDB66663 | 250 | 310 | |
| | | | 2 - 14 | 8 | MPDB67630 | MPDB67631 | MPDB67632 | MPDB67633 | MPDB66630 | MPDB66631 | MPDB66632 | MPDB66633 | | |
| | | 6 - 14 | 10 | MPDB67650 | MPDB67651 | MPDB67652 | MPDB67653 | MPDB66650 | MPDB66651 | MPDB66652 | MPDB66653 | | | |
| | | 10 - 14 | 15 | MPDB67620 | MPDB67621 | MPDB67622 | MPDB67623 | MPDB66620 | MPDB66621 | MPDB66622 | MPDB66623 | | | |
| | | 500 - 4 | 1 | MPDB67400 | MPDB67401 | MPDB67402 | MPDB67403 | MPDB66400 | MPDB66401 | MPDB66402 | MPDB66403 | | | |
| | | 350-6 & 2-14 | 1 & 3 | MPDB67450 | MPDB67451 | MPDB67452 | MPDB67453 | MPDB66450 | MPDB66451 | MPDB66452 | MPDB66453 | | | |
| | | 4/0 - 10 | 2 | MPDB67420 | MPDB67421 | MPDB67422 | MPDB67423 | - | - | - | - | | 380 | |
| E00 4 | 1 | 2/0 - 14 | 4 | MPDB67410 | MPDB67411 | MPDB67412 | MPDB67413 | MPDB66410 | MPDB66411 | MPDB66412 | MPDB66413 | 210 | | |
| 500 - 4 | ' | 2 - 14 | 6 | MPDB67460 | MPDB67461 | MPDB67462 | MPDB67463 | MPDB66460 | MPDB66461 | MPDB66462 | MPDB66463 | 310 | | |
| | | 2 - 14 | 8 | MPDB67430 | MPDB67431 | MPDB67432 | MPDB67433 | - | - | - | - | | | |
| | | 6 - 14 | 10 | MPDB67480 | MPDB67481 | MPDB67482 | MPDB67483 | - | - | - | - | | | |
| | | 10-14 | 18 | MPDB67490 | MPDB67491 | MPDB67492 | MPDB67493 | MPDB66490 | MPDB66491 | MPDB66492 | MPDB66493 | | | |
| | | 2/0 - 14 | 2 | MPDB67020 | MPDB67021 | MPDB67022 | MPDB67023 | MPDB66020 | MPDB66021 | MPDB66022 | MPDB66023 | | | |
| | | 2 - 14 | 6 | MPDB67510 | MPDB67511 | MPDB67512 | MPDB67513 | MPDB66510 | MPDB66511 | MPDB66512 | MPDB66513 | | | |
| 2/0 - 14 | 2 | 2 - 14 | 8 | MPDB67610 | MPDB67611 | MPDB67612 | MPDB67613 | MPDB66610 | MPDB66611 | MPDB66612 | MPDB66613 | 270 | 350 | |
| | | 6 - 14 | 10 | MPDB67530 | MPDB67531 | MPDB67532 | MPDB67533 | MPDB66530 | MPDB66531 | MPDB66532 | MPDB66533 | | | |
| | | 10 - 14 | 15 | MPDB67550 | MPDB67551 | MPDB67552 | MPDB67553 | MPDB66550 | MPDB66551 | MPDB66552 | MPDB66553 | | | |
| 4/0 0 | 2 | 4/0 - 10 | 2 | MPDB67520 | MPDB67521 | MPDB67522 | MPDB67523 | MPDB66520 | MPDB66521 | MPDB66522 | MPDB66523 | 200 | 400 | |
| 4/0 - 6 | 2 | 2 - 14 | 6 | MPDB67540 | MPDB67541 | MPDB67542 | MPDB67543 | MPDB66540 | MPDB66541 | MPDB66542 | MPDB66543 | 360 | 460 | |
| Box-Stud | Configura | tion | | | | | | | | | | | | |
| 350 - 6 | 1 | 3/8-16 x 1-1/16 | 1 | MPDB67250 | MPDB67251 | MPDB67252 | MPDB67253 | - | - | - | - | 250 | 310 | |
| 500 - 4 | 1 | 3/8-16 x 1-1/16 | 1 | MPDB67220 | MPDB67221 | MPDB67222 | MPDB67223 | - | - | - | - | 310 | 380 | |
| Stud-Stud | Configur | ation | | | | | | | | | | | | |
| 1/4-20 x 1-5/16 | 1 | 1/4-20 x 1-5/16 | 1 | - | - | - | - | MPDB66270 | MPDB66271 | MPDB66272 | MPDB66273 | 155 | 155 | |
| 3/8-16 x 1-1/8 | 1 | 1/4-20 x 1-5/16 | 2 | - | - | - | - | MPDB66230 | MPDB66231 | MPDB66232 | MPDB66233 | 400 | 400 | |
| 5,0 10 X 1-1/0 | | 3/8-16 x 1-1/8 | 1 | - | - | - | - | MPDB66260 | MPDB66261 | MPDB66262 | MPDB66263 | 400 | 400 | |

Hinged Safety Cover for MPDB66 and MPDB67 series: Catalog number **MPDBC6667** End Barrier for MPDB66 and MPDB67 series: Catalog Number **MPDBE6667**



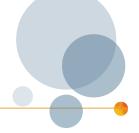
MPDB68 and MPDB69 Open-Style PDBs

Catalog Numbers (Large)

| Li | ne I | Loa | d | Ca | atalog Numb | | ım | (| Catalog Num | | r | Amp Rating | | |
|----------------|------------------|-----------------|------------------|-----------|-------------|-----------|-----------|-----------|-------------|-----------|-----------|------------|-----------|--|
| Wire | Open- | Wire | Open- | | Number I | of Poles | | | Number | of Poles | | per | Pole I | |
| Range | ings per Pole | Range | ings per Pole | ADDER | 1-P | 2-P | 3-P | ADDER | 1-P | 2-P | 3-P | Al | Cu | |
| Box-Bo | x Configu | ration | | | | | | | | | | | | |
| 250 0 | 4 | 2/0 - 14 | 6 | MPDB69170 | MPDB69171 | MPDB69172 | MPDB69173 | - | - | - | - | 050 | 240 | |
| 350 - 6 | 1 | 4 - 14 | 12 | MPDB69150 | MPDB69151 | MPDB69152 | MPDB69153 | MPDB68150 | MPDB68151 | MPDB68152 | MPDB68153 | 250 | 310 | |
| | | 500 - 4 | 1 | MPDB69050 | MPDB69051 | MPDB69052 | MPDB69053 | - | - | - | - | | | |
| | | 350 - 6 | 2 | MPDB69060 | MPDB69061 | MPDB69062 | MPDB69063 | MPDB68060 | MPDB68061 | MPDB68062 | MPDB68063 | | | |
| 500 - 4 | 1 | 4/0 - 6 | 4 | MPDB69510 | MPDB69511 | MPDB69512 | MPDB69513 | - | - | - | - | 310 | 380 | |
| | | 2/0 - 14 | 6 | MPDB69070 | MPDB69071 | MPDB69072 | MPDB69073 | - | - | - | - | | | |
| | | 4 - 14 | 12 | MPDB69080 | MPDB69081 | MPDB69082 | MPDB69083 | - | - | - | - | | | |
| 600 - 2 | 1 | 600 - 2 | 1 | MPDB69640 | MPDB69641 | MPDB69642 | MPDB69643 | - | - | - | - | 340 | 420 | |
| | | 1000 - 250 | 1 | MPDB69000 | MPDB69001 | MPDB69002 | MPDB69003 | - | - | - | - | | | |
| | | 500 - 4 | 2 | MPDB69010 | MPDB69011 | MPDB69012 | MPDB69013 | - | - | - | - | | | |
| 1000 - 250 | 1 | 350 - 6 | 2 | MPDB69020 | MPDB69021 | MPDB69022 | MPDB69023 | - | - | - | - | 445 | 545 | |
| | | 2/0 - 14 | 6 | MPDB69030 | MPDB69031 | MPDB69032 | MPDB69033 | - | - | - | - | | | |
| | | 4 - 14 | 12 | MPDB69040 | MPDB69041 | MPDB69042 | MPDB69043 | - | - | - | - | | | |
| 4 - 14 | 2 | 4 - 14 | 12 | MPDB69180 | MPDB69181 | MPDB69182 | MPDB69183 | - | - | - | - | 130 | 170 | |
| 0/0 14 | 0 | 4 - 14 | 12 | MPDB69160 | MPDB69161 | MPDB69162 | MPDB69163 | MPDB68160 | MPDB68161 | MPDB68162 | MPDB68163 | 070 | 250 | |
| 2/0 - 14 | 2 | 10 - 14 | 20 | MPDB69600 | MPDB69601 | MPDB69602 | MPDB69603 | - | - | - | - | 270 | 350 | |
| | | 350 - 6 | 2 | MPDB69120 | MPDB69121 | MPDB69122 | MPDB69123 | MPDB68120 | MPDB68121 | MPDB68122 | MPDB68123 | 500 | | |
| 250 6 | 2 | 4/0 - 10 | 4 | - | - | - | - | MPDB68320 | MPDB68321 | MPDB68322 | MPDB68323 | | 620 | |
| 350 - 6 | 2 | 2/0 - 14 | 6 | MPDB69130 | MPDB69131 | MPDB69132 | MPDB69133 | MPDB68130 | MPDB68131 | MPDB68132 | MPDB68133 | | 620 | |
| | | 4 - 14 | 12 | MPDB69140 | MPDB69141 | MPDB69142 | MPDB69143 | MPDB68140 | MPDB68141 | MPDB68142 | MPDB68143 | | | |
| | | 500 - 4 | 2 | MPDB69090 | MPDB69091 | MPDB69092 | MPDB69093 | MPDB68090 | MPDB68091 | MPDB68092 | MPDB68093 | | | |
| | | 4/0 - 6 | 4 | MPDB69310 | MPDB69311 | MPDB69312 | MPDB69313 | - | - | - | - | | | |
| 500 - 4 | 2 | 4/0 - 10 | 4 | - | - | - | - | MPDB68310 | MPDB68311 | MPDB68312 | MPDB68313 | 620 | 760 | |
| 300 - 4 | 2 | 2/0 - 14 | 6 | MPDB69100 | MPDB69101 | MPDB69102 | MPDB69103 | MPDB68100 | MPDB68101 | MPDB68102 | MPDB68103 | 620 | 700 | |
| | | 2/0 - 14 | 8 | MPDB69350 | MPDB69351 | MPDB69352 | MPDB69353 | - | - | - | - | | | |
| | | 4 - 14 | 12 | MPDB69110 | MPDB69111 | MPDB69112 | MPDB69113 | - | - | - | - | | | |
| 600 - 2 | 2 | 600 - 2 | 2 | MPDB69650 | MPDB69651 | MPDB69652 | MPDB69653 | - | - | - | - | 680 | 840 | |
| 000 - 2 | 2 | 4-14 & 3/0-10 | 4 & 4 | MPDB69540 | MPDB69541 | MPDB69542 | MPDB69543 | - | - | - | - | 000 | 040 | |
| Box-Stud | Configura | tion | | | | | | | | | | | | |
| 500 - 4 | 1 | 3/8-16 x 1 | 1 | MPDB69210 | MPDB69211 | MPDB69212 | MPDB69213 | - | - | - | - | 310 | 380 | |
| 000 T | · · | 3/8-16 x 1 | 2 | MPDB69270 | MPDB69271 | MPDB69272 | MPDB69273 | - | - | - | - | 010 | 500 | |
| 1000 - 250 | 1 | 1/2-13 x 1-3/16 | 1 | MPDB69280 | MPDB69281 | MPDB69282 | MPDB69283 | - | - | - | - | 445 | 545 | |
| 1/2-13 x 1 | 1 | 4 - 14 | 12 | - | - | - | - | MPDB68290 | MPDB68291 | MPDB68292 | MPDB68293 | 1000 | 1000 | |
| 500 - 4 | 2 | 3/8-16 x 1 | 2 | MPDB67230 | MPDB67231 | MPDB67232 | MPDB67233 | - | - | - | - | 620 | 760 | |
| tud-Stud | Configura | ation | | | | | | | | | | | | |
| 1/2-13 x 1-3/8 | 1 | 1/2-13 x 1-3/8 | 1 | - | - | - | - | MPDB68220 | MPDB68221 | MPDB68222 | MPDB68223 | 400 | 400 | |

Hinged Safety Cover for MPDB68 and MPDB69 series: Catalog number **MPDBC6869** End Barrier for MPDB68 and MPDB69 series: Catalog Number **MPDBE6869**





The MPDB double-wide series are designed for custom applications where large ampacities are required. Double-wide blocks are not UL or CSA certified unless otherwise notice. All double-wide blocks are Mersen self-certified and approved.

Catalog Numbers (Double-Wide)

| Line | | Lo | ad | Aluminum | Copper | Amp l | Rating | | | |
|--------------------|-----------------------|------------|----------|------------|-------------|-------|--------|--|--|--|
| Wire | Openings | Wire | Openings | Poles | Poles | per | Pole | | | |
| Range | per Pole | Range | per Pole | 1-P | 1-P | Al | Cu | | | |
| Box-Box Configu | Box-Box Configuration | | | | | | | | | |
| 1000 - 250 | 2 | 500 - 4 | 4 | MPDB69561 | - | 890 | 1090 | | | |
| 500 4 | 2 | 4/0 - 10 | 6 | - | MPDB800011 | 020 | 4440 | | | |
| 500 - 4 | 3 | 2/0 - 14 | 8 | MPDB900061 | - | 930 | 1140 | | | |
| 600 - 2 | 3 | 600 - 2 | 3 | MPDB69331 | - | 1020 | 1260 | | | |
| | | 500 - 4 | 4 | MPDB900071 | MPDB800031 | | | | | |
| 500 - 4 | 4 | 2/0 - 12 | 6 | MPDB900121 | MPDB800121 | 1240 | 1520 | | | |
| | | 6 - 14 | 30 | MPDB69191 | - | | | | | |
| 600 - 2 | 4 | 600 - 2 | 4 | MPDB69341 | - | 1360 | 1680 | | | |
| 500 - 4 | 7 | 500 - 4 | 7 | - | MPDB800061* | 2170 | 2660 | | | |
| Box-Stud Configura | ation | | | | | | | | | |
| 500 - 4 | 4 | 3/8-16 x 1 | 4 | MPDB900091 | - | 1240 | 1520 | | | |

^{*} This block is triple-wide

Dimensions:





Your Enclosure Source ®

Saginaw Control and Engineering 95 Midland Road Saginaw, MI 48638-5770 (800) 234-6871 - Fax: (989) 799-4524 SCE@SaginawControl.com

SCE-60XEL4912SSLP



Product Specifications:

Part Number: SCE-60XEL4912SSLP Description: S.S. 2DR XEL Enclosure Height: 60.00" Width: 49.00" Depth: 12.00" Price Code: S4 List Price: \$8,096.67 Catalog Page: 306

Est. Ship Weight: 569.00 lbs

Construction

- 0.104 ln. stainless steel Type 304. Seams continuously welded and ground smooth.
- Pour in place oil & water resistant gasket
- Flange trough collar around all sides of door opening. Stainless steel concealed hinges.
- Removable and interchangeable doors.
- 3-point latching mechanism. Removable print pocket.

- Lifting eyes for easy handling.
 Ground studs on door and body.
 Collar studs provided for mounting optional panels.
- 15 In. removable floor stands.
- Removable center post.
- Mechanical interlock.
- No door stiffeners required.
- Black zinc die cast coinproof/padlocking handle on main door of disconnect enclosures. Black zinc die cast padlocking handle on all other
- Provisions for light kit.

Application

Designed to house electrical and electronic controls, instrumentation and components in indoor & outdoor locations. Designed to house most standard type disconnects. For outdoor application a drip shield is recommended.

Finish

#4 brushed finish on all exterior surfaces. Optional sub-panels are powder coated white.

- Industry Standards (IS6)NEMA Type 3R, 4, 4X, 12 and Type 13UL Listed Type 3R, 4, 4X and 12
- CSA Type 4, 4X and 12
- IEC 60529
- IP 66

Disconnect switch (or circuit breaker) and operating mechanism are not

Special Instructions apply for IS3, IS4 and IS6 to maintain the environmental rating of Type 3R for these parts. Instructions are located on the enclosure door. Drip shield is required on IS3, drip shield is recommended on IS4 and IS6. Drain holes are required on all.

Optional Accessories
SCE-13ELJEXPP Pocket, Exterior Print
SCE-19ELJEXPP Pocket, Exterior Print

SCE-60P48 Subpanel, Bent SCE-60P48GALV Subpanel, Bent Galvanized SCE-BP5612 Plate, Barrier

SCE-BVK Breather Vent

SCE-BVK Breather Vent
SCE-DF60EL48 Panel, Dead Front (Enviroline Floor Mount)
SCE-DS48SS Shield, S.S. Drip
SCE-FS1212SS Shelf, S.S. Folding
SCE-FS1818SS Shelf, S.S. Folding
SCE-FS2424SS Shelf, S.S. Folding
SCE-LF18 Fixture, LED Light
SCE-LF18NO Fixture, LED Light w/o Outlet

Similar Part Numbers

SCE-60XEL4918SSLPS.S. 2DR XEL Enclosure SCE-60XEL6112SSLPS.S. 2DR XEL Enclosure

SCE-60XEL6118SSLPS.S. 2DR XEL Enclosure SCE-72XEL6112SSLPS.S. 2DR XEL Enclosure SCE-72XEL6118SSLPS.S. 2DR XEL Enclosure

Installation Information

- Siemens Flange Mounted, Disconnects and Circuit Breakers Moller Flange Mounted, Disconnects and Circuit Breakers Gould Flange Mounted, Disconnects and Circuit Breakers

- GE Flange Mounted, Disconnects and Circuit Breakers
- ABB Flange Mounted, Disconnects and Circuit Breakers
- Bussmann Flange Mounted, Disconnects and Circuit Breakers Allen-Bradley Flange Mounted, Disconnects and Circuit Breakers
- Cutler-Hammer Flange Mounted, Disconnects and Circuit Breakers Mechanical Defeater (2018 Rev) Video
- Square D Flange Mounted, Disconnects and Circuit Breakers
- LED Light Fixture
 Drip Shield Kit Assembly
- Polding Shelf Hole Pattern
 Dead Front 2 Door W/Disconnect Installation Instructions
 Service Parts Free Standing & Floor Mount Enclosures
 Mechanical Defeater (2018 Rev)

- LSis Flange Mounted Disconnect and Circuit Breakers



Your Enclosure Source®



SCE-60P48

Product Specifications:

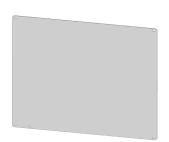
Part Number: SCE-60P48 Part Number: SCE-60P48
Description: Subpanel, Bent
Height: 56.00"
Width: 44.00"
Depth: 0.88"
Price Code: P3
List Price: \$268.38
Catalog Page: 418
Est. Ship Weight: 100.00 lbs
Edge Flanges: Four
Configuration: C

Similar Part Numbers

ilar Part Numbers
SCE-48P36Subpanel, Bent
SCE-48P4SSubpanel, Bent
SCE-48P48Subpanel, Bent
SCE-60BFP42Subpanel, Bent
SCE-60P36Subpanel, Bent
SCE-60P42Subpanel, Bent
SCE-60P60Subpanel, Bent
SCE-60PC36Subpanel, Bent
SCE-64P37Subpanel, Bent
SCE-64P52Subpanel, Bent

Installation Information

❖ Sub-Plate Layout & Grounding for 3/8-16



Finish Powder Coated White.

Industry Standards - (IS17) NEMA Not Applicable

- UL Not Applicable
- CSA N/A

Class J 600 Volt Fuse Blocks

FUSE BLOCKS & HOLDERS

MERSEN CLASS J FUSE BLOCKS ACCOMMODATE ALL CLASS J FUSES





A choice of screw, pressure plate, box and special order stud connectors fit a wide range of stranded or solid copper or aluminum conductors. Insulators are either molded glass-filled polycarbonate (GFPC) or phenolic with verified dielectric strength in excess of 2500V. 30A, 60A and the new 100A SJ fuse blocks feature a unique adder block configuration which can be snapped onto 1-, 2-, or 3-pole blocks to form multi-pole segmented blocks of as many poles as desired. All fuse clips are made of high conductivity tin-plated copper, with a choice of spring-reinforced or non-spring reinforced clips. Space saving options are now available in the 30A and 100A configurations which are noted in the product selection tables.

CLIP & CONNECTOR TYPES:

| 30A & 60A Clips | Connectors | Connectors | Connectors | Connectors |
|-----------------------|---|---|---|--|
| Spring Reinforced | Non-spring Reinforced 30A & 60A Box | Spring Reinforced 30A & 60A Box | Spring Reinforced 100A Box | Spring Reinforced 400A Box Side Clip |
| | | | | |
| Non-spring Reinforced | Non-spring Reinforced 30A Screw | Spring Reinforced 30A Screw | Spring Reinforced 100A Box Side Clip | Spring Reinforced 400A Box In-line Clip |
| | | | | |
| | Non-spring Reinforced 30A Pressure Plate | Spring Reinforced 30A Pressure Plate | Spring Reinforced 200A Box Side Clip | Spring Reinforced 600A Box In-line Clip |
| | | | | |

RATINGS:

Volts: 600VAC/DC

• **Amps:** 30A, 60A, 100A; 200A, 400A, 600A

• SCCR: 200kA

RECOMMENDED FUSE USAGE:

 Class J Blocks (600V) use with AJT, A4J, HSJ

APPROVALS:

- All class J fuse blocks meet the requirements of UL4248 (formerly UL512)
- UL listed Guide IZLT, File E52283
- CSA certified class 6225, File 32169







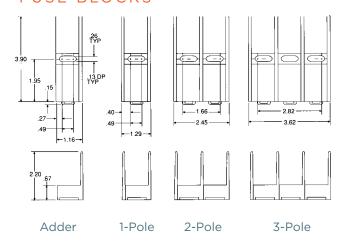
600 VOLT, 30 & 60 AMPERE CLASS J FUSE BLOCKS

| A | | Connectors | | Catalog Numb | er | Connector | | |
|------------------|-------|------------|---------------|--------------------------|----------------------|-------------------|--|--|
| Ampere Rating | Poles | Types | Wire Range | Non-Spring Reinforced | Spring Reinforced | Torque In - Ib | | |
| | ADDER | | | 60300J | 60305SJ | | | |
| | 1 | BOX | Al/Cu | 60301J | 60306SJ | 25 | | |
| | 2 | BUX | #2-14 | 60302J | 60307SJ | 35 | | |
| | 3 | | | 60303J | 60308SJ | | | |
| | ADDER | | | 60310J | 60315SJ | | | |
| | 1 | CCDEW | Cu* | 60311J | 60316SJ | 20 | | |
| | 2 | SCREW | #4-14 | 60312J | 60317SJ | 20 | | |
| 30 GFPC | 3 | | | 60313J | 60318SJ | | | |
| Insulator | ADDER | | Cu* #4-14 | 60320J | 60325SJ | | | |
| modiator | 1 | PRESSURE | | 60321J | 60326SJ | 20 | | |
| | 2 | PLATE | | 60322J | 60327SJ | 20 | | |
| | 3 | | | 60323J | 60328SJ | | | |
| | ADDER | | Cu* #4-14 | - | 60355SJ | 35 | | |
| | 1 | BOX | | - | 60356SJ | | | |
| | 2 | BUX | | - | 60357SJ | | | |
| | 3 | | | - | 60358SJ | | | |
| | ADDER | | | 60600J | 60605J | | | |
| | 1 | BOX | AI/Cu | 60601J | 60606J | 45 | | |
| | 2 | BUX | #2-14 | 60602J | 60607J | 45 | | |
| GFPC | 3 | | | 60603J | 60608J | | | |
| Insulator | ADDER | | | - | 60655J | | | |
| | 1 | BOX | Cu* | - | 60656J | 45 | | |
| | 2 | BUX | #4-14 | - | 60657J | 45 | | |
| | 3 | | | - | 60658J | | | |

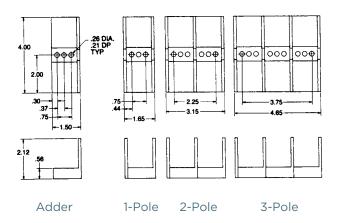
Note: To convert 30A "SJ" adder pole to single pole use end barrier cat # U09372. To convert 30A or 60A standard J adder pole to single use pole use end barrier cat # U09617. Recommended mounting screws for all 30A and 60A fuse blocks: 1/4" (0.250" dia).

*Fuses have copper box connectors and clips and are for copper wires only. These are specifically designed with the same coefficient of expansion as copper wire for improved heat cycling and meet or exceed OEM "no aluminum" specifications.

DIMENSIONS FOR 30A SPACE SAVING "SJ" STYLE FUSE BLOCKS



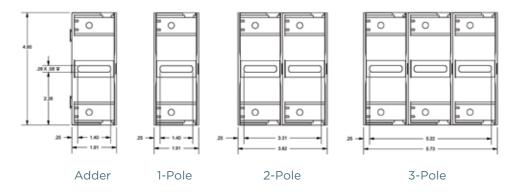
DIMENSIONS FOR 30A AND 60A STANDARD CLASS J STYLE FUSE BLOCKS



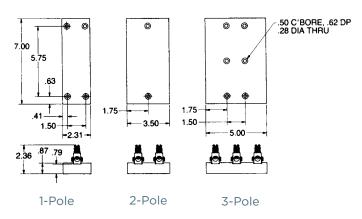
600 VOLT, 100 AMPERE CLASS J FUSE BLOCKS

| | | Conne | ectors | Catalog Number | Connector | |
|--------------------------|-------------|-------|-----------------|--|-----------------------------|--|
| Ampere Rating | Poles | Туре | Wire Range | Spring Reinforced | Connector Torque In - Ib | |
| 400 | | | AI/Cu 2/0-#6 | 61005SJ 61006SJ 61007SJ 61008SJ | 100 (AI) 60 (Cu) | |
| 100 GFCP Insulator | 1 2 3 | Box | Al/Cu 2/0-#6 | 61036J 61037J 61038J | 120 | |
| | 1 2 3 | Box | Cu* 2/0-#12 | 61006J 61007J 61008J | 50 | |

DIMENSIONS FOR 100A SPACE SAVING "SJ" STYLE FUSE BLOCKS



DIMENSIONS FOR 100A STANDARD CLASS J STYLE FUSE BLOCKS



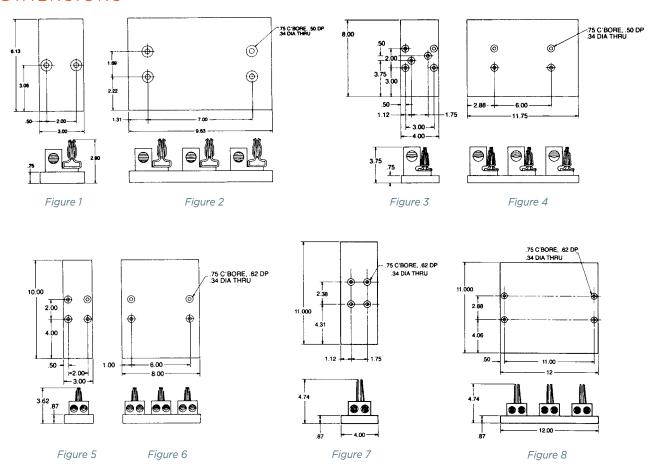
600 VOLT, 200, 400 & 600 AMPERE CLASS J FUSE BLOCKS

| | | Connector | | Catalog No. | | |
|-----------------------|-------|--------------|-----------------|-------------------|------|-----------------------------|
| Ampere Rating | Poles | Туре | Wire Range | Spring Reinforced | Fig. | Connector Torque In - Ib |
| | 1 | Box | Al/Cu | E2001 I | 1 | 0.75 |
| 200 | 3 | Side-Clip | 350kcmil-#6 | 62003J | 2 | 375 |
| Phenolic Insulator | 1 | Box | Cu** | 62U51J | 1 | 275 |
| modiator | 3 | Side-Clip | 350kcmil-#6 | 62053J | 2 | 275 |
| | 1 | Box* | AL/Cu | 64001J | 3 | 275 |
| | 3 | Side-Clip | 1000-250kcmil | 64003J | 4 | 375 |
| | 1 | Box | AL/Cu | 64031J | 5 | 275 |
| 400 | 3 | In-Line Clip | (2) 350kcmil-#4 | 64033J | 6 | 275 |
| Phenolic Insulator | 1 | Box* | Cu** | 64051J | 3 | 275 |
| modiator | 3 | Side-Clip | 1000-250kcmil | 64053J | 4 | 375 |
| | 1 | Box | Cu** | 64061J | 5 | 275 |
| | 3 | In-Line Clip | (2) 350kcmil-#6 | 64063J | 6 | 275 |
| | 1 | Box | AI/Cu | 6631J | 7 | 500 |
| 600 | 3 | In-Line Clip | (2) 500kcmil-#4 | 6633J | 8 | 500 |
| Phenolic Insulator | 1 | Box | Cu** | 6661J | 7 | 275 |
| | 3 | In-Line Clip | (2) 500kcmil-#4 | 6663J | 8 | 375 |

- * Not UL Listed or CSA Certified
- ** Fuse blocks have copper box connectors and clips and are for copper wires only. These are specifically designed with the same coefficient of expansion as copper wire for improved heat cycling and meet or exceed OEM "no aluminum" specifications.

Recommended mounting screws: All 200A, 400A & 600A - 5/16" (.313" dia.)

DIMENSIONS



DFC SERIES Dead-Front Fuse Covers

Mersen DFC dead-front fuse covers snap on to individual fuses installed in fuse blocks, covering exposed live clips and terminals and reducing accidental contact by personnel. They are sized to fit Class G, H, J, K, R, CC or midget fuses for increased safety and (optional) open-fuse indication. All DFC dead-front fuse covers are reusable when a fuse is replaced - simply detach from the open fuse and reattach to the new replacement fuse. On indicator models an orange indicator light will illuminate to indicate an open fuse. DFC fuse cover ends can be easily cut to accommodate existing wiring, safety switches or special installations. A blank label is provided with each DFC to write in circuit or fuse information.

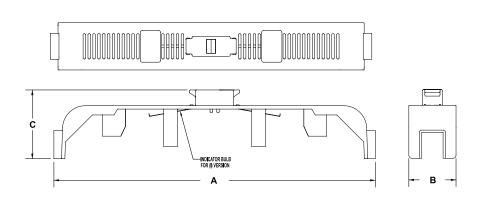
Features/Benefits:

- · Innovative design provides dead-front electrical safety to personnel
- · Optional orange indicator light shows open fuse
- · Many sizes to fit virtually all popular fuses/fuse blocks
- · Reusable with no changes or additional cost
- · Labels provided for write-in identification
- Thermoplastic flammability rating of UL 94-V2
- Low leakage current < 0.6 mA at 600V

Catalog Numbers & Dimensions

| Catalog I | Numbers | Fus | ses Accomoda | ted | Dimensions (inches) | | | |
|--------------------|------------|---------|--------------|---------------|---------------------|------|------|--|
| Non- indicating | indicating | Amps | Volts | Class | A | В | С | |
| DFC-1 | DFC-1I | 0-30 | 600 | J | 4.68 | 1.36 | 1.97 | |
| DFC-2 | DFC-2I | 0-30 | 600 | R, K, H | 7.45 | 1.35 | 1.80 | |
| DFC-3 | DFC-3I | 65-100 | 600 | J | 7.57 | 1.30 | 2.20 | |
| DFC-4 | DFC-4I | 65-100 | 250 | R, K, H | 8.73 | 1.40 | 2.02 | |
| DFC-5 | DFC-5I | 35-60 | 600 | R, K, H | 7.46 | 1.35 | 2.00 | |
| DFC-6 | DFC-6I | 35-60 | 600 | J | 4.64 | 1.40 | 2.17 | |
| DFC-7 | DFC-7I | 0-30 | 600 | Midget, CC, G | 3.71 | 0.69 | 1.37 | |
| DFC-8 | DFC-8I | 65-100 | 600 | R, K, H | 10.55 | 1.55 | 2.26 | |
| DFC-9 | DFC-9I | 0-30 | 250 | R, K, H | 3.71 | 0.85 | 1.55 | |
| DFC-10 | DFC-10I | 0-30 | 600 | SJ | 4.56 | 1.06 | 2.02 | |
| DFC-11 | DFC-11I | 65-100 | 600 | SJ | 5.52 | 1.7 | 2.04 | |
| DFC-12 | DFC-12I | 110-200 | 600 | J | 6.63 | 3.03 | 2.86 | |
| DFC-13 | DFC-13I | 35-60 | 250 | R, K, H | 5.20 | 1.12 | 1.92 | |

WARNING: To avoid electrical shock, TURN POWER OFF before installing, removing or servicing.





Ratings:

Non-Indicating

: 0 to 600VAC / DC Amps : Fits fuses rated 0 to

200A

Indicating

Volts : 90 to 600VAC

: 115 to 600VDC

Amps : Fits fuses rated 0 to

200A

Approvals:

- · UL Listed (All except midget size) guide JDVS, File E90426
- UL Recognized Component (midget) guide JDVS2, File E90426
- · CSA Certified class 6228, File 70159















Fuses and Fuse Blocks for use with DFC

| uses and | Tuse blo | | ise with Di | | |
|--------------|------------|-----------|----------------|------------|-----------|
| Fuse | Fuse Block | DFC | Fuse | Fuse Block | DFC |
| AG(0-30) | 40xxxG | -71, -7 | A6K(35-60)R | 606xxR | -51, -5 |
| AJT(1-30) | 603xxJ | -11, -1 | A6K(70-100)R | 610xxR | -81, -8 |
| AJT(1-30) | 603xxSJ | 101, -10 | A6Y(0-30)-2B | 303xx | -71, -7 |
| AJT(35-60) | 606xxJ | -61, -6 | A60Q(0-30)-2 | 303xx | -71, -7 |
| AJT(70-100) | 610xxJ | -31, -3 | A60X(0-30)-1 | 603xx | -11, -1 |
| AJT(70-100) | 6100xxSJ | -111, -11 | A70P(10-30)-1 | 203xx | -91, -9 |
| AJT(110-200) | 620xxJ | -12I, -12 | GFN(0-30) | 303xx | -71, -7 |
| ATDR(0-30) | 303xxR | -71, -7 | GGU(0-30) | 303xx | -71, -7 |
| ATM(0-30) | 303xx | -71, -7 | HSJ(15-30) | 603xxSJ | -101, -10 |
| ATMR(0-30) | 303xxR | -71, -7 | HSJ(70-100) | 6100xxSJ | -111, -11 |
| ATQ(0-30) | 303xx | -71, -7 | HSJ(110-200) | 620xxJ | -121, -12 |
| ATQR(0-30) | 303xxR | -71, -7 | OT(0-30) | 203xx | -91, -9 |
| A13X(1-30)-2 | 303xx | -71, -7 | OT(35-60) | 206xx | -13I, -13 |
| A2D(0-30)R | 203xxR | -91, -9 | OT(65-100) | 210xx | -41, -4 |
| A2D(35-60)R | 206xxR | -13I, -13 | OTM(0-30) | 303xx | -71, -7 |
| A2D(65-100)R | 210xxR | -41, -4 | OTS(0-30) | 603xx | -21, -2 |
| A2K(0-30)R | 203xxR | -91, -9 | OTS(35-60) | 606xx | -51, -5 |
| A2K(35-60)R | 206xxR | -13I, -13 | OTS(65-100) | 610xx | -81, -8 |
| A2K(70-100)R | 210xxR | -41, -4 | RF(0-30) | 203xx | -91, -9 |
| A2Y(0-30) | 203xx | -91, -9 | RF(35-60) | 206xx | -13I, -13 |
| A2Y(35-60) | 206xx | -13I, -13 | RF(65-100) | 210xx | -41, -4 |
| A2Y(70-100) | 210xx | -41, -4 | RFS(0-30) | 603xx | -21, -2 |
| A25X(1-30)-1 | 203xx | -91, -9 | RFS(35-60) | 606xx | -51, -5 |
| A25Z(1-30)-2 | 303xx | -71, -7 | RFS(65-100) | 610xx | -81, -8 |
| A4J(1-30) | 603xxJ | -11, -1 | TR(0-30)R | 203xx | -91, -9 |
| A4J(1-30) | 603xxSJ | -10I, -10 | TR(35-60)R | 206xx | -13I, -13 |
| A4J(35-60) | 606xxJ | -61, -6 | TR(70-100)R | 210xx | -41, -4 |
| A4J(70-100) | 610xxJ | -31, -3 | TRM(0-30) | 303xx | -71, -7 |
| A4J(70-100) | 6100xxSJ | -111, -11 | TRS(0-30)R | 603xxR | -21, -2 |
| A4J(110-200) | 620xxJ | -12I, -12 | TRS(35-60)R | 606xxR | -51, -5 |
| A50P(10-30) | 203xx | -91, -9 | TRS(65-100)R | 610xxR | -81, -8 |
| A6D(0-30)R | 603xxR | -21, -2 | TRS(35-60)RDC | 606xxR | -51, -5 |
| A6D(35-60)R | 606xxR | -51, -5 | TRS(70-100)RDC | 610xxR | -81, -8 |
| A6D(70-100)R | 610xxR | -81, -8 | | | |
| A6K(0-30)R | 603xxR | -21, -2 | | | |

Note: DFC Covers fit single pole blocks and each pole of multi-pole blocks. Consult factory for data sheets of DFC trim instructions for safety switches.

WARNING: To avoid electrical shock, TURN POWER OFF before installing, removing or servicing.



POWR-GARD® Blocks & Holders LPSC / LPSM POWR-SAFE FUSE HOLDERS

600 V





Littelfuse POWR-SAFE dead front holders provide optimum protection to personnel for Class CC and midget-style fuses.

Features/Benefits

- Indicating and non-indicating options available
- 1-, 2-, 3- and 4-pole configurations
- Easy installation and fuse removal with no additional pullers or tools required
- 35 mm DIN-rail mountable
- Ventilated design for cooler operation

Ordering Information

| INDI | CATING | NON-IN | DICATING | | |
|-------------------|--------------------|-------------------|--------------------|-----------|-------|
| CATALOG NUMBER | ORDERING NUMBER | CATALOG NUMBER | ORDERING NUMBER | FUSE TYPE | POLES |
| LPSC001ID | LPSC0001ZXID | LPSC001 | LPSC0001Z | Class CC | 1 |
| LPSC002ID | LPSC0002ZXID | LPSC002 | LPSC0002Z | Class CC | 2 |
| LPSC003ID | LPSC0003ZXID | LPSC003 | LPSC0003Z | Class CC | 3 |
| LPSC004ID | LPSC0004ZXID | LPSC004 | LPSC0004Z | Class CC | 4 |
| LPSM001ID | LPSM0001ZXID | LPSM001 | LPSM0001Z | Midget | 1 |
| LPSM002ID | LPSM0002ZXID | LPSM002 | LPSM0002Z | Midget | 2 |
| LPSM003ID | LPSM0003ZXID | LPSM003 | LPSM0003Z | Midget | 3 |
| LPSM004ID | LPSM0004ZXID | LPSM004 | LPSM0004Z | Midget | 4 |

Mulit-Pole Assembly Kit

Ordering No. CYHP0001Z-KIT

(Kit contains 20 connector pincers & 10 handle pins)



Specifications

Voltage Rating Ampere Rating Interrupting Rating

Terminal Type
Suggested Torque
Wire Range
Housing
Fuse Clip
Zinc Plated Steel
Terminal Screws
Operating Temperature
Flammability Rating
Approvals

600 V ac/dc 30 A 200 kA (Class CC) 100 kA (Midget) Pressure plate 17.7 in-lbs #8-#14 CU Thermoplastic Silver plated copper Zinc plated steel Nickel plated steel -50 °C to +125 °C UL 94 V-0

UL Listed (LPSC File: E14721) UL Recognized (LPSM File: E14721) CSA Certified (LPSC/LPSM File: LR7316) RoHS Compliant, Lead (Pb) Free

Environmental

Download CAD drawings and other technical information:

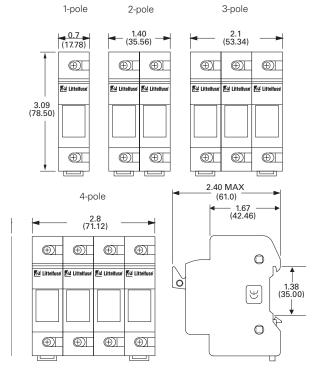
Littelfuse.com/lpsc Littelfuse.com/lpsm

Web Resources

Recommended Fuses

Class CC Midget-style (10 x 38 mm)

Dimensions Inches (mm)



Disclaimer Notice — Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littleffuse products are not designed for, and may not be used in, all applications. Read complete Disclaimer Notice at www.littleffuse.com/product-disclaimer.



BUS BAR SYSTEM

POWR-BAR Distribution





Description

A key objective for panel designers is safe distribution of power to multiple fuse holders in a compact design. The Littelfuse UL 508 Listed bus bar system eliminates most wire terminations in a timesaving package. A power distribution block and associated conductors are no longer needed to feed multiple POWR-SAFE fuse holders.

Features/Benefits

- Touch-safe design offers protection when replacing fuses
- · Compact design
- 35 mm DIN-rail mountable
- Available in one and three phase configurations
- No fuse pullers or tools required for fuse removal
- Can be cut down to optimal size

Recommended Fuse Holders

LFPSC / LFPSM Series LPSC / LPSM Series (600 V) LPHV Series (1000 V)

Web Resources

Download technical information: littelfuse.com/busbar

Specifications

Voltage Ratings 600 VAC/DC 1000 VDC*

Current Ratings

| CROSS SECTION (mm²) | 18 mm ² | 25 mm ² |
|---------------------|--------------------|--------------------|
| END FED | 80 A | 100 A |
| CENTER FED | 160 A | 200 A |

 SCCR
 10 kA, 100 kA†

 Conductor
 Copper

 Pitch
 17.8 mm

Approvals UL 508 Listed (File E328654)
Environmental RoHS Compliant, Lead (Pb) free

Ordering Information

| | 1 PHASE, 18 mm ² | | LENGTH | 1 PHASE, 25 n | LENGTH | |
|---|-----------------------------|-------|--------|--------------------|--------|------|
| | ORDERING NUMBER | POLES | (mm) | ORDERING NUMBER | POLES | (mm) |
| | 1PH3P18mm | 3 | 50 | 1PH3P25mm | 3 | 50 |
| | 1PH4P18mm | 4 | 79 | 1PH4P25mm | 4 | 79 |
| | 1PH6P18mm | 6 | 104 | 1PH6P25mm | 6 | 104 |
| C | 1PH9P18mm | 9 | 155 | 1PH9P25mm | 9 | 155 |
| | 1PH12P18mm | 12 | 208 | 1PH12P25mm | 12 | 208 |
| | 1PH15P18mm | 15 | 270 | 1PH15P25mm | 15 | 270 |
| | 1PH57P18mm | 57 | 1009 | 1PH57P25mm | 57 | 1009 |
| | | | | | | |

| | 3 PHASE, 18 n | nm² | LENGTH | 3 PHASE, 25 n | LENGTH | | |
|---|----------------------|-------|--------|--------------------|--------|------|--|
| | ORDERING NUMBER | POLES | (mm) | ORDERING NUMBER | POLES | (mm) | |
| | 3PH6P18mm | 6 | 104 | 3PH6P25mm | 6 | 104 | |
| (| 3PH9P18mm | 9 | 158 | 3PH9P25mm | 9 | 158 | |
| | 3PH12P18mm | 12 | 214 | 3PH12P25mm | 12 | 214 | |
| | 3PH15P18mm | 15 | 266 | 3PH15P25mm | 15 | 266 | |
| | 3PH57P18mm | 57 | 1009 | 3PH57P25mm | 57 | 1009 | |

Endcaps are standard with all 3 phase configurations except 57-pole. Endcaps are not needed for the 1 phase configurations from the factory or if the copper bus is trimmed per the supplied instructions. Power feed lugs and protective covers are extra.

Accessories

Power Feed Lug

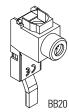
| PART NUMBER | WIRE RANGE | WIRE TYPE | TORQUE | PHASE | FUSE HOLDER |
|----------------|---------------|--------------|----------|--------|----------------|
| BB17 | #10 - 1/0 AWG | CU | 50 lb-in | Single | LPSM/LPSC/LPHV |
| BB18 | #10 - 1/0 AWG | CU | 50 lb-in | Three | LPSM/LPSC |
| BB19 | #10 - 1/0 AWG | CU | 50 lb-in | Single | LFPSM/LFPSC |
| BB20 | #10 - 1/0 AWG | CU | 50 lb-in | Three | LEPSM/LEPSC |

Power Feed Lugs are 115A 1000V AC/DC rated









Endcaps

BB17

| PART NUMBER | PHASE | QUANTITY | | |
|----------------|--------|----------|--|--|
| EDCP42 | Single | 50 | | |
| EDCP7 | Three | 50 | | |





Pole Protective Covers

| PART NUMBER | QUANTITY |
|----------------|----------|
| CTPT5 | 5 |



^{*1} Phase 18 mm² rated 1000 VDC up to 160 A when center fed

¹ Phase 25 mm² rated 1000 VDC up to 200 A when center fed

[†] When protected directly upstream by Class J 175 amperes max (18 mm² bus bar) and Class J 200 amperes max (25 mm² bus bar).

AJT Time Delay/Class J

UL/CSA LISTED POWER FUSES

MAXIMUM CIRCUIT PROTECTION



Amp-Trap 2000® AJT fuses provide non-indication as well as a SmartSpot® visual open fuse indicator. With advanced material technology the AJT fuse provides IEC Type 2 No Damage protection to main, feeder, and branch circuits, for all types of loads — yet, they require only half the mounting space needed for 600VAC Class RK fuses. AJT's time-delay characteristics are ideal for handling typical motor and transformer inrush currents, while also providing superior current-limiting ability.

FEATURES/BENEFITS:

- Non-indicating or solid state SmartSpot visual blown fuse indicator
- Time-delay for motor starting and transformer inrush
- 300kA interrupting rating self-certified, UL witnessed tests
- Extremely current-limiting for low peak let-thru current
- Non-indicating fuses suitable for use in NEC Class I Division 2 hazardous locations¹
- Recommended for Arc Flash energy reduction
- Small footprint requires less mounting space and allows smaller, more economical fuse blocks
- Easy 2-to-1 selectivity for prevention of nuisance shutdowns
- Unique Class J dimensions prevent replacement errors
- High-visibility orange label gives instant brand recognition
- Metal-embossed date and catalog number for traceability and lasting identification
- Fiberglass body provides dimensional stability in harsh environments
- High-grade silica filler ensures fast arc quenching
- Optional El open fuse indicator/switch mount for AJT70 to 600

¹ Mersen highly recommends installation in Class I Division 2 certified sealed enclosure.

RATINGS:

- **Volts**: 600VAC or less, 500VDC or less
- Amps: 1 to 600A
- IR: 200kA I.R. AC, 100kA I.R. DC (Self-certified for 600VAC, 300kA I.R., UL witnessed).

APPLICATIONS:

- Motor circuits
- Mains
- Feeders
- Branch circuits
- Lighting, heating & general loads
- Transformers
- Control panels
- Circuit breaker back-up
- Bus duct
- Load centers

APPROVALS:

AJT (1-600)[N]:

- UL listed to standard 248-8 File E2137
- DC listed to UL standard 248
- CSA certified to standard C22.2 No. 248.8
- IEC 60269-2-1

AJT (70-600) EI:

- UL listed
- DC tested to UL standard 248







CATALOG NUMBERS (AMPS)

| 1-7A: Non-ind SmartSpot vi not available | sual indicator | 8-600A: Non-indicating and SmartSpot versions available For non-indicating, add suffix 'N' to catalog number. Ex.: AJT30 (indicating); AJT30N (non-indicating). | | | | | |
|--|----------------|---|--------|--------|--|--|--|
| AJT1 | AJT3-2/10 | AJT8 | AJT45 | AJT200 | | | |
| AJT1-1/4 | AJT3-1/2 | AJT9 | AJT50 | AJT225 | | | |
| AJT1-1/2 | AJT4 | AJT10 | AJT60 | AJT250 | | | |
| AJT1-6/10 | AJT4-1/2 | AJT12 | AJT70 | AJT300 | | | |
| AJT1-8/10 | AJT5 | AJT15 | AJT80 | AJT350 | | | |
| AJT2 | AJT5-6/10 | AJT17-1/2 | AJT90 | AJT400 | | | |
| AJT2-1/4 | AJT6 | AJT20 | AJT100 | AJT450 | | | |
| AJT2-1/2 | AJT6-1/4 | AJT25 | AJT110 | AJT500 | | | |
| AJT2-8/10 | AJT7 | AJT30 | AJT125 | AJT600 | | | |
| AJT3 | | AJT35 | AJT150 | | | | |
| | | AJT40 | AJT175 | | | | |

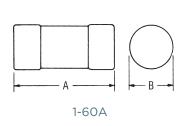
RECOMMENDED FUSE BLOCKS WITH BOX CONNECTORS FOR AMP-TRAP® CLASS J FUSES

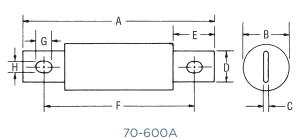
| Fuse Ampere | Catalog Number 600V or Less | | | | | |
|-------------|--------------------------------|--------|--|--|--|--|
| Rating | 1 Pole | 3 Pole | | | | |
| 0-30 | US3J1I | US3J3I | | | | |
| 31-60 | US6J1I | US6J3I | | | | |
| 61-100 | 61036J | 61038J | | | | |
| 101-200 | 62001J | 62003J | | | | |
| 201-400 | 64031J | 64033J | | | | |
| 401-600 | 6631J | 6633J | | | | |

A variety of pole configurations and termination provisions are available. Refer to Section FB for details.

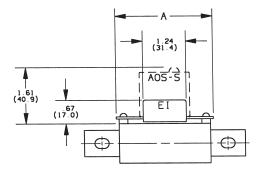
DIMENSIONS

| Ampere | A | | В | | С | | D | | Е | | F | | G | | Н | |
|---------|-------|-----|--------|----|------|-----|-------|----|-------|----|-------|-----|-------|----|-------|----|
| Rating | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm |
| 1-30 | 2-1/4 | 57 | 13/16 | 21 | - | - | - | - | - | - | - | - | - | - | - | - |
| 31-60 | 2-3/8 | 60 | 1-1/16 | 27 | - | - | - | - | - | - | - | - | - | - | - | - |
| 61-100 | 4-5/8 | 117 | 1-1/16 | 27 | 1/8 | 3.2 | 3/4 | 19 | 1 | 25 | 3-5/8 | 92 | 3/8 | 10 | 9/32 | 7 |
| 101-200 | 5-3/4 | 146 | 1-5/8 | 41 | 3/16 | 4.8 | 1-1/8 | 29 | 1-3/8 | 35 | 4-3/8 | 111 | 3/8 | 10 | 9/32 | 7 |
| 201-400 | 7-1/8 | 181 | 2-1/8 | 54 | 1/4 | 6.3 | 1-5/8 | 41 | 1-7/8 | 48 | 5-1/4 | 133 | 17/32 | 14 | 13/32 | 10 |
| 401-600 | 8 | 203 | 2-1/2 | 64 | 3/8 | 9.5 | 2 | 51 | 2-1/8 | 54 | 6 | 152 | 11/16 | 18 | 17/32 | 13 |





OPTIONAL INDICATOR/MICROSWITCH MOUNT (EI) DIMENSIONS:



Note: Fuses with the El option are designed to work with the AOS-S or AOS-Q add-on switch (ordered separately).



| Catalog Number | A |
|--------------------|-----------|
| A IT (70 400) FI | 2.8 in |
| AJT (70-100)-EI | (71.0 mm) |
| A IT (440, 200) EI | 3.22 in |
| AJT (110-200)-EI | (81.8 mm) |
| A IT (225 400) FI | 3.24 in |
| AJT (225-400)-EI | (82.2 mm) |
| A IT (4E0 C00) EI | 3.61 in |
| AJT (450-600)-EI | (91.8 mm) |

ATDR Time-delay/Class CC

The best protection for today's small motors

Amp-Trap 2000® ATDR small-dimension fuses can provide IEC Type 2 No Damage protection to your facility's increasingly sensitive branch circuit components and small motors - minimizing the risk of fault-related damage. ATDR Class CC fuses deliver the best time-delay characteristics in their class with excellent cycling ability for small motor loads.

Features/Benefits:

- · Time-delay for motor starting inrush currents without nuisance opening
- · Highly current-limiting for low peak let-thru current
- Improved cycling ability for frequent motor starts/stops without nuisance fuse opening
- Rejection-style design prevents replacement errors (when used with recommended fuse blocks)
- · High-visibility orange label ensures instant brand recognition, simplifies replacement
- Metal-embossed date and catalog number for traceability and lasting identification
- · Fiberglass body provides dimensional stability in harsh industrial settings
- · High-grade silica filler ensures fast arc quenching and optimum current-limitation

Highlights:

- Time-delay
- Best choice for small motor protection
- · Highly current-limiting
- AC & DC rated

Applications:

- Small motors
- Contactors
- · Lighting, heating & general loads
- Branch circuit protection

Note: See motor fuse applications tables on page P7



Ratings:

Volts: 600VAC

: 300VDC Amps : 1/4 to 30A

> : 200kA I.R. AC : 100kA I.R. DC

Approvals:

- UL listed to standard 248-4 File E2137
- CSA certified to standard C22.2 No. 248.4
- DC listed to UL standard 248







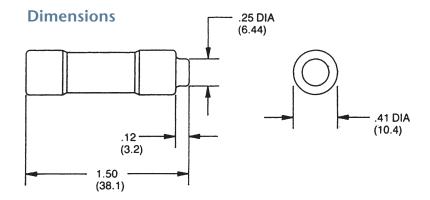
ATDR Time-delay/Class CC

Catalog Numbers (amps)

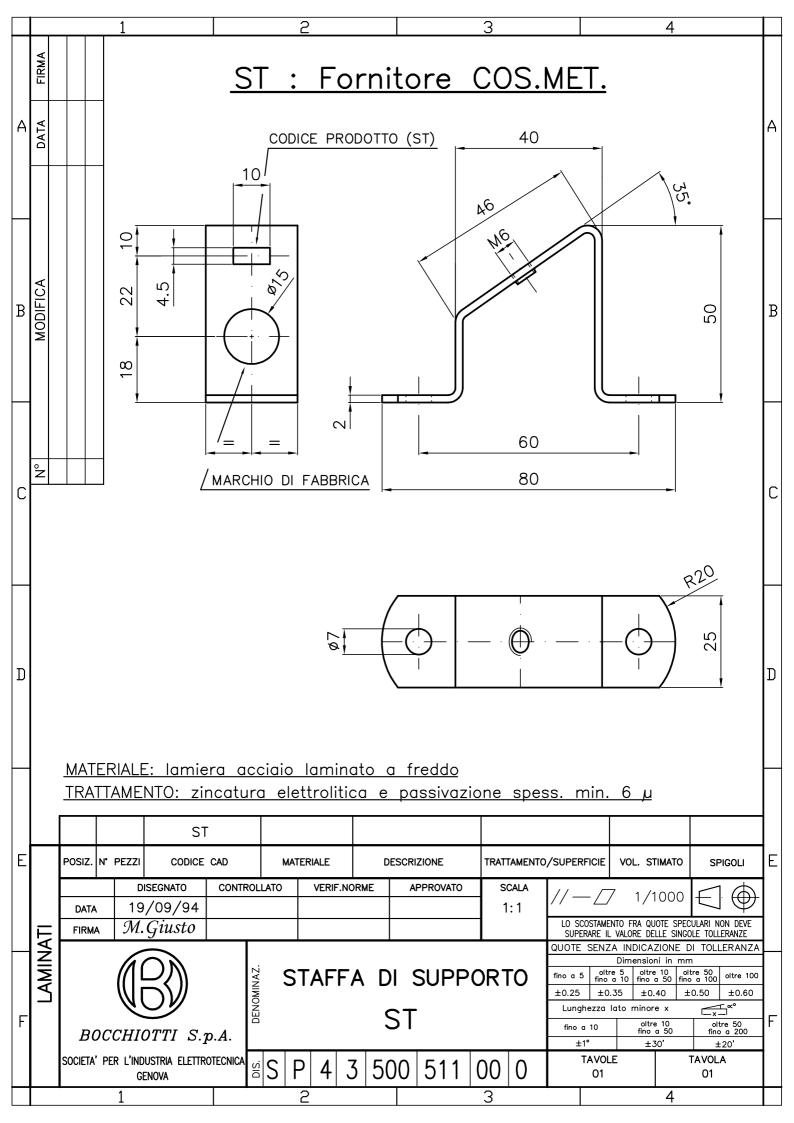
| ATDR1/4 | ATDR1-1/2 | ATDR3 | ATDR6 | ATDR12 |
|------------|------------|------------|-----------|------------|
| ATDR1/2 | ATDR1-6/10 | ATDR3-2/10 | ATDR6-1/4 | ATDR15 |
| ATDR8/10 | ATDR1-8/10 | ATDR3-1/2 | ATDR7 | ATDR17-1/2 |
| ATDR1 | ATDR2 | ATDR4 | ATDR7-1/2 | ATDR20 |
| ATDR1-1/8 | ATDR2-1/4 | ATDR4-1/2 | ATDR8 | ATDR25 |
| ATDR1-1/4 | ATDR2-1/2 | ATDR5 | ATDR9 | ATDR30 |
| ATDR1-4/10 | ATDR2-8/10 | ATDR5-6/10 | ATDR10 | |

Recommended Fuse Blocks for Class CC Fuses

| | Catalog Numbers | | | | | | |
|-----------------------|---|---|--|----------------------------|--|--|--|
| Number of Poles | UltraSafe™ Indicating Fuse Holder | Screw Connector w/ Double Quick Connects | Pressure Plate Connector w/ Double Quick Connects | Copper Box Connector | | | |
| ADDER | | 30310R | 30320R | 30350R | | | |
| 1 | USCC1I | 30311R | 30321R | 30351R | | | |
| 2 | USCC2I | 30312R | 30322R | 30352R | | | |
| 3 | USCC3I | 30313R | 30323R | 30353R | | | |
| 3 | USFMCCI | | | | | | |





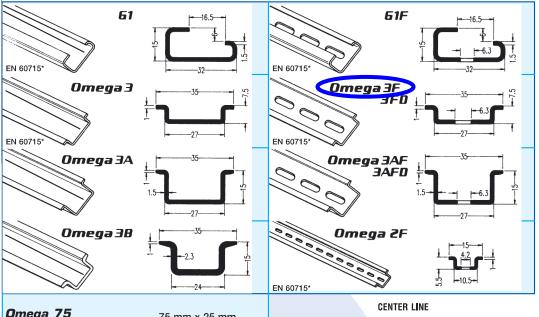




DIN RAILS

RoHS compliant

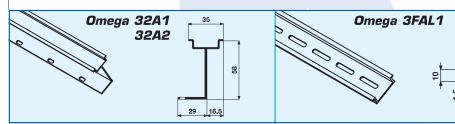
The most comprehensive range of *Din metal mounting rails*



Omega 75EN 60715*

75 mm x 25 mm

The unperforated mounting rails (G1/OMEGA 3/OMEGA 3A/ OMEGA 3B) have a center line in order to expedite the drilling of the mounting holes.

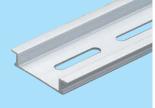


| Catalog | Lengths |
|------------|----------|
| Number | Per Pack |
| G1 | 12 |
| G1F | 12 |
| OMEGA 2F | 20 |
| OMEGA 2F1 | 40* |
| OMEGA 3 | 20 |
| OMEGA 3F | 20 |
| OMEGA 3F1 | 40* |
| OMEGA 3FD | 20 |
| OMEGA 3A | 10 |
| OMEGA 3AF | 10 |
| OMEGA 3AF1 | 20* |
| OMEGA 3AFD | 10 |
| OMEGA 3B | 10 |
| OMEGA 3B1 | 10* |
| OMEGA 75 | 2 |

| Catalog Number | Lengths Per Pack |
|---|---------------------|
| ALUMINUM | |
| OMEGA 32A1 OMEGA 32A2 OMEGA 3FAL1 | 6* 6 40* |
| GROMMET | |
| IG-11 | 10 |
| COPPER | |
| OMEGA 3ACU | 1 |
| STAINLESS STEEL | |
| OMEGA 3SS OMEGA 3SS1 | 2 6* |
| | |

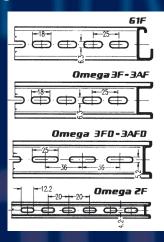
^{*}One meter long



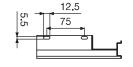


Treated with galvanic zinc plating and passivation (gal Zn 8c according to Din 50960)
Minimum thickness 6 microns
Standard length: 2 meters (6'63/4")

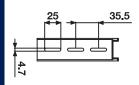
Bottom perforation



Omega 32A1 32A2



Omega 3FAL1



In compliance with EN 60715 standard



DUCT SERIES

Material

Rigid PVC, self-extinguishing

Color

Light GREY RAL 7030 WHITE

Standard Length

6 Feet 6 3/4 Inches

Standard Unit

Duct complete with cover

| Catalog Number | Nominal Size (WxH) | Dimen: | sions in H | inches (| (Actual) F | Dimensions WxH (in millimeters) | Standard Cart Lengths (1) | on (Qty) Feet |
|-------------------|-----------------------|--------|---------------|----------|---------------|------------------------------------|------------------------------|------------------|
| T1E-1015* | 1 x 1½ | 1.00 | 1.57 | .16 | .24 | 25 x 40 | 18 | 108 |
| T1E-1022* | 1 x 2¼ | 1.00 | 2.36 | .16 | .24 | 25 x 60 | 24 | 144 |
| T1E-1030* | 1 x 3 | 1.00 | 3.15 | .16 | .24 | 25 x 80 | 24 | 144 |
| T1E-1040* | 1 x 4 | 1.00 | 3.94 | .16 | .24 | 25 x 100 | 8 | 48 |
| T1E-1515* | 1½ x 1½ | 1.57 | 1.57 | .16 | .24 | 40 x 40 | 20 | 120 |
| T1E-1522* | 1½ x 2¼ | 1.57 | 2.36 | .16 | .24 | 40 x 60 | 18 | 108 |
| T1E-1530* | 1½ x 3 | 1.57 | 3.15 | .16 | .24 | 40 x 80 | 16 | 96 |
| F1E-1540* | 1½ x 4 | 1.57 | 3.94 | .16 | .24 | 40 x 100 | 8 | 48 |
| T1E-2215G | 2½ X 1½ | 2.36 | 1.57 | .16 | .24 | 60 x 40 | 12 | 72 |
| T1E-2222* | 2¼ X 2¼ | 2.36 | 2.36 | .16 | .24 | 60 x 60 | 12 | 72 |
| T1E-2230* | 2¼ X 3 | 2.36 | 3.15 | .16 | .24 | 60 x 80 | 12 | 72 |
| T1E-2240* | 2¼ X 4 | 2.36 | 3.94 | .16 | .24 | 60 x 100 | 4 | 24 |
| T1E-3015G | 3 x 1½ | 3.15 | 1.57 | .16 | .24 | 80 x 40 | 12 | 72 |
| T1E-3022* | 3 x 2¼ | 3.15 | 2.36 | .16 | .24 | 80 x 60 | 12 | 72 |
| T1E-3030* | 3 x 3 | 3.15 | 3.15 | .16 | .24 | 80 x 80 | 12 | 72 |
| T1E-3040* | 3 x 4 | 3.15 | 3.94 | .16 | .24 | 80 x 100 | 4 | 24 |
| T1E-4015G | 4 x 1½ | 3.94 | 1.57 | .16 | .24 | 100x 40 | 8 | 48 |
| T1E-4022G | 4 x 2¼ | 3.94 | 2.36 | .16 | .24 | 100x 60 | 8 | 48 |
| T1E-4030* | 4 x 3 | 3.94 | 3.15 | .16 | .24 | 100x 80 | 8 | 48 |
| T1E-4040* | 4 x 4 | 3.94 | 3.94 | .16 | .24 | 100x 100 | 4 | 24 |

C€

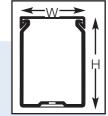
Available in 1 meter length contact sales office

All wiring ducts come complete with cover. Wiring duct covers can be sold separately: see page 8 and IBOCO Corp. Price List.

Example: T1E-1015 G = $1"x1\frac{1}{2}"$ light GREY duct with cover

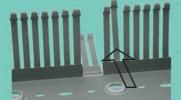
- (1) Each standard length is actually 6'6 3/4" but is counted as 6 feet for packaging and pricing
- * Color add suffix "G" for light GREY "W" for WHITE

ADHESIVE BACKING - add suffix "A" to catalog number - contact sales office for pricing (see page 22)





Restricted slot opening for wire retaining.

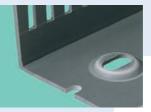


Two predetermined breaklines:

- for breaking off and removal of sidewall finger segments only.
- for removal of sidewall finger and base segments.



Burr-free edges.



Recess boss for rapid mounting of components.



Non- slip cover design of minimun encumbrance and maximum grip.

For wire fill capacity and base perforation of the wiring duct, see page 18.

Copper Mechanical Conductors

Each connector accommodates a wide range of conductor sizes.

LOCKTITE® Stud Connectors

- · Fast, simple installation
- Convenient pigtail is easy to tape
- To order with hex head screws, add prefix H to catalog number
- Standard tapping shown in diagrams
- Other tapping to meet specific requirements available on request
- For use with code copper conductor (600V)



| | CABLE | | DIMENSIONS (IN.) | | | | |
|----------|------------|-------|------------------|------|-------|-----|----------------------|
| CAT. NO. | SIZE | A | В | D | E | F | . Stud Size (in.) |
| 31007-T | 4 to 1 | 1% | 25/32 | 7/8 | 5/8 | 3/4 | %-16 |
| 31009-T | 1 to 2/0 | 1% | 7/8 | 1 | 3/4 | 3/4 | %-16 |
| 31011-T | 2/0 to 4/0 | 1% | 11/16 | 1¾6 | 7∕8 | 1 | 1/2-13 |
| 31013-T | 4/0 to 300 | 1% | 1¾6 | 1¾ | 11/16 | 1 | 1/2-13 |
| 31015-T | 300 to 500 | 25/32 | 1 5⁄16 | 11/2 | 11/4 | 1 | 1/2-13 |

G

В

Fig. B

Type FL

 $\vdash G \rightarrow$

В

Fig. A

Type MS

G Bolt Size

Female — Type FL

†With Filister Head Screw.

Male — Type MS

| | CABLE | | DIMENSIONS (IN.) | | | |
|--------------------|------------|------|------------------|--------|-------------------------------|--|
| CAT. NO. | SIZE | FIG. | G | Α | В | |
| 31262 [†] | 8 to 4 | А | 3/8-16 | 11/16 | 5/8 | |
| 31263 | 4 to 1 | В | 3/8-16 | 115/32 | 3/4 | |
| 31265 | 4 to 1 | В | 1/2-13 | 115/32 | 3/4 | |
| 31267 | 2/0 to 4/0 | В | 1/2-13 | 23/16 | ¹³ ⁄ ₁₆ | |

Designed to grip cable firmly between its strong body and serrated copper tongue.

LOCKTITE® LUG-IT One-Hole Lugs, Offset Tonque

- Double laps at top give greater thread strength and lock screw when tightened
- Copper tongue makes a low-resistance terminal
- For use with code copper conductor(600V)

T&B Recommended Tightening Torque for Copper Connections

| SIZE OF Conductor Ranges | WRENCH Torque InLBS. | SCREW DRIVER TORQUE INLBS. |
|--------------------------------|----------------------------|----------------------------------|
| 14 to 8 | _ | 20 |
| 8 to 4 | _ | 35 |
| 4 to 1 | 125 | _ |
| 1 to 2/0 | 150 | _ |
| 2/0 to 4/0 | 200 | _ |
| 4/0 to 300 | 250 | _ |
| 300 to 500 | 300 | _ |
| 500 to 750 | 300 | _ |
| 750 to 1,000 | 400 | _ |
| | | |



DIMENSIONS (IN.) **CABLE** CAT. NO. G Α D F SIZE 35301 14 to 6 #10 13/16 1/2 .064 7/32 35401 8 to 2 1/4 11/16 5/8 1/2 .081 1/4 35501*1 4 to 2/0 1/4 113/16 13/16 3/4 .101 3/8 35601*1 1/0 to 4/0 3/8 211/32 .128 13/32

* Aluminum body. †Hex head bolt.

Add suffix G to above Cat. Nos. for lug connector with green screw for grounding identification.

For torque requirements, see table at left.

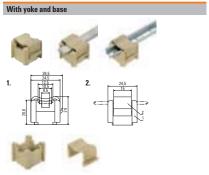


United States

Tel: 901.252.8000 800.816.7809 Fax: 901.252.1354 **Technical Services** Tel: 888.862.3289

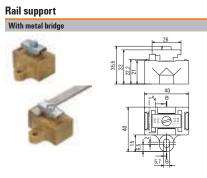


Rail support



SH 1

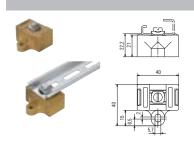
| Туре | Width | Height | Depth | Qty. | O dor ivo. |
|---------------------|--------------------------------|-------------------------------|-------|------|------------|
| SH 1 | 26 mm | 24.5 mm | 24 mm | 20 🤇 | 0299860000 |
| Individual par | ts | | | Qty. | Uruer wo. |
| SO SH1 | | | | 20 | 0401460000 |
| KLBUE SH1 | | | | 20 | 0635960000 |
| Screwable cro | oss-connection | | | | |
| BFSC M4X9T | | | | 100 | 0103300000 |
| BFSC M4X30 | | | | 50 | 0267100000 |
| SH 1: for busbar of | cross-section 10 x 3, 6 x 6, 1 | 5 x 2, 12 x 2, 15 x 2, 15 x 6 | | | |



SH 2S

| Туре | Width | Height | Depth | Qty. Order No. | |
|---------------------|-------------------------------------|--------|---------|-------------------|------|
| SH 2 S | 40 mm | 40 mm | 35.5 mm | 10 0641720 | 1000 |
| For busbar cross-se | ction 10 x 3, 6 x 6, 10 x 5, 15 x 6 | | | | |

Rail support



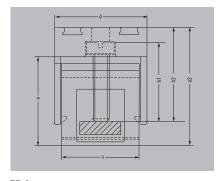
SH 2

| Туре | Width | Height | Depth | Qty. Order l | Vo. |
|----------------|--|--------|-------|-----------------|-------|
| SH 2 | 40 mm | 40 mm | 25 mm | 10 04949 | 20000 |
| The arrangemen | The state of the s | | | | |

Weidmüller ₹ C.13 2028740000

C

Clamping yoke, insulated



for busbar 10 x 3 mm



Solid 0.5...6 mm² Flexible Stranded Clamping screw М3 Stripping length 16 mm

ZB 4

| Туре | Colour | Width | Height | Depth | Qty. | Order No. |
|-------------|--------|--------|---------|---------|------|------------|
| ZB 4G BL | Silver | 7.4 mm | 19.5 mm | 27 mm | 50 | 0322180000 |
| ZB 4G GN/GE | Silver | 7.4 mm | 19.5 mm | 27 mm | 50 | 0322160000 |
| ZB 4G SW | Silver | 7.4 mm | 19.5 mm | 27 mm | 50 | 0322110000 |
| ZB 4K BL | Silver | 6 mm | 19 mm | 20.4 mm | 50 | 0475380000 |
| ZB 4K GE/GN | Silver | 6 mm | 19 mm | 20.4 mm | 50 | 0475360000 |
| | | | | | | |

for busbar 10 x 3 mm



1...10 mm² Solid Flexible 1.5...10 mm² Stranded Clamping screw M 4 Stripping length 19 mm

ZBE 6

| Туре | Colour | Width | Height | Depth | Qty. | Order No. |
|--------------|---------------|-------|---------|---------|------|------------|
| ZBE 6K BL | Blue | 8 mm | 22.5 mm | 19.5 mm | 50 | 0525980000 |
| ZBE 6K GE/GN | Yellow, Green | 8 mm | 22.5 mm | 19.5 mm | 50 | 0525960000 |
| ZBE 6K SW | Black | 8 mm | 22.5 mm | 19.5 mm | 50 | 0525910000 |
| | | | | | | |

for busbar 10 x 3 mm



Solid 2.5...16 mm² 2.5...16 mm² Flexible 16...25 mm² Stranded Clamping screw M 4 Stripping length 16 mm

ZB 16K

| Туре | Colour | Width | Height | Depth | Qty. | OrdenNo |
|--------------|--------|-------|--------|---------|------|------------|
| ZB 16K BL | Silver | 10 mm | 19 mm | 26.8 mm | 50 | 0502880000 |
| ZB 16K GE/GN | Silver | 10 mm | 19 mm | 26.8 mm | 50 | 0502860000 |
| | | | | | | |

for busbar 10 x 3 mm



Solid 16...16 mm² Flexible 16...35 mm² Stranded M 6 Clamping screw Stripping length 19 mm

ZB 35K

| Туре | Colour | Width | Height | Depth | Qty. | Order No. |
|--------------------|--------|-------|--------|-------|------|------------|
| ZB 35K BL M6X16 | Silver | 14 mm | 32 mm | 34 mm | 20 | 0502680000 |
| ZB 35K GE/GN M6X16 | Silver | 14 mm | 32 mm | 34 mm | 20 | 0502660000 |
| ZB 35K SW M6X16 | Silver | 14 mm | 32 mm | 34 mm | 20 | 0502610000 |
| | | | | | | |

for busbar 10 x 3 mm



Solid Flexible Stranded Clamping screw Stripping length 0.5...4 mm² 0.5...2.5 mm²

10 mm

ZF 4 S

| Туре | Colour | Width | Height | Depth | Qty. | Order No. |
|-----------|--------|--------|---------|-------|------|------------|
| ZF 4 S | Silver | 6.1 mm | 24.5 mm | 22 mm | 50 | 1814680000 |
| ZF 4 S BL | Silver | 6.1 mm | 24.5 mm | 22 mm | 50 | 1814660000 |
| ZF 4 S GN | Silver | 6.1 mm | 24.5 mm | 22 mm | 50 | 1814670000 |
| | | | | | | |

for busbar 6 x 6 mm



0.5...6 mm² Solid Flexible 0.5...4 mm² Stranded Clamping screw M 3 Stripping length 16 mm

ZB4/6K

| Туре | Colour | Width | Height | Depth | Qty. | Order No. |
|---------------|--------|-------|--------|---------|------|------------|
| ZB 4/6K BL | Silver | 6 mm | 25 mm | 14.7 mm | 50 | 0565480000 |
| ZB 4/6K GE/GN | Silver | 6 mm | 25 mm | 14.7 mm | 50 | 0565460000 |
| | | | | | | |

for busbar 6 x 6 mm



2.5...16 mm² Solid 2.5...16 mm² Flexible Stranded 16...25 mm² Clamping screw M 4 Stripping length 12 mm

ZB 16 / 6K

| Туре | Colour | Width | Height | Depth | Qty. | Order No. |
|----------------|--------|-------|--------|---------|------|------------|
| ZB 16/6K GE/GN | Silver | 10 mm | 25 mm | 30.7 mm | 50 | 0569660000 |
| | | | | | | |

Busbars, unslotted



SSch

| Туре | Material | Cross-section | Length | Rated current | Qty. | Order No. |
|----------------------|----------|---------------|---------|---------------|------|------------|
| SSCH 10X3X1000 CU/SN | Copper | 103 mm | 1000 mm | 140 A | 1 | 0348900000 |
| SSCH 10X3X1000 MS/BK | Brass | 103 mm | 1000 mm | 100 A | 1 | 0259800000 |
| SSCH 10X3X1000 ST/ZN | Steel | 103 mm | 1000 mm | | 1 | 0438000000 |
| SSCH 15X6X1000 CU/SN | Copper | 156 mm | 1000 mm | 265 A | 1 | 0357400000 |
| SSCH 6X6X1000 CU/SN | Copper | 66 mm | 1000 mm | 140 A | 1 | 0571300000 |
| | | | | | | |

Busbars, slotted



NSch / ESch

| Туре | Material | Cross-section | Length | Rated current | Qty. | Order No. |
|---------------|----------|---------------|---------|---------------|------|------------|
| ESCH 1 M | Steel | 122 mm | 1000 mm | 24 A | 1 | 0280300000 |
| NSCH 1M | Copper | 152 mm | 1000 mm | 24 A | 1 | 0280200000 |
| NSCH 2M | Copper | 152 mm | 2025 mm | 24 A | 2 | 1313600000 |
| Pressure pied | e | | | | Qty. | Order No. |
| DKSUE NSCH/ | 'ESCH | | | | 100 | 0280100000 |
| Clamping scr | ew | | | | | |
| BFSC M5X8 S | chlitz | - | | - | 100 | 0296700000 |
| | | | | | | |

Technical data

| Solid | 0.52.5 mm ² |
|------------------------|-------------------------|
| Stripping length | 9 mm |
| Cable lug to DIN 46234 | max. 16 mm ² |
| Current | 27 A |

New TWND Series – Full Size NEMA Pushbuttons



New! TWND Series: Heavy duty switches built to last Key features:

- Variety of button sizes up to 2 9/16" (65mm)
- Rugged construction includes chrome plated zinc locking ring die cast zinc mounting thread
- LED illumination
- Transformer or full voltage
- Slow make, double break wiping contacts
- Modular construction for maximum flexibility
- Available assembled or as sub-components
- UL Type 4X, 13 and IP65 watertight/oiltight panel

The rugged series of TWND switches offers both variety and durability in an attractive design.

With button sizes up to 2 9/16" (65mm), chrome plated zinc locking rings, die cast zinc mounting threads, steel anti-rotation rings, and self cleaning contacts, the TWNDs are here to stay.

The TWND series also offers LED illumination in full voltage and transformer models.

Regardless of your switching needs, the NEW TWND series provides the kind of long lasting, industrial strength quality you've come to expect from IDEC.











Specifications

746

| Conforming to Standards | EN60947-5-1, UL508, CSA C22-2 No.14 |
|--|---|
| Approvals | CSA: pushbuttons and selector switches: A600 pilot lights and illuminated pushbuttons, direct supply pilot lights and illuminated pushbuttons with integral transformer (100/110, 115, 120, 200/220, 230, 240, 380, 400/440, 480V) UL: pushbuttons and selector switches: A600 pilot lights and illuminated pushbuttons, direct supply pilot lights and illuminated pushbuttons with integral transformer (100/110, 115, 120, 200/220, 230, 240, 380, 400/440, 480V) TÜV: pushbuttons and selector switches: A600 pilot lights and illuminated pushbuttons, direct supply pilot lights and illuminated pushbuttons with integral transformer (100/110, 115, 120, 200/220, 230, 240, 380, 400/440, 480V) |
| Operating Temperature | Operation: -25 to $+50$ °C (illuminated versions) $-25 \sim +70$ C non-illuminated Storage: -40 to $+80$ °C (without freezing) C-> °C |
| Vibration Resistance | 5 to 55Hz, 98m/sec ² (10g) conforming to IEC60068-2-6 |
| Shock Resistance | 980m/sec ² (100g) conforming to IEC60068-2-27 |
| Electric Shock Protection | Class 2 conforming to IEC60664-1 |
| Degree of Protection | IP65 (from front of the panel) (conforming to IEC60529) UL Type 1, 2, 3, 3R, 3S, 4, 4X, 5, 12, 13 (conforming to NEMA ICS6-110) |
| Mechanical Life | Momentary pushbuttons: 5,000,000 (1800 operations per hour) All other switches: 500,000 |
| Pollution Degree (conforming to IEC60947-1) | 3 |

Mechanical-Electrical Specifications

| Rated Operational Characteristics | AC-15: A600 | | | | | | | | |
|---|--|--|---|-----------------|---------------------------------------|----------------|--|--|--|
| Rated Insulation Voltage | 600V | 300V | | | | | | | |
| Rated Impulse Withstanding Voltage øDielectric Strength | Between live and dead meta 2.5kV AC, 1 minute | etween live and dead metal parts 5kV AC, 1 minute | | | | | | | |
| Rated Thermal Current | 10 Amp | | | | | | | | |
| Minimum Switching Capacity | 5 mA at 3V AC/DC (applicab | le range may var | y with operating conditions and load | types) | | | | | |
| Contact Operation | Slow break NC or NO | | | | | | | | |
| Operating Force | Flush and extended pushbut Additional contacts—1NO of | | or 1NC contact: 6.2±2N (momentary), | , 9.0±1.5N | | | | | |
| | Unit | | Wire | Number of Wires | Recommended Tightening Torque (Nm) | Terminal Screw | | | |
| | HW-U Contact Block | | Crimping Terminal | 2 | 1.0 to 1.3 | | | | |
| Recommended Terminal Torque | | Solid Wire | ø0.5 to 1.6 mm (AWG14 to 22) | 2 | 1.0 to 1.3 | M3.5 | | | |
| | | John Wile | ø1.7 to 2.0 mm (AWG12) | 1 | 1.2 to 1.3 | | | | |
| | | Stranded Wire | 0.3 to 2.0 mm ² (AWG14 to 22) | 2 | 1.0 to 1.3 | | | | |
| | | Stranueu vviie | 2.1 to 3.5 mm ² (AWG12) | 1 | 1.2 to 1.3 | | | | |
| | | Crimping Terminal | | | | | | | |
| | Illuminated Unit (*1) | Solid Wire | ø0.5 to 1.6 mm (AWG14 to 22) | 2 | 1.0 to 1.3 | M3.5 | | | |
| | | Stranded Wire | 0.3 to 2.0 mm (AWG14 to 22) | | | | | | |
| | | | Crimping Terminal | | 0.6 to 1.0 (N | 13.0) | | | |
| Applicable Wire Size | Pilot Light | Solid Wire | ø0.5 to 1.6 mm (AWG14 to 22) | 2 | 1.0 to 1.2 /\ | 10 E) | | | |
| | | Stranded Wire | ø0.3 to 2.0 mm (AWG14 to 22) | | 1.0 to 1.3 (N | 13.5) | | | |
| | 1. * refers to the lar | np terminals of the i | illuminated push buttons and selector switc | hes. | | | | | |
| Contact Resistance | Initial contact resistance of | 50mΩ or less | | | | | | | |
| Contact Gap | 4mm (NO and NC) 2mm (NO-EM and NC-LB) | | | | | | | | |
| LED Ratings | LEDs: 6V: 8mA, 12V: 11mA, | 24V: 11mA, 120V | : 8.8mA, 240V: 8.6mA | | | | | | |
| Contact Material | Silver | | | | | | | | |
| | | | | | | | | | |

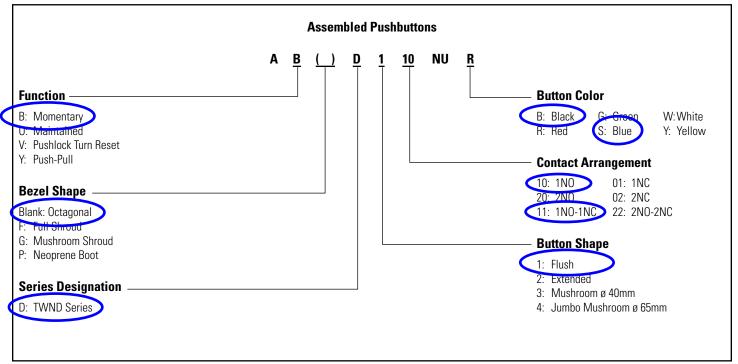
Contact Ratings

| Contact Ratings by Utilization Category IEC 60947-5-1 | | AC-15 (A600) | | | | | | | |
|---|--|---|--------------------------------|-----|-----|------|------|------|----|
| Contact natings by Ot | Contact natings by Othization Gategory IEC 00347-5-1 | | DC-13 (P600) | | | | | | |
| | | Contact R | atings by Utilization Category | | | | | | |
| Operational Voltage | | | 24V | 48V | 50V | 110V | 220V | 440V | |
| | AC 50/60 Hz | AC-12 Control of resistive loads & solid state lo | oads | 10A | _ | 10A | 10A | 6A | 2A |
| Operation Current | AC 50/00 HZ | AC-15 Control of electromagnetic loads (> 72V/ | 4) | 10A | - | 7A | 5A | 3A | 1A |
| | DC | DC-12 Control of resistive loads & solid state lo | oads | 10A | 5A | _ | 2.2A | 1.1A | _ |
| | DC-13 Control of electromagnets | | | 5A | 2A | _ | 1.1A | 0.6A | _ |



Non-Illuminated Pushbuttons (Assembled)







- 1. Use only when interpreting part numbers. Do not use for developing part numbers.
- 2. Custom contact configurations available, contact IDEC for details.

Non-Illuminated Pushbuttons (Assembled)

Non-Illuminated Pushbuttons

| Non-illuminated Pu | Style | Contacts | Momentary | Maintained |
|--|-------|-------------------------------------|---|--|
| Flush | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD110NU® ABD101NU® ABD111NU® ABD120NU® ABD102NU® | AOD110NU® AOD101NU® AOD111NU® AOD120NU® AOD102NU® |
| Extended | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD210NU® ABD201NU® ABD211NU® ABD220NU® ABD202NU® | AOD210NU® AOD201NU® AOD211NU® AOD220NU® AOD202NU® |
| Extended with Neoprene Boot [†] | | 1NO 1NC 1NO-1NC 2NO 2NC | ABPD210NU® ABPD201NU® ABPD211NU® ABPD220NU® ABPD202NU® | AOPD210NU® AOPD201NU® AOPD211NU® AOPD220NU® AOPD202NU® |
| Recessed | | 1NO 1NC 1NO-1NC 2NO 2NC | ABFD110NU® ABFD101NU® ABFD111NU® ABFD120NU® ABFD102NU® | AOFD110NU® AOFD101NU® AOFD1111NU® AOFD120NU® AOFD102NU® |
| Extended with Full Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABFD210NU® ABFD201NU® ABFD211NU® ABFD220NU® ABFD220NU® | AOFD210NU® AOFD201NU® AOFD211NU® AOFD220NU® AOFD202NU® |
| ø 40mm Mushroom Head | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD310NU® ABD301NU® ABD311NU® ABD320NU® ABD302NU® | AOD310NU® AOD301NU® AOD311NU® AOD320NU® AOD302NU® |
| ø 40mm Mushroom Head with Full Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABGD310NU® ABGD301NU® ABGD311NU® ABGD320NU® ABGD302NU® | AOGD310NU® AOGD301NU® AOGD311NU® AOGD320NU® AOGD302NU® |
| ø 65mm Jumbo Mushroom Head | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD410NU® ABD401NU® ABD411NU® ABD420NU® ABD420NU® | AOD410NU® AOD401NU® AOD411NU® AOD420NU® AOD402NU® |
| ø 65mm Jumbo Mushroom Head with Shallow Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABGD410NU® ABGD401NU® ABGD411NU® ABGD420NU® ABGD402NU® | AOGD410NU® AOGD401NU® AOGD411NU® AOGD420NU® AOGD402NU® |
| ø 65mm Jumbo Mushroom Head With Deep Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABFD410NU® ABFD401NU® ABFD411NU® ABFD420NU® ABFD402NU® | AOFD410NU® AOFD401NU® AOFD411NU® AOFD420NU® AOFD402NU® |

① Button Color Codes

| Color | Code | | |
|--------|------|--|--|
| Black | В | | |
| Green | G | | |
| Red | R | | |
| Blue | S | | |
| Yellow | Υ | | |
| White | W | | |



- 1. 65mm Jumbo mushroom not available in white.
- 2. Neoprene boot is not available in blue or white.

1. In place of ①, specify the Button Color Code.

For sub-assembly part numbers, see next page.
 Neoprene boot available only in Black (B), Green (G), Red (R) and Yellow (Y).



Non-Illuminated Pushbuttons (Sub-Assembled)



Operators

| Uperators | | | | |
|---|-------------|------------|-------------|--|
| | Part Number | | | |
| | Style | Momentary | Maintained | |
| Flush/Extended | | ABD1200T8 | AOD1200T8 | |
| Extended with Full Shroud | | ALFD2300T8 | AOLFD2300T8 | |
| ø 40mm Mushroom/ø 65mm Jumbo Mushroom | 6 | ABD3400T8 | A0D3400T8 | |
| ø 40mm Mushroom with Full Shroud | | ABGD-300T | AOGD-300T | |
| ø 65mm Jumbo Mushroom with Shallow Shroud | 0 | ABGD-400T | AOGD-400T | |
| ø 65mm Jumbo Mushroom with Deep Shroud | | ABFD-400T | AOFD-400T | |

Buttons and Lenses

| | Style | Part Number |
|--------------------------|-------|-------------|
| Flush | | ABD1BN-⊕ |
| Extended | | ABD2BN-① |
| ø 40mm Mushroom | | ABD3BN-① |
| ø 65mm Jumbo Mushroom | | ABD4BN-⊕ |



In place of ①, specify the Button Color Code. (See table previous page)

Contact Blocks

| | Part Number | | |
|-------------------|-------------|---------------------------------------|---------------------------------------|
| | 1N0 | 1NC | |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) |
| Dummy Block | | HW | -DB |

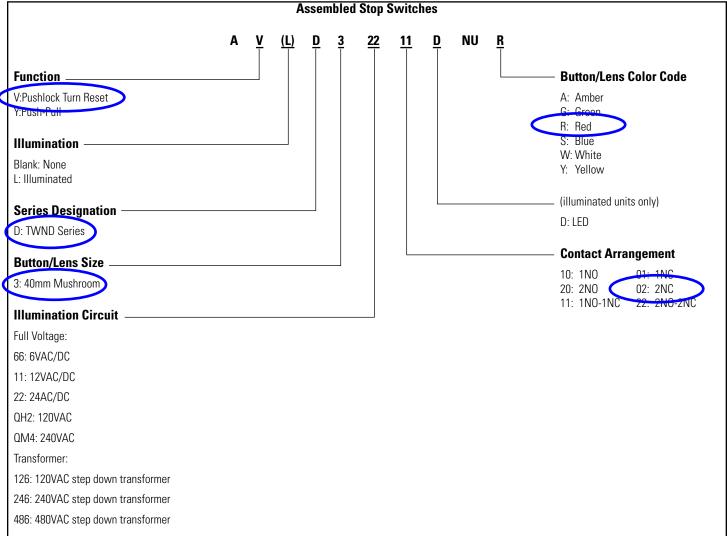


Dummy blocks (no contacts) are used with an odd number of contact blocks.

Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or closed, when switch is moved between two positions).

Stop Switches (Assembled)







- . Use only when interpreting part numbers. Do not use for developing part numbers.
- Custom contact configurations available, contact IDEC for details.

Stop Switches (Assembled)

Stop Switches

| Style | | Contacts | Part Number |
|--|-----------------|-------------------------------------|--|
| ø 40mm Pushlock Turn Reset | Non-Illuminated | 1N0 1NC 1NO-1NC 2NO 2NC | AVD310NUR* AVD301NUR* AVD311NUR* AVD320NUR* AVD302NUR* |
| ø 40mm Illuminated Pushlock Turn Reset | Full Voltage | 1NO-1NC 2NO 2NC | AVLD3@11DNUR* AVLD3@20DNUR* AVLD3@02DNUR* |
| | Transformer | 1NO-1NC 2NO 2NC | AVLD3 ⊕ 11DNUR* AVLD3 ⊕ 20DNUR* AVLD3 ⊕ 02DNUR* |
| ø 40mm Push-Pull | Non-Illuminated | 1NO 1NC 1NO-1NC 2NO 2NC | AYD310NU® AYD301NU® AYD311NU® AYD320NU® AYD302NU® |
| ø 40mm Illuminated Push-Pull | Full Voltage | 1NO-1NC 2NO 2NC | AYLD3③11DNU② ** AYLD3③20DNU② ** AYLD3③02DNU② ** |
| | Transformer | 1NO-1NC 2NO 2NC | AYLD3 |



- 1. In place of ①, specify the button color code
- 2. In place of ②, specify the lens color code.
- 3. In place of ③, specify the Full Voltage (lamp voltage) Code.
- 4. * Only available in red.
 5. In place of ①, specify the transformer voltage code.
 6. **Not available in blue.
- 7. For sub-assembly part numbers, see next page.
- 8. For nameplates and accessories, see page 769 and page 767.
- 9. For dimensions, see page 772.

① Button Color Codes

| Color | Code | | |
|--------|------|--|--|
| Black | В | | |
| Green | G | | |
| Red | R | | |
| Blue | S | | |
| Yellow | Υ | | |

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |
| | |

3 Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |

4 Transformer Voltage Codes

| Voltage | Code |
|---------|------|
| 120VAC | 126 |
| 240VAC | 246 |
| 480VAC | 486 |



Transformers step down to 6V.

Stop Switches (Sub-Assembled)

| Transformer* | + | Operator | + | Lamp | + | Button/Lens | = | Complete Part |
|--------------|---|----------|---|------|---|-------------|---|---------------|
| | | 6 | | | | | | |

^{*} Not required for full voltage units.

Operators

| St | Part Number | |
|---|-------------|----------|
| ø40mm Illuminated and Non-illuminated Pushlock Turn Reset | 6 | AVD000T8 |
| ø 40mm Illuminated and Non-illuminated Push-Pull | 6 | AYD000T8 |

Buttons and Lenses

| Style | | Part Number |
|--|--------|-------------|
| Button for Pushlock Turn Reset Stop Switches (ø40mm, red only) | | AVN3B-R |
| Lens for Illuminated Pushlock Turn Reset Stop Switches (ø40mm, red only) | | AVLN3LU-R |
| Button for Push-Pull Stop Switches (ø40mm) | | AYD3BN-⊕ |
| Lens for Illuminated Push-Pull Stop Switches (ø40mm) | 2 pos* | AYLD3L-② |



- 1. In place of ①, specify the Button Color Code. (See table below)
- In place of ②, specify the LED Color Code.
 *Not available in blue.

Lamp Circuit Components

| Style | Application | Part Number |
|------------------|--|-------------|
| Long Lamp Holder | Used with Full-size Transformer and two contact blocks Used with Full Voltage Adaptor and two contact blocks | TW-LH2 |
| Lead Holder | Used with TW-LH2 holder when using four contact blocks | HW-LH3 |

Lamps

| Style | Voltage | Part Number | |
|-------|-----------|-------------|--|
| LED | 6V AC/DC | LSTD-6③ | |
| | 12V AC/DC | LSTD-13 | |
| | 24V AC/DC | LSTD-23 | |
| | 120V AC | LSTD-H2® | |
| | 240V AC | LSTD-M43 | |



1. In place of ②, specify the LED color code. 2. The LED contains a current-limiting resistor and a protection diode.

① Button Color Codes

| Color | Code |
|--------|------|
| Black | В |
| Green | G |
| Red | R |
| Blue | S |
| Yellow | Υ |

② Lens Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| | |

③ LED Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| | |

Contact Blocks

| Style | | Part Number | |
|-------------------|----------|---------------------------------------|---------------------------------------|
| All Control Units | 3 | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) |
| Dummy Block | | HW | -DB |



- Dummy blocks (no contacts) are used with an odd number of contact blocks.
 Combining HW-U10R-F and HW-U01R-F result in overlapping contacts.

Transformers

| Style | Primary Voltage (50/60Hz) | Part Number |
|-------|------------------------------|-------------|
| TE | 120V AC | TW-F126B |
| | 240V AC | TW-F246B |
| | 480V AC | HW-L486 |



6V secondary voltage (uses 6V LED).

Full Voltage Modules

| | Style | | Description | Part Number |
|--|-------|---------------------------------------|-------------|-------------|
| Dummy Block with Full Voltage Adaptor | | For use with odd number of contacts. | Finger-Safe | HW-DA1FBN |
| Full Voltage Adaptor | | For use with even number of contacts. | Finger-Safe | TW-DA1FB |

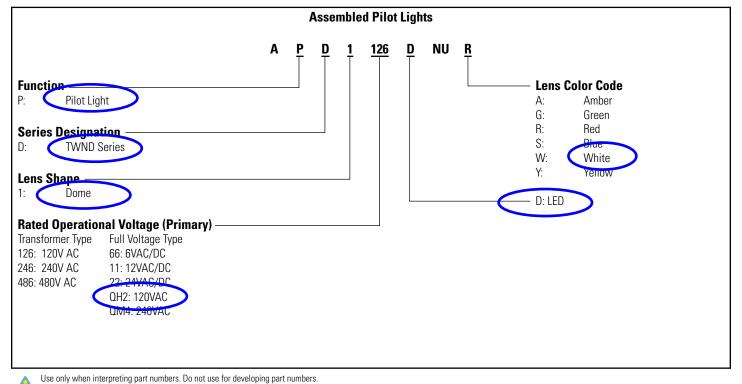


All Transformers step down to 6V (use 6V lamp).



Pilot Lights (Assembled)





LED Pilot Lights

Style

Operating Voltage

IED

Transformer Dome

120V AC 240V AC 480V AC 480V AC APD1246DNU② APD1486DNU②

Full Voltage Dome

— APD1③DNU②



- 1. In place of $\ensuremath{\mathfrak{D}}$, specify the Lens/LED Color Code.
- 2. In place of ③, specify the Full Voltage Code (LED voltage).
- 3. Yellow pilot light comes with white LED.

2 Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |
| | |

③ Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |
| | |

Pilot Lights (Sub-Assembled)



| | One Each from Left Colur | mn | plus | One Selection from Right Colum | n |
|-----------|--------------------------|----|------|--------------------------------|---|
| Operators | | | Fu | l Voltage Clips | |
| | | | | | |

| - | | |
|--------------------------------|-------|-------------|
| | Style | Part Number |
| Transformer or FULL Voltage | | APD09ST8 |

Lenses

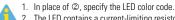
| Style | | Part Number |
|-----------|--|-------------|
| Dome Lens | | APN106LN-@ |



1. In place of ②, specify the Lens Color Code.

Lamps

| | Style | Voltage | Part Number |
|-----|-----------|----------|-------------|
| | | 6V AC/DC | LSTD-6® |
| LED | 12V AC/DC | LSTD-13 | |
| | 24V AC/DC | LSTD-2③ | |
| | 120V AC | LSTD-H2® | |
| | 240V AC | LSTD-M43 | |



2. The LED contains a current-limiting resistor and a protection diode.

| Primary Voltage (50/60Hz) | Part Number |
|---------------------------|-------------|
| Per | APD-F |



Required for all full voltage models. Two pieces each. 2 clips required for full voltage pilot lights

Transformers (only for Pilot Lights)

| Style | Primary Voltage (50/60Hz) | Part N | umber |
|-------|------------------------------|----------|----------|
| | 120V AC | TWD-0126 | |
| LED | | 240V AC | TWD-0246 |
| | | 480V AC | TWD-0486 |



6V secondary voltage (use 6V lamp).

2 Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

3 LED Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |

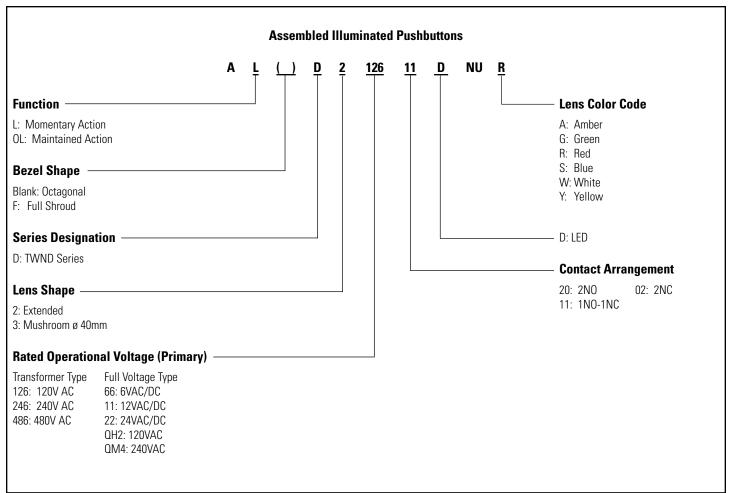


Yellow LED not available, use white LED with Yellow lens.



Illuminated Pushbuttons (Assembled)







- 1. Use only when interpreting part numbers. Do not use for developing part numbers.
- 2. All transformers step down to 6V.

Illuminated Pushbuttons (Assembled)

Illuminated Pushbuttons

| Part Number | | | | |
|--------------------------------|--------------|-----------------------|--|---|
| Style | | Contacts | | |
| | | | Momentary | Maintained |
| Extended Lens | Full Voltage | 1NO-1NC 2NO 2NC | ALD2@11DNU@ ALD2@20DNU@ ALD2@02DNU@ | AOLD2@11DNU@ AOLD2@20DNU@ AOLD2@02DNU@ |
| | Transformer | 1NO-1NC 2NO 2NC | ALD2 ⊕ 11DNU@ ALD2 ⊕ 20DNU@ ALD2 ⊕ 02DNU@ | AOLD2 @ 11DNU@ AOLD2 @ 20DNU@ AOLD2 @ 02DNU@ |
| Extended Lens with Full Shroud | Full Voltage | 1NO-1NC 2NO 2NC | ALFD2@11DNU@ ALFD2@20DNU@ ALFD2@02DNU@ | AOLFD2③11DNU② AOLFD2③20DNU② AOLFD2③02DNU② |
| | Transformer | 1NO-1NC 2NO 2NC | ALFD2 @ 11DNU@ ALFD2 @ 20DNU@ ALFD2 @ 02DNU@ | AOLFD2 	 11DNU@ AOLFD2 	 20DNU@ AOLFD2 	 02DNU@ |
| ø 40mm Mushroom Lens | Full Voltage | 1NO-1NC 2NO 2NC | ALD3@11DNU@ ALD3@20DNU@ ALD3@02DNU@ | AOLD3@11DNU@ AOLD3@20DNU@ AOLD3@02DNU@ |
| | Transformer | 1NO-1NC 2NO 2NC | ALD3 | AOLD3 @ 11DNU@ AOLD3 @ 20DNU@ AOLD3 @ 02DNU@ |

② Lens Color Codes

| Color | Code | |
|--------|------|--|
| Amber | Α | |
| Green | G | |
| Red | R | |
| Blue | S | |
| White | W | |
| Yellow | Υ | |

3 Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |
| | |

4 Transformer Voltage Codes

| Voltage | Code |
|---------|------|
| 120VAC | 126 |
| 240VAC | 246 |
| 480VAC | 486 |



6V secondary voltage (uses 6V LED).

- 1. In place of ②, specify the Lens Color Code.
- In place of ③, specify the Full Voltage Code (LED voltage).
 In place of ④, specify the Transformer Voltage Code.
 Light is independent of switch position.

- 5. Yellow pushbutton comes with white LED only.

Illuminated Pushbuttons (Sub-Assembled)



^{*}Not required for full voltage types.

Operators

| | Style | Part Number | | |
|------------------------------|-------|-------------|-------------|--|
| | Style | Momentary | Maintained | |
| Extended | 6 | ALD2300T8 | A0LD2300T8 | |
| Extended with Full Shroud | | ALFD2300T8 | AOLFD2300T8 | |
| 40mm Mushroom | 6 | ALD2300T8 | A0LD2300T8 | |

Lamps

| Style | Voltage | Part Number | |
|-------|-----------|-------------|--|
| LED | 6V AC/DC | LSTD-6® | |
| LED | 12V AC/DC | LSTD-13 | |
| | 24V AC/DC | LSTD-23 | |
| | 120V AC | LSTD-H2® | |
| | 240V AC | LSTD-M43 | |



 In place of ②, specify the LED color code.
 The LED contains a current-limiting resistor and a protection diode.

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

3 LED Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |



Yellow lens only. Yellow LED not available, use white LED.

Lenses

| | Part Number | |
|-----------------|-------------|-----------|
| Extended | | ALN06LU-@ |
| ø 40mm Mushroom | | ALN3LU-@ |



In place of $\ensuremath{\mathfrak{D}}$, specify the Lens Color Code.

Lamp Circuit Components

| Style | Application | Part Number |
|------------------|--|-------------|
| Long Lamp Holder | Used with Full-size Transformer and two contact blocks Used with Full Voltage Adaptor and two contact blocks | TW-LH2 |
| Lead Holder | Used with TW-LH2 holder when using four contact blocks | HW-LH3 |

Contact Blocks

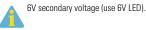
| Style | | Part Number | | |
|-------------------|---|---------------------------------------|---------------------------------------|--|
| | , | 1N0 | 1NC | |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) | |
| Dummy Block | | HW | '-DB | |



- 1. Dummy blocks (no contacts) are used with an odd number of contact blocks.
- Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or closed, when switch is moved between two positions).

Transformers

| Style | | Primary Voltage (50/60Hz) | Part Number |
|--------------|---|------------------------------|-------------|
| | | 120V AC | TW-F126B |
| Transformers | | 240V AC | TW-F246B |
| | - | 480V AC | HW-L486 |



Full Voltage Modules

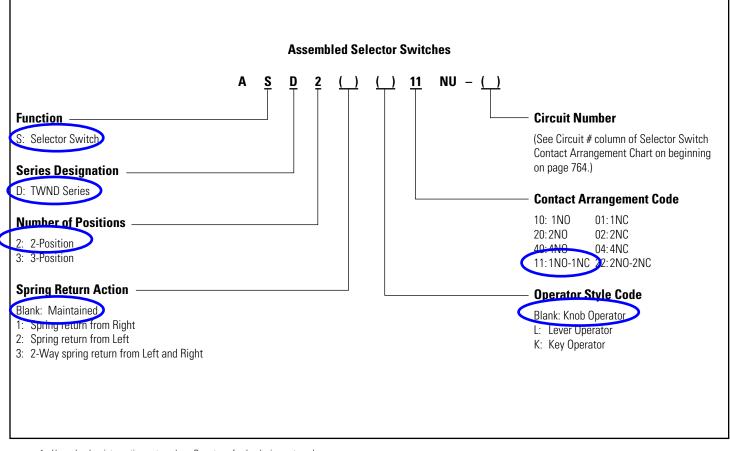
| | Style | | Description | Part Number |
|--|-------|---------------------------------------|-------------|-------------|
| Dummy Block with Full Voltage Adaptor | | For use with odd number of contacts. | Finger-Safe | HW-DA1FBN |
| Full Voltage Adaptor | | For use with even number of contacts. | Finger-Safe | TW-DA1FB |



All Transformers step down to 6V (use 6V lamp).

Non-Illuminated Selector Switches (Assembled)







- 1. Use only when interpreting part numbers. Do not use for developing part numbers.
- 2. Custom key removal codes available. Please contact IDEC for details.

Non-Illuminated Selector Switches (Assembled)

Non-Illuminated 2-Position Selector Switches

| | Style | | /le | | Part Number | | |
|------------|------------------|------------------|------------------|----------------------|--|---|---|
| act | ıting | Oper Pos | rator ition | | Maintained | Spring Return from Right | Spring Return from Left |
| Contact | Mounting | L | R | | L R | L R | L ^C R |
| 1N0 | 1 2 | 0 0 | X 0 | Knob Lever Key | ASD210NU ASD2L10NU ASD2K10NU | ASD2110NU ASD21L10NU ASD21K10NU | ASD2210NU ASD22L10NU ASD22K10NU |
| 1NC | 1 2 | X 0 | 0 0 | Knob Lever Key | ASD201NU ASD2L01NU ASD2KUTNU | ASD2101NU ASD21L01NU ASD21K01NU | ASD2201NU ASD22L01NU ASD22K01NU |
| 1NO 1NC | 1 2 | 0 X | X 0 | Knob Lever Key | ASD211NU ASD2L11NU ASD2K11NU | ASD2111NU ASD21L11NU ASD21K11NU | ASD2211NU ASD22L11NU ASD22K11NU |
| 2N0 | 1 2 | 0 0 | X X | Knob Lever Key | ASD220NU ASD2L20NU ASD2K20NU | ASD2120NU ASD21L20NU ASD21K20NU | ASD2220NU ASD22L20NU ASD22K20NU |
| 2NC | 1 2 | X X | 0 0 | Knob Lever Key | ASD202NU ASD2L02NU ASD2K02NU | ASD2102NU ASD21L02NU ASD21K02NU | ASD2202NU ASD22L02NU ASD22K02NU |
| 2N0 2NC | 1 2 3 4 | 0 X 0 X | X 0 X 0 | Knob Lever Key | ASD222NU ASD2L22NU ASD2K22NU | ASD2122NU ASD21L22NU ASD21K22NU | ASD2222NU ASD22L22NU ASD22K22NU |
| 2NO 2NC | 1 2 3 4 | 0 0 X X | X X 0 0 | Knob Lever Key | ASD222NU-111 ASD2L22NU-111 ASD2K22NU-111 | ASD2122NU-111 ASD21L22NU-111 ASD21K22NU-111 | ASD2222NU-111 ASD22L22NU-111 ASD22K22NU-111 |



- The truth table indicates the operating position of contact block when the operator is switched to that position.
 - X = On (closed contacts) O = Off (open contacts)
 X—X = Overlapping Contacts: Remain on (closed contacts) when switch is moved between these two positions.
- All knob and lever selector switches come in black.
 Other colors are available by ordering the knob or lever separately.
- 3. Custom contact arrangements available, see page 764.

Non-Illuminated 3-Position Selector Switches

| Style | | | | | | | Part Number | | | | | |
|------------|------------------|-------------------|--------------------|--------------------|----------------------|--|---|---|---|--|--|--|
| + | ВL | Operator Position | | | | Maintained | Spring Return from Right | Spring Return from Left | Spring Return Two-Way | | | |
| Contact | Mounting | L | C | R | | L C R | L C R | L C R | L C R | | | |
| 2N0 | 1 2 | X 0 | 0 0 | 0 X | Knob Lever Key | ASD320NU ASD3L20NU ASD3K20NU | ASD3120NU ASD31L20NU ASD31K20NU | ASD3220NU ASD32L20NU ASD32K20NU | ASD3320NU ASD33L20NU ASD33K20NU | | | |
| 2NC | 1 2 | 0 X | X—X | —X 0 | Knob Lever Key | ASD302NU ASD3L02NU ASD3K02NU | ASD3102NU ASD31L02NU ASD31K02NU | ASD3202NU ASD32L02NU ASD32K02NU | ASD3302NU ASD33L02NU ASD33K02NU | | | |
| 2N0 2NC | 1 2 3 4 | X 0 0 X | 0 0 X— X | 0 X —X 0 | Knob Lever Key | ASD322NU ASD3L22NU ASD3K22NU | ASD3122NU ASD31L22NU ASD31K22NU | ASD3222NU ASD32L22NU ASD32K22NU | ASD3322NU ASD33L22NU ASD33K22NU | | | |
| 2N0 2NC | 1 2 3 4 | X X 0 0 | 0 | X 0 0 X | Knob Lever Key | ASD322NU-309 ASD3L22NU-309 ASD3K22NU-309 | ASD3122NU-309 ASD31L22NU-309 ASD31K22NU-309 | ASD3222NU-309 ASD32L22NU-309 ASD32K22NU-309 | ASD3322NU-309 ASD33L22NU-309 ASD33K22NU-309 | | | |
| 2N0 2NC | 1 2 3 4 | 0 0 0 0 | X 0 X 0 | 0 X 0 X | Knob Lever Key | ASD322NU-310 ASD3L22NU-310 ASD3K22NU-310 | ASD3122NU-310 ASD31L22NU-310 ASD31K22NU-310 | ASD3222NU-310 ASD32L22NU-310 ASD32K22NU-310 | ASD3322NU-310 ASD33L22NU-310 ASD33K22NU-310 | | | |
| 4N0 | 1 2 3 4 | X 0 X 0 | 0 0 0 | 0 X 0 X | Knob Lever Key | ASD340NU ASD3L40NU ASD3K40NU | ASD3140NU ASD31L40NU ASD31K40NU | ASD3240NU ASD32L40NU ASD32K40NU | ASD3340NU ASD33L40NU ASD33K40NU | | | |
| 4NC | 1 2 3 4 | 0 X 0 X | X——X ——X ——X | —X 0 —X 0 | Knob Lever Key | ASD304NU ASD3L04NU ASD3K04NU | ASD3104NU ASD31L04NU ASD31K04NU | ASD3204NU ASD32L04NU ASD32K04NU | ASD3304NU ASD33L04NU ASD33K04NU | | | |

Non-Illuminated Selector Switches (Sub-Assembled)

| Contact Blocks | + | Operator | + | Knob or Lever* | + | Color Insert* | = | Complete Part [†] |
|----------------|---|----------|---|----------------|---|---------------|---|----------------------------|
| | | 6 | | | | | | |

ø30mm - TWND Series

*Not needed with key type switches.

†Knob type shown.

Operators

| Style | Position | Description | Part Number |
|------------|----------|--|----------------------------|
| | | Maintained | ASD0201T8 |
| | 2 | Spring return from right | ASD0213T8 |
| Knob/Lever | | Spring return from left | ASD0224T8 |
| KHOD/LEVE | | Maintained, Cam 1 Maintained, Cam 2 | ASD0302T8 ASD0306T8 |
| | 3 | Spring return from right, Cam 1 Spring return from right, Cam 2 | ASD0314T8 ASD0310T8 |
| | 3 | Spring return from left, Cam 1 Spring return from left, Cam 2 | ASD0323T8 ASD0328T8 |
| | | Spring return from left/right, Cam 1 Spring return from left/right, Cam 2 | ASD0335T8 ASD0339T8 |
| | | Maintained | ASD0201KT8 |
| | 2 | Spring return from right | ASD0213KT8 |
| Key | | Spring return from left | ASD0224KT8 |
| | | Maintained, Cam 1 Maintained, Cam 2 | ASD0302KT8 ASD0306KT8 |
| | 3 | Spring return from right, Cam 1 Spring return from right, Cam 2 | ASD0302KT8B ASD0310KT8B |
| | 3 | Spring return from left, Cam 1 Spring return from left, Cam 2 | ASD0323KT8 ASD0310KT8B |
| | | Spring return from left/right, Cam 1 Spring return from left/right, Cam 2 | ASD0335KT8 ASD3K339KT8 |



- 1. Order knobs, levers, color inserts separately (see below).
- 2. For key switches, keys are removable in all maintained positions. Other options available, contact IDEC for details.
- 3. See page 766 "Operator Truth Tables" for details of difference between cams.

① Color Codes

| Knob/Lever Color | Code |
|------------------|------|
| Black | В |
| Blue | S |
| Green | G |
| Red | R |
| Yellow | Υ |
| White | W |
| | |



- Knob/Lever not available in white.
- Color inserts not available in Black.
- 3. Lever not available in yellow.

Handles and Inserts

Switches & Pilot Devices

| | Style | | | | | | |
|--------------|-------|-----------|--|--|--|--|--|
| Knob | | ASDHHY-① | | | | | |
| Lever | | ASDHHL-⊕* | | | | | |
| Color Insert | | TW-HC1-① | | | | | |



1. In place of ①, specify the Color Code. *Not available in yellow.

Contact Blocks

| | Part Number | | |
|-------------------|-------------|---------------------------------------|---------------------------------------|
| | Style | 1N0 | 1NC |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) |
| Dummy Block | | HW | '-DB |

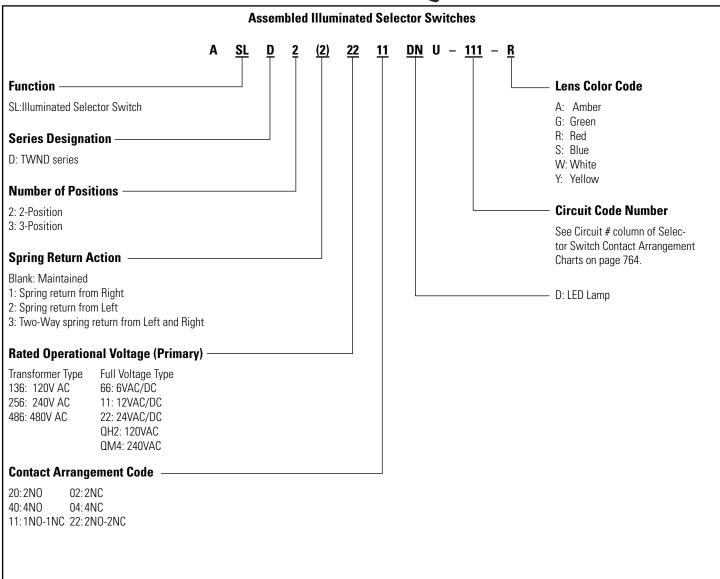


Dummy blocks (no contacts) are used with an odd number of contact blocks.
 Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or

closed, when switch is moved between two positions).

Illuminated Selector Switches (Assembled)







Use only when interpreting part numbers. Do not use for developing part numbers.

Illuminated Selector Switches (Assembled)

Illuminated 2-Position Selector Switches

| | St | yle | | | Part Number | | | | | |
|------------|------------------|------------------|------------------|-----------------------------|--|--|---|--|--|--|
| Contact | ting | | rator ition | Lamp | Maintained | Spring Return from Right | Spring Return from Left | | | |
| | Mounting | L | R | Circuit Type | L\R | L\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\ | L ^C R | | | |
| 1NO 1NC | 1 2 | 0 X | X 0 | Transformer Full Voltage | ASLD2 @11DNU@ ASLD2@11DNU@ | ASLD21 @11DNU@ ASLD21@11DNU@ | ASLD22 @11DNU@ ASLD22@11DNU@ | | | |
| 2N0 | 1 2 | 0 0 | X X | Transformer Full Voltage | ASLD2 @20DNU@ ASLD2 @20DNU@ | ASLD21 @20DNU@ ASLD21 @20DNU@ | ASLD22 @20DNU@ ASLD22 @20DNU@ | | | |
| 2NC | 1 2 | X | 0 0 | Transformer Full Voltage | ASLD2 @02DNU-@ ASLD2 @02DNU-104-@ | ASLD21 | ASLD22 | | | |
| 2N0 2NC | 1 2 3 4 | 0 X 0 X | X 0 X 0 | Transformer Full Voltage | ASLD2 @22DNU@ ASLD2 @22DNU@ | ASLD21 @22DNU@ ASLD21 @22DNU@ | ASLD22 ⊕22DNU@ ASLD22③22DNU@ | | | |
| 2N0 2NC | 1 2 3 4 | 0 0 X X | X X 0 0 | Transformer Full Voltage | ASLD2 @22DNU-111-@ ASLD2 @22DNU-111-@ | ASLD21 @22DNU-111-@ ASLD21 @22DNU-111-@ | ASLD22 ⊕22DNU-111-@ ASLD22③22DNU-111-@ | | | |

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

③ Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |

Illuminated 3-Position Selector Switches, Maintained and Spring Return

| Style | | | | | | Part Number | | | | |
|------------|------------------|------------------|--------------------|--------------------|-----------------------------|--|--|--|--|--|
| + | бı | Oper | Operator Position | | | Maintained | Spring Return From Right | Spring Return from Left | Spring Return Two-Way | |
| Contact | Mounting | L | C ↑ | R | Lamp Circuit Type | C R | L C R | L C R | L C R | |
| 2N0 | 1 2 | X 0 | 0 0 | 0 X | Transformer Full Voltage | ASLD3 ⊕ 20DNU@ ASLD3@20DNU@ | ASLD31 @ 20DNU@ ASLD31@20DNU@ | ASLD32 @ 20DNU@ ASLD32@20DNU@ | ASLD33 ⊕ 20DNU@ ASLD33③20DNU@ | |
| 2NC | 1 2 | 0 X— | X— —X | —X 0 | Transformer Full Voltage | ASLD3 @ 02DNU@ ASLD3@02DNU@ | ASLD31 @ 02DNU@ ASLD31@02DNU@ | ASLD32 @ 02DNU@ ASLD32@02DNU@ | ASLD33 ⊕ 02DNU@ ASLD33③02DNU@ | |
| 2NO 2NC | 1 2 3 4 | X 0 0 X | 0 0 X— —X | 0 X X 0 | Transformer Full Voltage | ASLD3 @ 22DNU@ ASLD3 @ 22DNU@ | ASLD31 @ 22DNU@ ASLD31 @ 22DNU@ | ASLD32 | ASLD33 @ 22DNU@ ASLD33@22DNU@ | |
| 2N0 2NC | 1 2 3 4 | X X 0 0 | 0 —X X 0 | X 0 0 X | Transformer Full Voltage | ASLD3 @ 22DNU-309-@ ASLD3 @ 22DNU-309-@ | ASLD31 @ 22DNU-309-@ ASLD31@22@DNU-309-@ | ASLD32 @ 22DNU-309-@ ASLD32 @ 22DNU-309-@ | ASLD33 @ 22DNU-309-@ ASLD33@22DNU-309-@ | |
| 2NO 2NC | 1 2 3 4 | 0 0 0 0 | X 0 X 0 | 0 X 0 X | Transformer Full Voltage | ASLD3 @ 22DNU-310-@ ASLD3@22DNU-310-@ | ASLD31 @ 22DNU-310-@ ASLD31 @ 22DNU-310-@ | ASLD32 @ 22DNU-310-@ ASLD32 @ 22DNU-310-@ | ASLD33 @ 22DNU-310-@ ASLD33 @ 22DNU-310-@ | |
| 4N0 | 1 2 3 4 | X 0 X 0 | 0 0 0 0 | 0 X 0 X | Transformer Full Voltage | ASLD3 @ 40DNU@ ASLD3 @ 40DNU@ | ASLD31 @ 40DNU@ ASLD31 @ 40DNU@ | ASLD32 | ASLD33 | |
| 4NC | 1 2 3 4 | 0 X 0 X | X— X X— X | —X 0 —X 0 | Transformer Full Voltage | ASLD3 @ 04DNU@ ASLD3@04DNU@ | ASLD31 @ 04DNU@ ASLD31 @ 04DNU@ | ASLD32 @ 04DNU@ ASLD32 @ 04DNU@ | ASLD33 | |



- In place of ③, specify the Lens/LED Color Code, in place of ③, specify the Full Voltage (LED voltage) Code, in place of ④, specify the Transformer Voltage Code.
- The truth table indicates the operating position of contact block when the operator is switched to that position.

X = On (Closed Contacts) O = Off (Open Contacts)

 $X\!\!-\!\!X=$ Overlapping Contacts: Remain on (closed contacts) when switch is moved between these positions

3. Yellow selector switch comes with white LED.

4 Transformer Voltage Codes

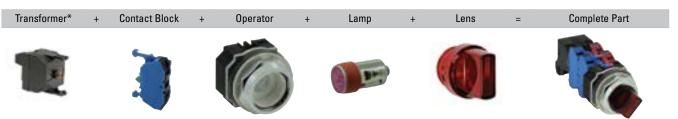
| Voltage | Code |
|---------|------|
| 120VAC | 136 |
| 240VAC | 256 |
| 480VAC | 486 |



Transformers step down to 6V (use 6V LED).



Illuminated Selector Switches (Sub-Assembled)





*Not required for full voltage units.

Operators

| Style | Position | Description | Part Number |
|----------|----------|--|--------------------------|
| | 2 | Maintained | ASLD0201T8 |
| Operator | 3 | Maintained, Cam 1 Maintained, Cam 2 | ASLD0302T8 ASLD0306T8 |
| Орогасог | 2 | Spring return from right | ASLD0213T8 |
| 500 | Z | Spring return from left | ASLD0224T8 |
| | | Spring return from right, Cam 1 Spring return from right, Cam 2 | ASLD0314T8 ASLD0310T8 |
| | 3 | Spring return from left, Cam 1 Spring return from left, Cam 2 | ASLD0323T8 ASLD0328T8 |
| | | Spring return from left/right, Cam 1 Spring return from left/right, Cam 2 | ASLD0335T8 ASLD0339T8 |

Lenses

| | Part Number | | |
|------|-------------|------------|--|
| Knob | | ASLNHU-③ ② | |

Lamps

| Style | Voltage | Part Number | | |
|--------|-----------|-------------|--|--|
| | 6V AC/DC | LSTD-6③ | | |
| LED | 12V AC/DC | LSTD-13 | | |
| A BANK | 24V AC/DC | LSTD-2③ | | |
| | 120V AC | LSTD-H2® | | |
| | 240V AC | LSTD-M43 | | |



- 1. In place of ②, specify the LED color code.
- 2. The LED contains a current-limiting resistor and a protection diode.

Contact Blocks

| | Part Number | | | |
|-------------------|-------------|---------------------------------------|---------------------------------------|--|
| | 1N0 | 1NC | | |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U10-F HW-U10R-F (late break) | |
| Dummy Block | | HW | '-DB | |



Dummy blocks (no contacts) are used with an odd number of contact blocks.
 Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remains).

Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or closed, when switch is moved between two positions).

Lamp Circuit Components

| Style | Application | Part Number |
|------------------|---|-------------|
| Long Lamp Holder | Used with Full-size Transformer and two contact blocks Used with Full Voltage Adaptor and two contact blocks | TW-LH2 |
| Lead Holder | Used with TW-LH2 holder when using four contact blocks | HW-LH3 |

Full Voltage Modules

| J | | | | |
|--|-------|---------------------------------------|-------------|-----------|
| | Style | Description | Part Number | |
| Dummy Block with Full Voltage Adaptor | | For use with odd number of contacts. | Finger-Safe | HW-DA1FBN |
| Full Voltage Adaptor | | For use with even number of contacts. | Finger-Safe | TW-DA1FB |



All Transformers step down to 6V (use 6V lamp).

Transformers

| | Style | Primary Voltage (50/60Hz) | Part Number |
|--------------|-------|------------------------------|-------------|
| | | 120V AC | TW-F126B |
| Transformers | | 240V AC | TW-F126B |
| | | 480V AC | HW-L486 |



6V secondary voltage.

2 Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

3 LED Color Codes

| C | olor | Code |
|----------|-----------|-----------------|
| Ar | nber | А |
| Gr | reen | G |
| F | Red | R |
| В | lue | S |
| W | hite | W |
| <u> </u> | Yellow le | ens only. Yello |



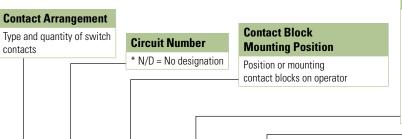
Yellow lens only. Yellov LED not available, use white LED. Relays & Sockets

764

Contact Arrangement Charts

How to Read Contact Arrangement Charts

To determine contact block mounting position, first make sure the selector switch is oriented as shown on the right



Contact Arrangement Chart: 2-Position Selector Switches

Operator Position

Truth table indicates the operating position of contact block when operator is switched to that position.

X = On (Closed Contacts)

0 = Off (Open Contacts)

X—X = Overlapping Contacts: Remain on (closed) when switch is moved between these two positions

Contact Block Part Number

Part number to use when ordering sub-assembly contact blocks, as required for use with corresponding mounting position

| Sty | ⁄le | | One | | | | Operator Part N | | umber | |
|---------|---------------------|----------------------|-----------|----------------|------------------------------|-------------------------|--------------------------|--------------------------|--------------------------|--|
| | Circuit | Mounting Position | | rator ition | Contact Block Part Number | Description | Maintained | Spring Return from Right | Spring Return from Left | |
| Contact | Number Position L R | | L R | L R | L [*] R | | | | | |
| | | 1 | 0 | Х | HW-U10-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 | |
| 1NO | N/D | 2 | 0 | 0 | HW-DB | Key Illuminated Knob | ASD0201KT8 ASLD0201T8 | ASD0213KT8 ASLD0213T8 | ASD0224KT8 ASLD0224T8 | |
| 1NC | N/D | 1 | Χ | 0 | HW-U01-F | Knob/Lever | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| INC | N/D | 2 | 0 | 0 | HW-DB | Key Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASD0224K18 ASLD0224T8 | |
| | N/D | 1 | 0 | Χ | HW-U10-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| 1NO | N/D | 2 | Χ | 0 | HW-U01-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224K18 | |
| 1NC | 103 | 1 | Χ | 0 | HW-U01-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| | 100 | 2 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| | 600 | 1 | 0 | Χ | HW-U10R-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| 1NO-EM | 000 | 2 | Х | 0 | HW-U01R-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| 1NC-LB | 601 | 1 | Χ | 0 | HW-U01R-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| | | 2 | 0 | Χ | HW-U10R-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| 2N0 | N/D | 1 | 0 | Χ | HW-U10-F | Knob/Lever Kev | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| | .,,5 | 2 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| 2NC | N/D | 1 | Χ | 0 | HW-U01-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| | , | 2 | X | 0 | HW-U01-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| | N/D | 1 2 | 0 X | X 0 | HW-U10-F HW-U01-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| | N/D | 3 4 | 0 X | X 0 | HW-U10-F HW-U01-F | Illuminated Knob | ASLD0201R18 | ASLD0213T8 | ASLD0224R18 | |
| | | 1 | Χ | 0 | HW-U01-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 | |
| 2N0 | 110 | 2 3 | 0 X | X 0 | HW-U10-F | Key | ASD020118 | ASD021310 | ASD0224KT8 | |
| 2NC | | 4 | 0 | X | HW-U01-F HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| | | 1 | 0 | Χ | HW-U10-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 | |
| | 111 | 2 3 | 0 X | X 0 | HW-U10-F HW-U01-F | Key | ASD0201KT8 | ASD0213KT8 | ASD0224KT8 | |
| | | 4 | X | 0 | HW-U01-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| | 1 0 X HW-U10-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 | | | | | |
| 4N0 | N/D | 2 | 0 | X | HW-U10-F HW-U10-F | Key | ASD0201KT8 | ASD0213KT8 | ASD0224KT8 | |
| | | 4 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |

Contact Arrangement Chart: 3-Position Selector Switches

| St | yle | | | | | | | | | art Number | |
|---------|---------|----------|--------|---------------|---------|----------------------|-------------------------|--------------------------|-----------------------------|--------------------------|-------------------------|
| | Circuit | Mounting | Oper | ator Pos | sition | Contact Block | Description | Maintained | Spring Return from Right | Spring Return from Left | Two-Way |
| Contact | Number | Position | L | C ♠ | R | Part Number | Beschiption | L C R | L C R | L C R | L C |
| | 000 | 1 | Х | 0 | 0 | HW-U10-F | Knob/Lever | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 |
| | 202 | 2 | X | —X | 0 | HW-U01-F | Key Illuminated Knob | ASD0302KT8 ASLD0302T8 | ASD0314KT8 ASLD0314T8 | ASD0323KT8 ASLD0323T8 | ASD0335KT8 ASD0335T8 |
| | 203 | 1 | 0 | X | —X | HW-U01-F | Knob/Lever Kev | ASD0302T8 ASD0302KT8 | ASD0314T8 ASD0314KT8 | ASD0323T8 ASD0323KT8 | ASD0335T8 ASD0335KT8 |
| NO | 203 | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 |
| NC | 302 | 1 | Х | 0 | Χ | HW-U10-F | Knob/Lever Key | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 |
| | 302 | 2 | X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 |
| | 303 | 1 | 0 | Χ | 0 | HW-U01-F | Knob/Lever Kev | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 |
| | 303 | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0323T8 | ASLD0339T8 |
| | N/D | 1 | Х | 0 | 0 | HW-U10-F | Knob/Lever Key | ASD0302T8 ASD0302KT8 | ASD0314T8 ASD0314KT8 | ASD0323T8 ASD0323KT8 | ASD0335T8 ASD0335KT8 |
| NO | 14/5 | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 |
| | 301 | 1 | Х | 0 | Χ | HW-U10-F | Knob/Lever Key | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 |
| | 00. | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 |
| | 304 | 1 | 0 | Χ | 0 | HW-U01-F | Knob/Lever Key | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 |
| NC | | 2 | X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 |
| | N/D | 1 | 0 | X | X | HW-U01-F | Knob/Lever Key | ASD0302T8 ASD0302KT8 | ASD0314T8 ASD0314KT8 | ASD0323T8 ASD0323KT8 | ASD0335T8 ASD0335KT8 |
| | | 2 | X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0302T8 | SLD0302T8 ASLD0314T8 | ASLD0323T8 | ASD0335T8 |
| | N/D | 1 2 | X 0 | 0 | 0 X | HW-U10-F HW-U10-F | Knob/Lever | ASD0302T8 | 0302KT8 ASD0314KT8 | ASD0323T8 | ASD0335T8 |
| | N/D | 3 | 0 | Χ | —X | HW-U01-F | Key Illuminated Knob | ASD0302KT8 ASLD0302T8 | | ASD0323KT8 ASLD0323T8 | ASD0335KT8 ASD0335T8 |
| | | 4 | X | X | 0 | HW-U01-F | Illuminated Knob | AGEDOSOZIO | AULDUSTATO | A0LD032010 | A0D000010 |
| | | 1 2 | 0 | X | —X X | HW-U01-F HW-U10-F | Knob/Lever | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 |
| | 210 | 3 | 0 | X | X | HW-U01-F | Key | ASD0302KT8 | ASD0314KT8 | ASD0323KT8 | ASD0335KT8 |
| | | 4 | 0 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 |
| | | | X | 0 | X | HW-U10-F | | | | | |
| 10 | | 2 | X— | —X | 0 | HW-U01-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASD0339T8 |
| VC | 308 | 3 | X | 0 | Х | HW-U10-F | Key | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 |
| | | 4 | X X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 |
| | | 1 | X | 0 | Х | HW-U10-F | | | | | |
| | | 2 | Χ— | —X | 0 | HW-U01-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASD0339T8 |
| | 309 | 3 | 0 | X | 0 | HW-U01-F | Key | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 |
| | | 4 | 0 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 |
| | | 1 | 0 | Х | 0 | HW-U01-F | | | | | |
| | 0.15 | 2 | 0 | 0 | X | HW-U10-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASD0339T8 |
| | 310 | 3 | 0 | X | 0 | HW-U01-F | Key | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 |
| | | 4 | 0 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 |



Each operator sub-assembly is available as an "02" and an "06" for 3-position selector switches. The internal cam of an "02" is different from that of an "06". This results in designated combinations of open and closed contacts in the various operator positions.

^{2.} N/D = No circuit number designation required in assembled part number.

^{3.} X = On (closed contacts) 0 = Off (open contacts). X—X Overlapping contacts remain on (closed) when switch is moved between these two positions.

Contact Arrangement Chart: 3-Position Selector Switches

| St | yle | | | | | | Operator Part Number | | | | |
|---------|-------------------|---|-------------------|---------------|-----------------|-------------|-------------------------|--------------------------|--|--------------------------|--------------------------|
| | 0: : | | Operator Position | | _ Contact Block | Description | Maintained | Spring Return from Right | Spring Return from Left | Two-Way | |
| Contact | Circuit Number | Position | L | C ≜ | R | Part Number | Description | C R | L C | L C | L C R |
| | | 1 | Χ | 0 | 0 | HW-U10-F | | | | | |
| | N/D | 2 | 0 | 0 | Χ | HW-U10-F | Knob/Lever | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 |
| | N/D | 3 | Χ | 0 | 0 | HW-U10-F | Key Illuminated Knob | ASD0302KT8 ASLD0302T8 | ASD0314KT8 ASLD0314T8 | ASD0323KT8 ASLD0323T8 | ASD0335KT8 ASD0335T8 |
| 4N0 | | 4 | 0 | 0 | Χ | HW-U10-F | mammatou Knob | 71022000210 | | | 710200010 |
| 4110 | | 1 | Χ | 0 | Χ | HW-U10-F | 14 1 11 | AODOGGTO | 10000000 | AODOGGTO | AODOGGTO |
| | 305 | 2 | 0 | 0 | Χ | HW-U10-F | Knob/Lever Key | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 |
| | 300 | 3 | Χ | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0306T8 | | ASLD0328T8 | ASLD0339T8 |
| | | 4 | 0 | 0 | Χ | HW-U10-F | aatou ruros | 7.022000010 | | 7.0250020.0 | 7.02500010 |
| | | 1 | 0 | Χ— | X | HW-U01-F | | | ASD0302T8 ASD0314T8 ASD0302KT8 ASD0314KT8 | | |
| | N/D | 2 | Χ— | —X | 0 | HW-U01-F | Knob/Lever Key | ASD030218 ASD0302KT8 | | ASD0323T8 ASD0323KT8 | ASD0335T8 ASD0335T8 |
| | IN/ D | 3 | 0 | Х | X | HW-U01-F | Illuminated Knob | ASLD0302T8 | ASLD0314K18 | ASLD0323KT6 | ASD0335T8 |
| | | 4 | X | —X | 0 | HW-U01-F | aatou ruros | 7.0250002.0 | 7.025.00 | 7.0250020.0 | 7.02000.0 |
| 4NC | | 1 | 0 | Χ | 0 | HW-U01-F | | | | | |
| | | 2 | X | —X | 0 | HW-U01-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASLD0339T8 |
| | 314 | 3 | 0 | Χ | 0 | HW-U01-F | Key | ASD0306KT8 | ASD0301KT8 ASLD0301T8 | ASD0328KT8 ASLD0328T8 | ASD0339KT8 ASLD0339T8 |
| | | 4 X X 0 HW-U01-F Illuminated Knob ASLD03061 | | 01-F | | | | | | | |



- Each operator sub-assembly is available as an "02" and an "06" for 3-position selector switches. The internal cam of an "02" is different from that of an "06". This results in designated combinations of open and closed contacts in the various operator positions.

 2. N/D = No circuit number designation required in assembled part number.
- 3. X = On (closed contacts) 0 = Off (open contacts). X—X Overlapping contacts remain on (closed) when switch is moved between these two positions.

Operator Truth Tables

Use the following tables to build custom selector switches.

2 Position Selector Switches

| | Contact | Mounting | Operator Position | | |
|--------------|-----------------------|----------|-------------------|----------------|--|
| | Contact | Position | Left | Right | |
| | HW-U10-F (N0) | L | 0 | Χ | |
| | HVV-010-F (INO) | R | 0 | Χ | |
| | UNA/ LIO1 E (NIC) | L | Х | 0 | |
| A CL DO201TO | HW-U01-F (NC) | R | Χ | 0 | |
| ASLD0201T8 | HW-U10R-F (NO-EM) | L | 0 | -X- | |
| | HVV-UTUN-F (INU-EIVI) | R | 0 | -X- | |
| | LIM/ LIG1D E (NIC LD) | L | -X- | 0 | |
| | HW-U01R-F (NC-LB) | R | -X- | 0 | |

3 Position Selector Switches

| | Contact | Mounting | Operator Position | | | |
|---------------------------------------|-------------------------|----------|-------------------|--------|-------|--|
| | Contact | Position | Left | Center | Right | |
| | H/M/ 1.110 E (NIO) | L | Χ | 0 | 0 | |
| | HW-U10-F (NO) | R | 0 | 0 | Χ | |
| ASD0302T8 ASLD0302T8 ASD0302KT8 | UNA/ 1101 F (NIC) | L | 0 | Χ | X | |
| | HW-U01-F (NC) | R | Χ | X | 0 | |
| | 11/A/ 114 OD E /NO ENA) | L | X | . 0 | 0 | |
| | HW-U10R-F (NO-EM) | R | 0 | _0_ | Χ | |
| | UNATION FAMOUR | L | 0 | X | —X | |
| | HW-U10R-F (NC-LB) | R | X | X | 0 | |

| | Contact | Mounting | Operator Position | | | |
|--------------------------|-------------------------|----------|-------------------|--------|---------------|--|
| | Contact | Position | Left | Center | Right | |
| | HW-U10-F (NO) | L | Χ | 0 | Χ | |
| | HVV-010-F (IVO) | R | 0 | 0 | Χ | |
| | HW-U01-F (NC) | L | 0 | Χ | 0 | |
| ASD0306T8 | | R | X | X | 0 | |
| ASLD0306T8 ASD0306KT8 | HW-U10R-F (NO-EM) | L | X | . 0 | X | |
| | TIVV-OTOII-I (IVO-LIVI) | R | 0 | 0 | Χ | |
| | HW-U01R-F (NC-LB) | L | 0 | X | 0 | |
| | HVV-UUTN-F (IVU-LD) | R | Χ | X | 0 | |

Accessories — TWND Series

| Item | Appearance | | Description/Usage | Part Number | |
|----------------------|-------------|---|---|--|--|
| Lamp Removal Tool | | Rubber tool used to install or rer | move LED's | OR-55 | |
| Metal Bezel | 0 | Replacement locking ring/ bezel | Standard octagonal units (chrome-pl.). Extended, non-illuminated (chrome-pl.). Extended, illuminated (chrome-pl.). Jumbo Mushroom Shallow Shroud Jumbo Mushroom Deep Shroud | OG-81 OG-82 OG-83L ABN4G ABN4F | |
| Plastic Bezel | 0 | Black plastic locking ring/bezel | | OGP11B | |
| Boot/Cover | | Used to cover and protect pushbuttons | In place of ①, specify Neoprene Rubber Boot color: B (black), G (green), R (red), Y (yellow) Flush units (clear plastic -40° to +60°C). | 0C-11 ① 0C-121 | |
| | | | Extended units (clear plastic -40° to +60°C). Plastic washer For nameplates or panels that should not be scratched. | | |
| Anti-Rotation Ring | | Thrust washer/Anti-rotation ring | OGL-D1S | | |
| Mounting Hole Plug | | Plugs used to fill unused 30mm panel cutouts. | Plastic with locking nut attached. Metal with locking nut attached Grey rubber (-5° to +60°C) | OBP-11 OB-11 OB-13 | |
| Terminal Tab Adaptor | | Tab #250 17/64" x 3/64" (6.35m | m x 0.8mm): Single tab | TW-FA4 | |
| Long Lamp Holder | | Used with Transformer and two | | TW-LH2 | |
| Lead Holder | - | Used with TW-LH2 holder whe | en using four contact blocks | HW-LH3 | |
| Lock Out Adaptor | (90) | Used to provide lockout protection for TWTD pushbuttons and knob selectors. ø 1-13/64" (30mm) | | OL-KL1 | |
| Full Voltage Clips | Per | Primary Voltage (50/60Hz) Requi required for full voltage pilot ligl | APD-F | | |
| Replacement Keys | do | Pair of keys (#0) | | TW-SK | |

Accessories TWND Series continued

| Item | Appearance | Description/Usage | Part Number | | |
|--|------------|---|---|---|--|
| | | | 1NC | 1NO | |
| Contact Blocks (with side entry) | | These contacts are applicable for wires terminated by ring, fork, terminals, not recommended for bare wire connections . | HW-U01 HW-U01-MAU HW-U01R HW-U01R-MAU (with side entry) | HW-U10 HW-U10-MAU HW-U10R HW-U10R-MAU (with side entry) | |
| Contact Blocks (without side entry) | | These contacts are applicable for wires terminated by ring, fork, or ferule terminals, and also bare wire connections . | HW-U01-F HW-U01-MAU-F HW-U01R-F HW-U01R-MAU-F (no side entry) | HW-U10-F HW-U10-MAU-F HW-U10R-F HW-U10R-MAU-F (no side entry) | |

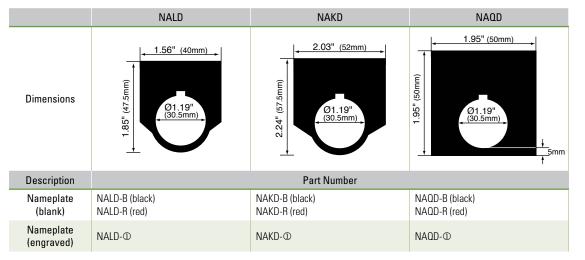
Fingersafe Covers for TWND Series

| ltem | Description | Used with | Part Number |
|------|---|---------------------------|-------------|
| | Fingersafe terminal cover, for full voltage pilot lights, adds 3mm to overall depth | Full voltage pilot lights | APD-PVL |
| | Fingersafe terminal cover, adds 1.5mm to overall depth | Transformer pilot lights | N-VL3 |



Nameplates — TWND Series

Faceplates





- 1. Nameplates are made of 0.031" aluminum. Lettering is white letters engraved on black background.
- 2. In place of ①, insert either the standard legend code from table below or custom engraving delimited by " ".

Standard Legend Codes

| Pushbuttons | | | | Pushbuttons/Selector Switches | | | Selector Switches | | |
|--|---|---|---|---|---|--|--|---|---|
| Legend | Code | Legend | Code | Legend | Code | Legend | Code | Legend | Code |
| AUTO CLOSE DOWN EMERG.STOP* FAST FORWARD HAND HIGH IN INCH JOG LOW LOWER OFF | 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 | OPEN OUT RAISE RESET REVERSE RUN SLOW START STOP* STOP TEST UP I (Int'l On) O (Int'l Off) EMO | 116 117 118 119 120 121 122 123 124 125 126 127 150 151 152 | AUTO-MAN CLOSE-OPEN DOWN-UP FAST-SLOW FOR-REV HAND-AUTO HIGH-LOW JOG-RUN LEFT-RIGHT LOWER-RAISE MAN-AUTO OFF-ON ON-OFF OPEN-CLOSE RAISE-LOWER | 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 | REV-FOR RUN-JOG RUN-SAFE SAFE-RUN SLOW-FAST START-STOP STOP-START UP-DOWN | 216 217 218 219 220 221 222 223 | AUTO-MAN-OFF AUTO-OFF-MAN CLOSE-OFF-OPEN DOWN-OFF-SLOW FAST-OFF-SLOW FOR-OFF-REV LEFT-OFF-RIGHT LOWER-OFF-RAISE OFF-MAN-AUTO OFF-SLOW-FAST OFF-1-2 OPEN-OFF-CLOSE SLOW-OFF-FAST SUMMER-OFF-WINTER UP-OFF-DOWN 1-OFF-2 HAND-OFF-AUTO | 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 |



- *Available in Red as standard legend code 104 and 124. To order engraved nameplate and codes, add legend code to nameplate part number. Character height based on the number of characters, space and size of nameplate. Standard character size is 3/16".
- 2. Nameplates with standard legends are the same list price as blank nameplates. Special engravings, additional cost.

To specify engraving instructions, use the Nameplate order form on next page.

770

Custom engraved Nameplates Order Form — TWND Series

| Copy this order form and use it to spe To ensure engraving accuracy, fax it to Your Company Name: | cify Letter Height, Custom Engravings, Loca your IDEC representative. or Distributor. | | or Contact: | |
|---|---|--|---|---|
| | | | if known): | |
| Telephone: | | IDEC Rep/Distribu | tor Phone: | |
| Fax & Email: | | IDEC Rep/Distributor Fa | x & Email: | |
| NALD Nameplate | Step 1. Choose Letter Size - 7/64" or 1/8". | Sample Letter Sizes | 1/01 | haracters max —— 7/64" size letters) |
| Engraving Location | Check the box for the letter size you want. Then write your lettering in box below checkboxes. Note: 1/8" size letters cannot exceed 13 characters. | 7/64" Letters: A B C D 1/8" Letters: A B C D | 1/8" | characters max 1/8" size letters) |
| | Step 2. Specify Quantity. | | | · _ |
| | Enter the number of nameplates desired in the box on the right. | 1 2 3 4 | 5 6 7 8 9 10 11 12 | i I |
| NAKD Nameplate | Step 1. Choose Letter Size - 7/64" or 1/8". | | | |
| Engraving Location | Check the box for the letter size you want. Then write your lettering in box below checkboxes. Note: 1/8" size letters cannot exceed 9 characters. | | | |
| | Step 2. Specify Quantity. | 1 2 3 4 5 | 6 7 8 9 10 11 12 13 | 14 15 16 17 |
| | Enter the number of nameplates desired in the box on the right. | 0 . 0 | Sample Letter Sizes | 14 13 10 17 |
| | in the box on the right. | | 1/8" Letters: A B C D | |
| NAQD Nameplate | Step 1. Choose Letter Size - 7/64" or 1/8" | 7/64" Letter Size | 20 characters max ——————————————————————————————————— | |
| Engraving Location | Check the box for the letter size you want. Then write your lettering in below checkboxes. Note: 1/8" size letters cannot exceed the characters. | box 1/8" | 16 characters max (for 1/8" size letters) | |
| | | | | |
| Step 2. | 1 2 | | 9 10 11 12 13 14 15 16 | 17 18 19 20 |
| Specify Quantity. | 7 | | nple Letter Sizes " Letters: ABCD | |
| Enter the number of nameplates desired in the box on the right. | | | Letters: A B C D | |

Switch Engraving Order Form – TWND Series

| T | n insure e | naravina | accuracy | fay it to | VOUR IDEC | renresent | ative o | r Distributor | |
|---|------------|----------|----------|-----------|-----------|-----------|---------|---------------|--|

| Your Company: | Telephone: | |
|---------------|-----------------------------|--|
| Name: | Fax: | |
| Address: | Email: | |
| PO: | Part Number to be Engraved: | |

Please check one of the boxes below to indicate your choice of engraving options:

Square Switch

| | # of Lines | Letter Height | Max. Characters Per Line | | | |
|--|---------------|------------------|-----------------------------|--|--|--|
| | 1 | 5/32 | 7 | | | |
| | | 1/8 | 8 | | | |
| | 2 | 5/32 | 7 | | | |
| | | 1/8 | 8 | | | |
| | 3 | 1/8 | 8 | | | |
| | 4 | Custom* | | | | |

^{*}Engraving is possible, but character size will be smaller than standard sizes.

Round Switch

| | # of Lines | Letter Height | Max. Characters Per Line | | |
|--|---------------|------------------|-----------------------------|--|--|
| | 1 | 5/32 | 7 | | |
| | | 1/8 | 8 | | |
| | 2 | 5/32 | 7 | | |
| | | 1/8 | 8 | | |
| | 3 | 1/8 | 8 | | |
| | 4 | Custom* | | | |

^{*}Engraving is possible, but character size will be smaller than standard sizes.



| # of Lines | Letter Height | Max. Characters Per Line |
|---------------|------------------|-----------------------------|
| 1 | 3/4 | 4 |
| ' | 5/16 | 5 |
| | 5/16 | 5 |
| 2 | 1/4 | 6 |
| | 5/32 | 8 |
| 2 | 5/32 | 8 |
| 3 | 1/8 | 9 |
| 4 | 1/8 | 9 |

ø29mm, ø40mm Mushroom Head



| | # of Lines | Letter Height | Max. Characters Per Line |
|-----------|---------------|------------------|-----------------------------|
| Engraving | 1 | 5/32 | 5 |
| Area 1 | | 1/8 | 5 |
| Engraving | 1 | 5/32 | 7 |
| Area 2 | | 1/8 | 7 |
| | | | |



- 1. Above mentioned specifications hold true for standard size pushbuttons (round and square).
- Engraving Area 2 can be engraved for 40mm mushroom head non-Illuminated pushbutton only.
- Engraving is done on the button itself for non-Illuminated push buttons and on marking plate for illuminated push buttons and pilot lights.
- Please enter text exactly how you want it engraved, take care to emphasize capital or small letters.

Line 1:
Line 2:
Line 3:

Sample Letter Sizes

1/8 Letters: OPEN

5/32 Letters: OPEN

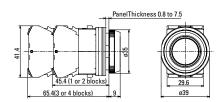
| 1 | All |
|---|-----|
| 4 | wi |

All engraving is 5/8mm

| For IDEC Internal Use Only: | |
|-----------------------------|--|
| Work Order #: | |
| | |

Line 4:

Pushbutton

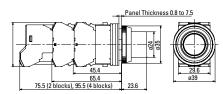


Mushroom Pushbutton w/Full Shroud



Illuminated Pushbuttons

w/Transformer



Lever

45.4 (1 or 2 blocks)

| Illuminated Pushbuttons | Dimension A | Dimension B |
|--|-----------------------------------|------------------------------------|
| Flush w/Full Shroud | 0.975" (25mm) 0.995" (25.5mm) | ø 0.936" (24mm) ø 0.936" (24mm) |
| Extended w/Full Shroud | 0.741" (19mm) 0.761" (19.5mm) | ø 0.936" (24mm) ø 0.936" (24mm) |
| ø 1.56" (40mm) Mushroom Pushlock Turn Reset, Push-Pull | *0.975" (25mm) **0.975" (25mm) | ø 1.56" (40mm) ø 1.56" (40mm) |

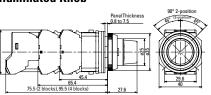


- *Dimension when operator is in reset position.
 **Dimension when operator is in pull position.

Selector Switches

Knob 45.4 (1 or 2 blocks) i.4 (3 or 4 blocks)

Illuminated Knob



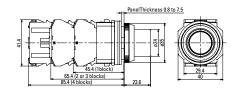
Dimensions (mm)

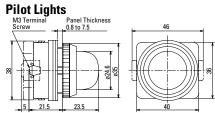
| Pushbuttons | Dimension A | Dimension B |
|--|--|---|
| Flush Extended Extended w/Full Shroud | 0.351" (9mm) 0.566" (14.5mm) 0.663" (17mm) | ø 0.975" (25mm) ø 0.975"(25mm) ø 1.11" (28.5mm) |
| Mushroom Mushroom w/Full Shroud Jumbo Mushroom ø 1.56" (40mm) | 0.858" (22mm) 0.936" (24mm) 1.13" (29mm) | ø 1.56" (40mm) ø 1.87" (48mm) ø 2.54" (65mm) |
| Mushroom, Pushlock Turn Reset and Push-Pull ø 1.56" (40mm) | *0.975" (25mm) **0.975" (25mm) | ø 1.56" (40mm) ø 1.56" (40mm) |



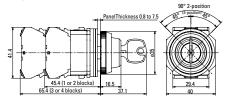
- *Dimension when operator is in reset position.
- *Dimension when operator is in pull position.

Full Voltage



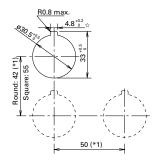


Key





Selector Switches Panel Cut-Out





1. *Jumbo Mushroom < 2.61" (66mm)

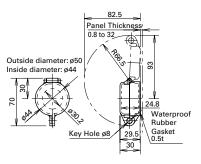
Switches & Pilot Devices

- Minimum mounting centers are applicable to switches with one stack of contact blocks. When mounting two stacks of contact blocks, minimum centers should allow for access to wiring.
- 3. The ø 0.195" (ø 5mm) recess is necessary when either the nameplate or anti-rotation ring is used.

IlluminatedSelector Switches

OL-KL1

Lock-Out Adaptor

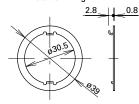


OC-31 **Pushbutton Clear Boot**

ø32.6 18 (OC-31) 22 (OC-32)

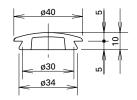
OGL-31

Anti-Rotation Ring



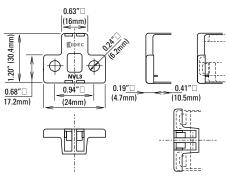
OB-31

Mounting Hole Rubber Plug

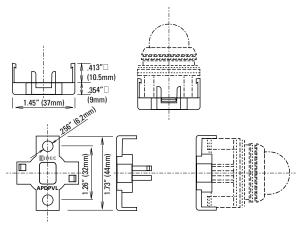


Finger-Safe Cover

N-VL3



APD-PVL

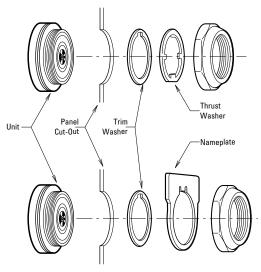




Operating Instructions

Adjustment for Panel Thickness

Each unit is shipped with several waterproof gaskets which are 0.06" (1.5mm) and 0.12" (3mm) thick. Combine the gaskets for a dimension approximately equal to panel thickness and install between the bezel and the body of the unit.

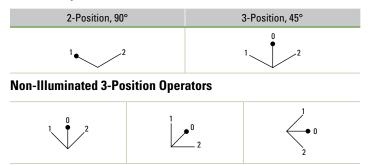


A trim washer must be used with a thrust washer or a nameplate to prevent the control unit from rotating in the mounting hole. When using anti-rotation rings (trim washer with thrust washer or nameplate), install as shown below.

Selector Switches

The operator shaft of each unit has a recess to identify in which direction to install the handle. Align the handle with the recess. Press color insert (TW-HC1) into the Standard Operating Positions.

Standard Operation Positions



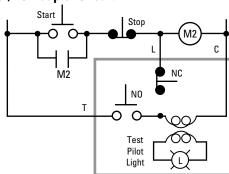
Insallation of LED Illuminated Units

Transformer units are recommended for use in areas subjected to inductive noise.

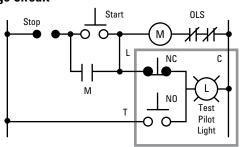
Application Example For Push-To-Test Pilot Light

A typical application of illuminated pushbuttons is a push-to-test pilot light which can be used to check the lamp/LED circuit.

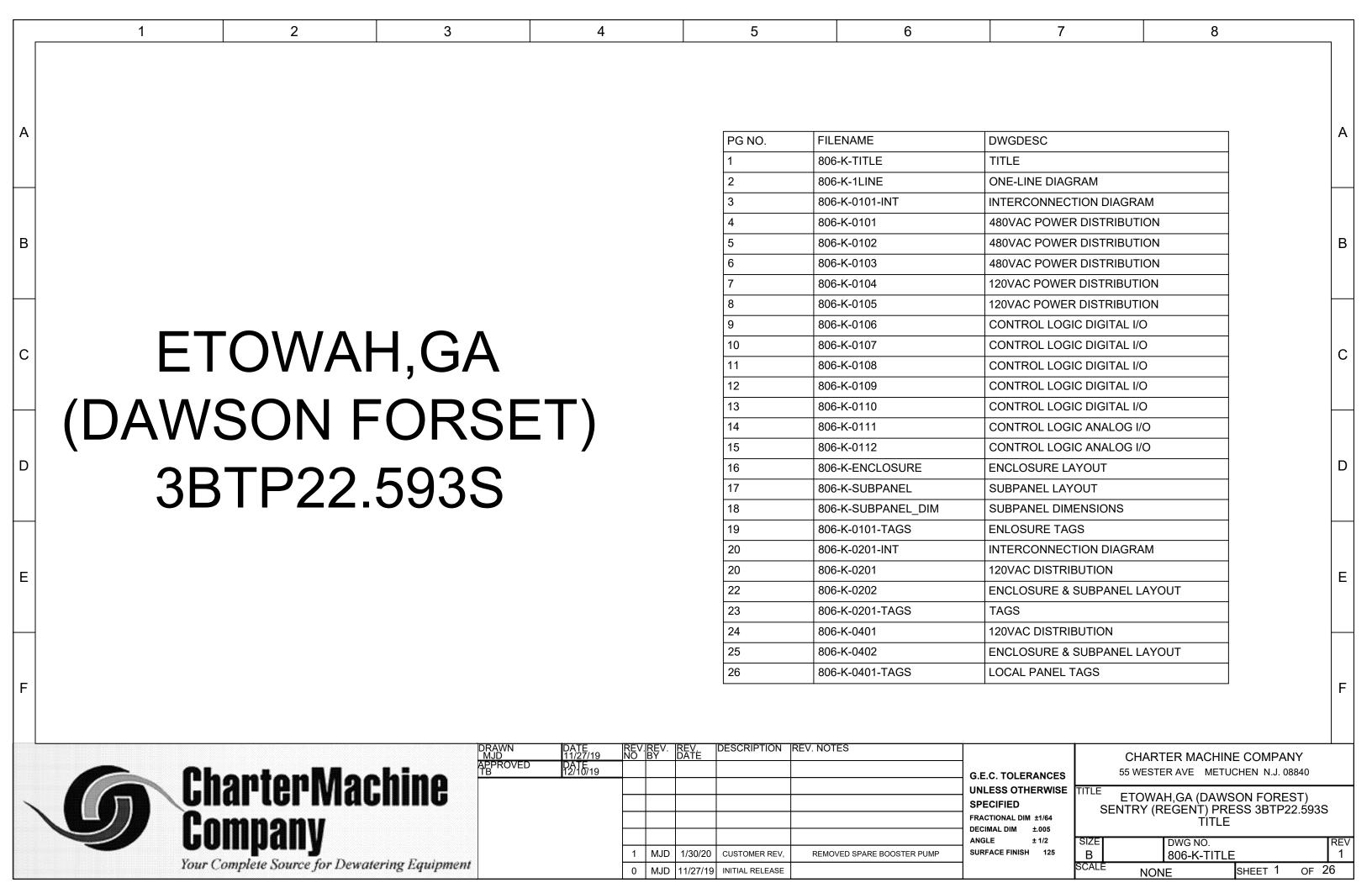
Transformer/AC-Adapter Circuit



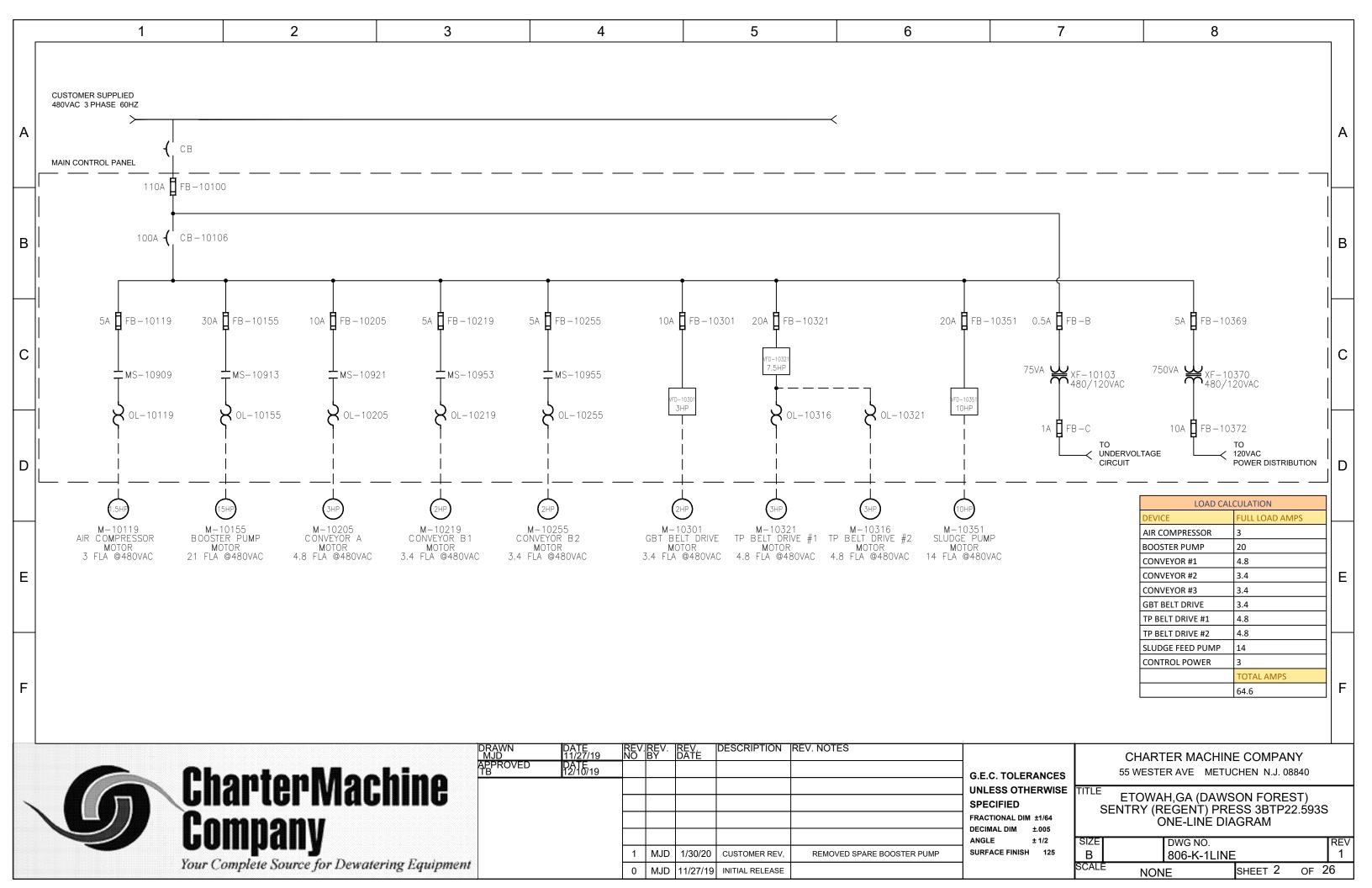
Full Voltage Circuit



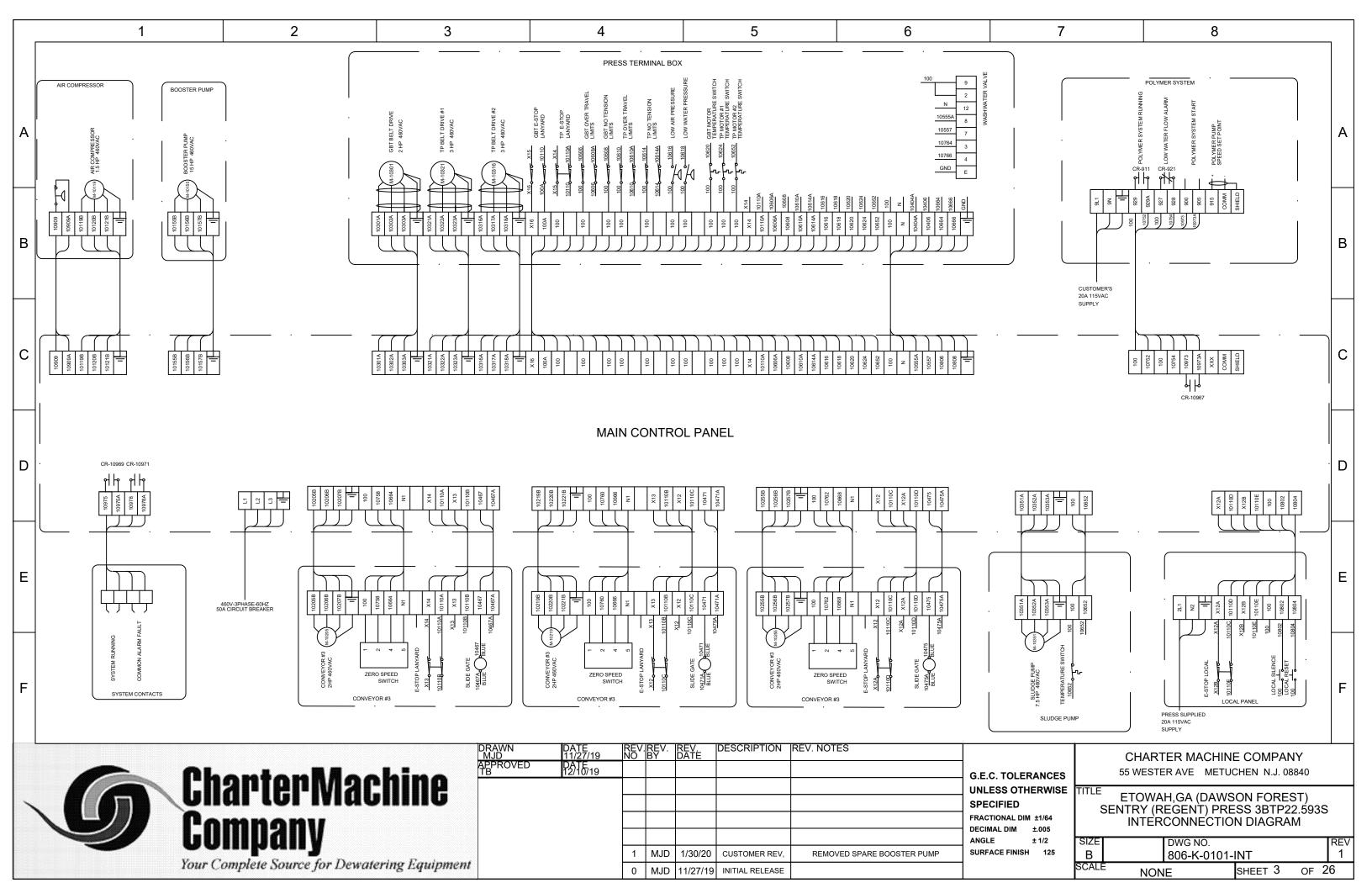




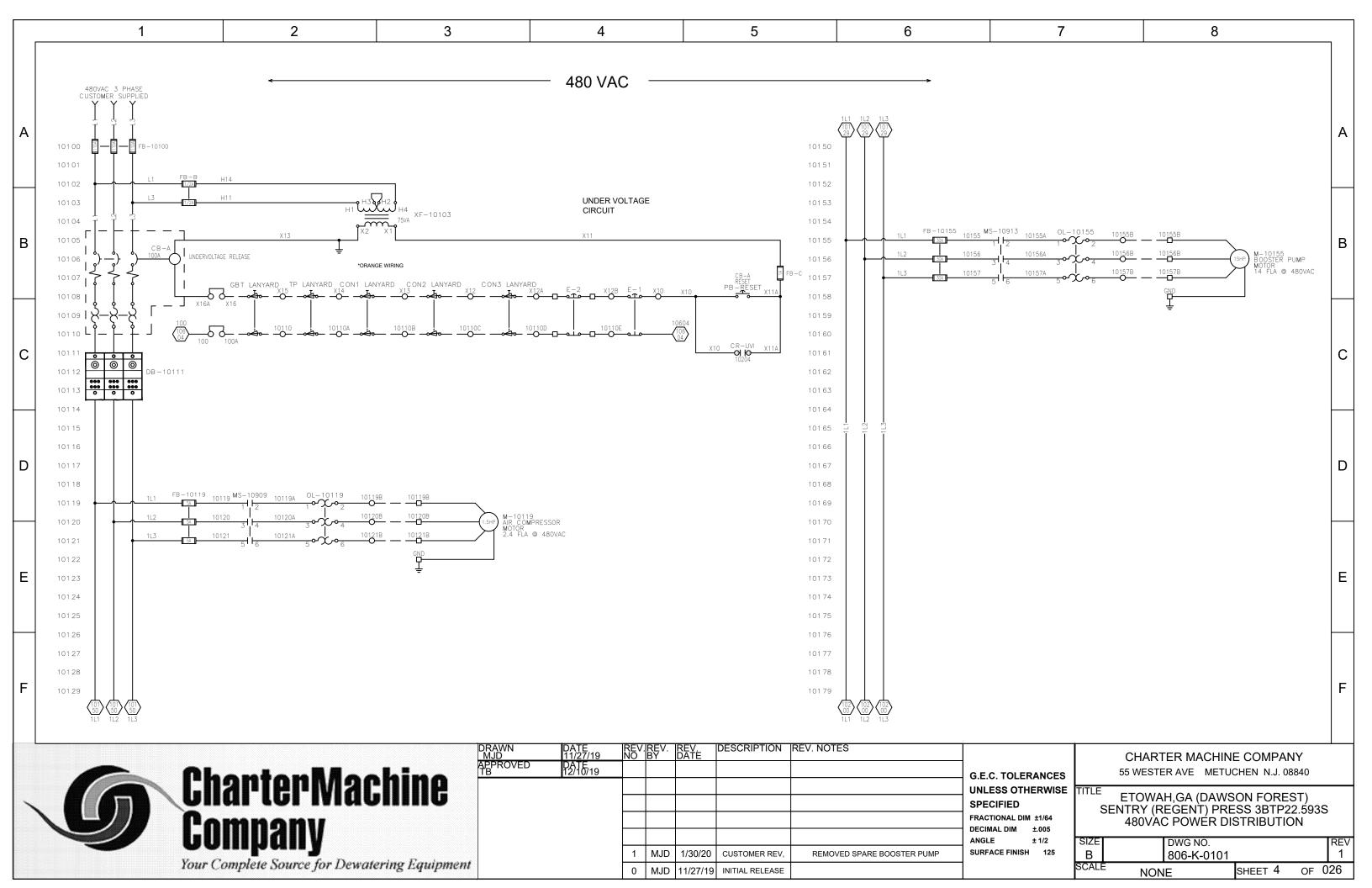




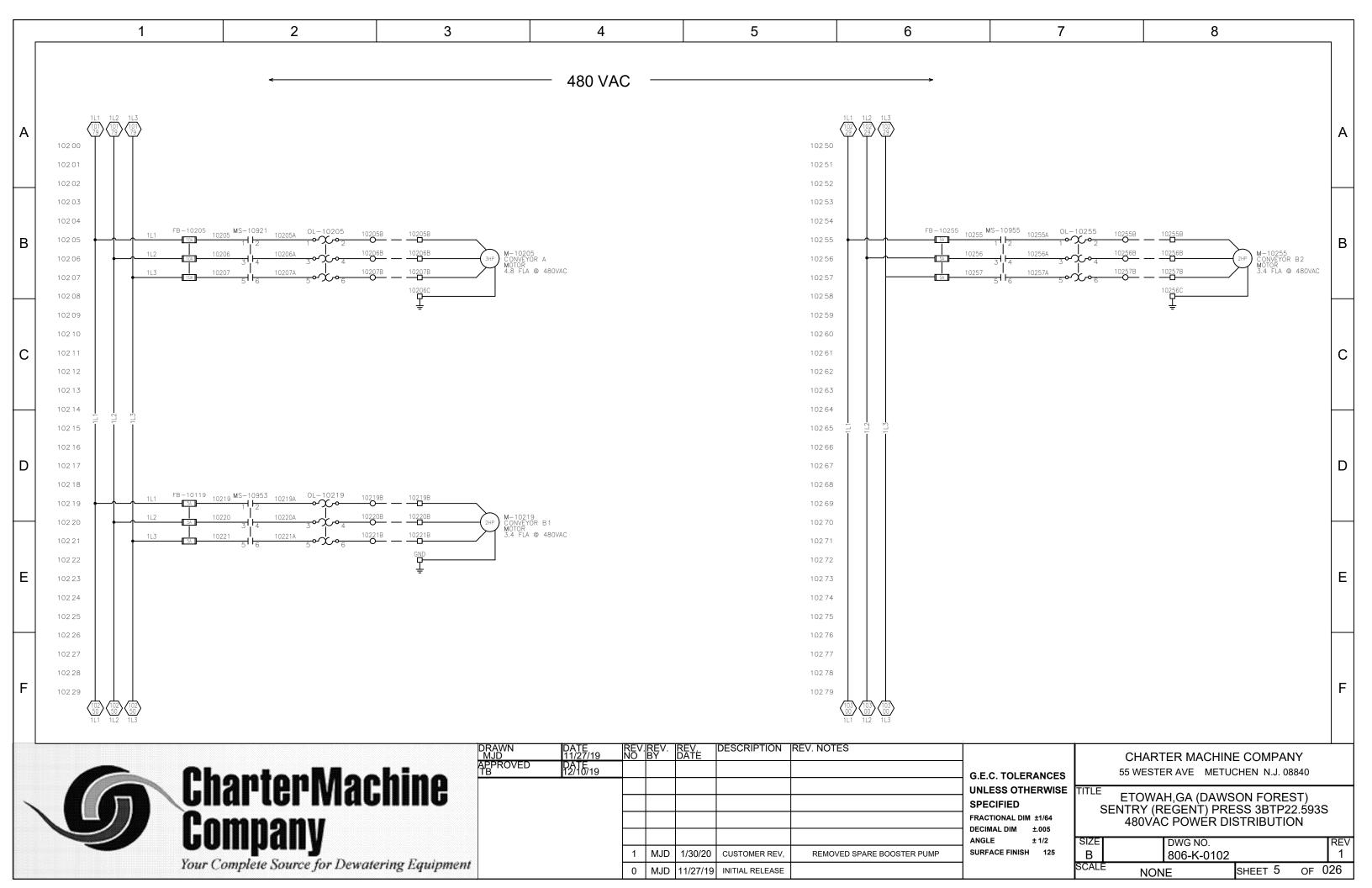




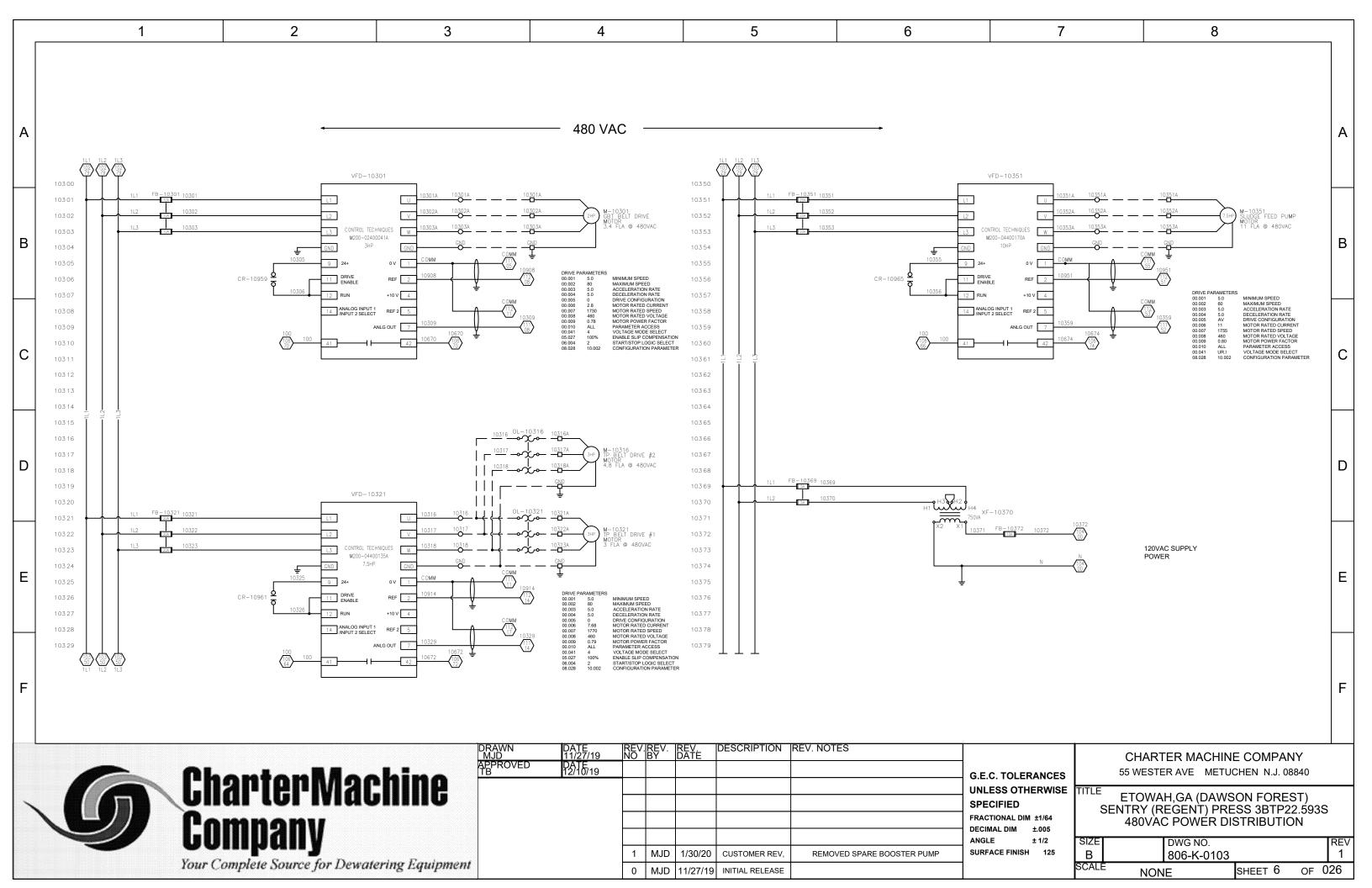




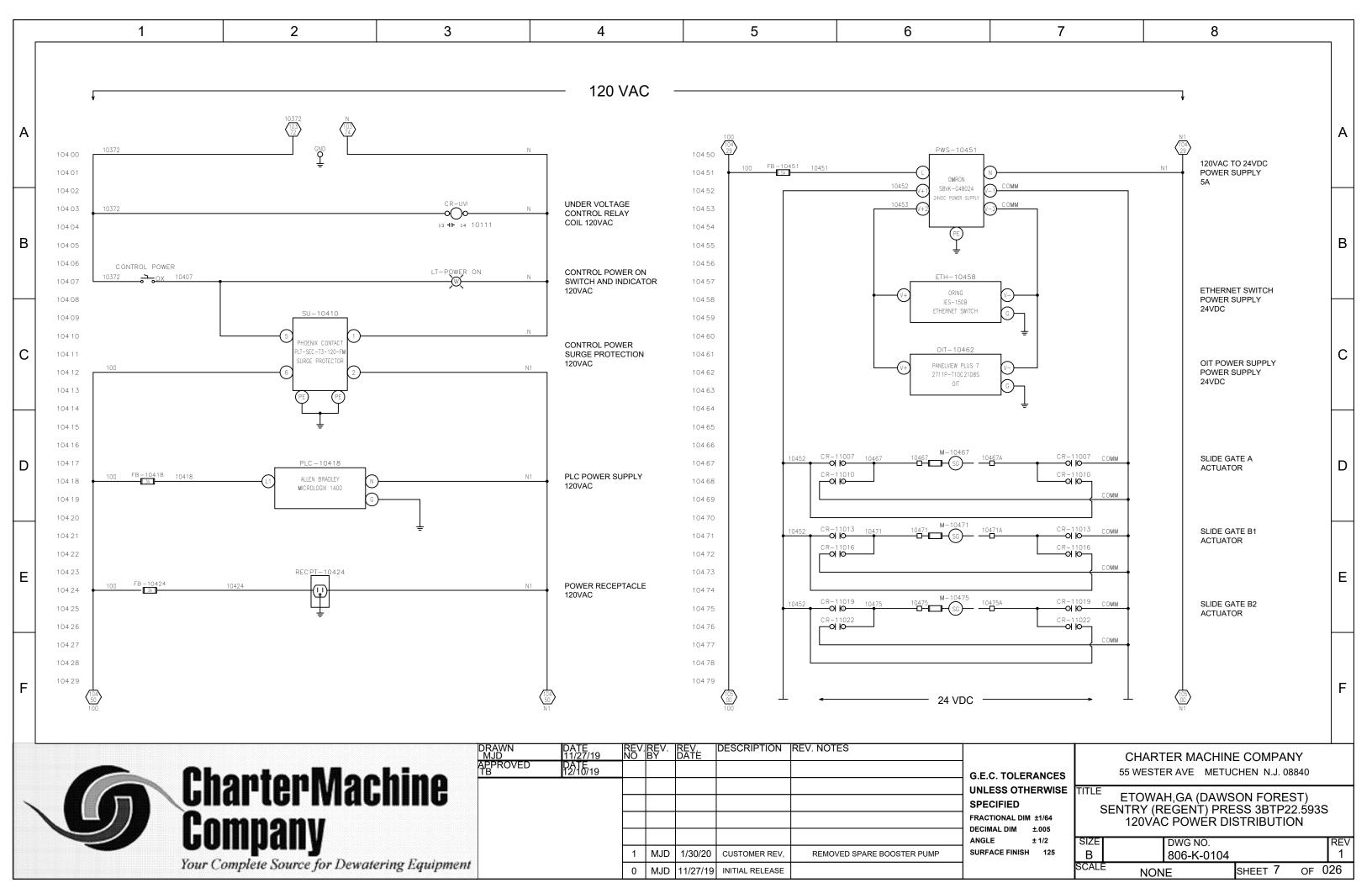




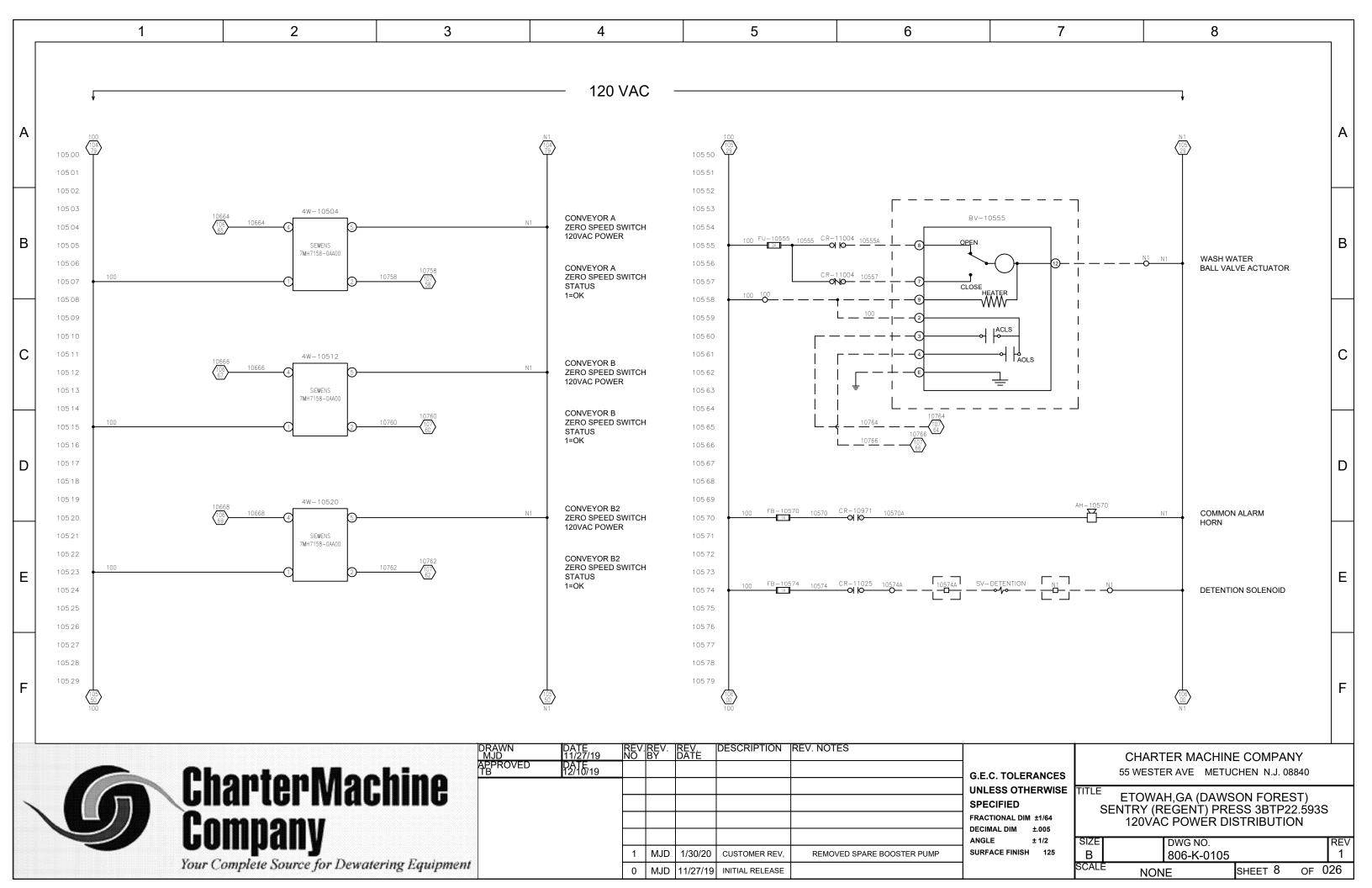




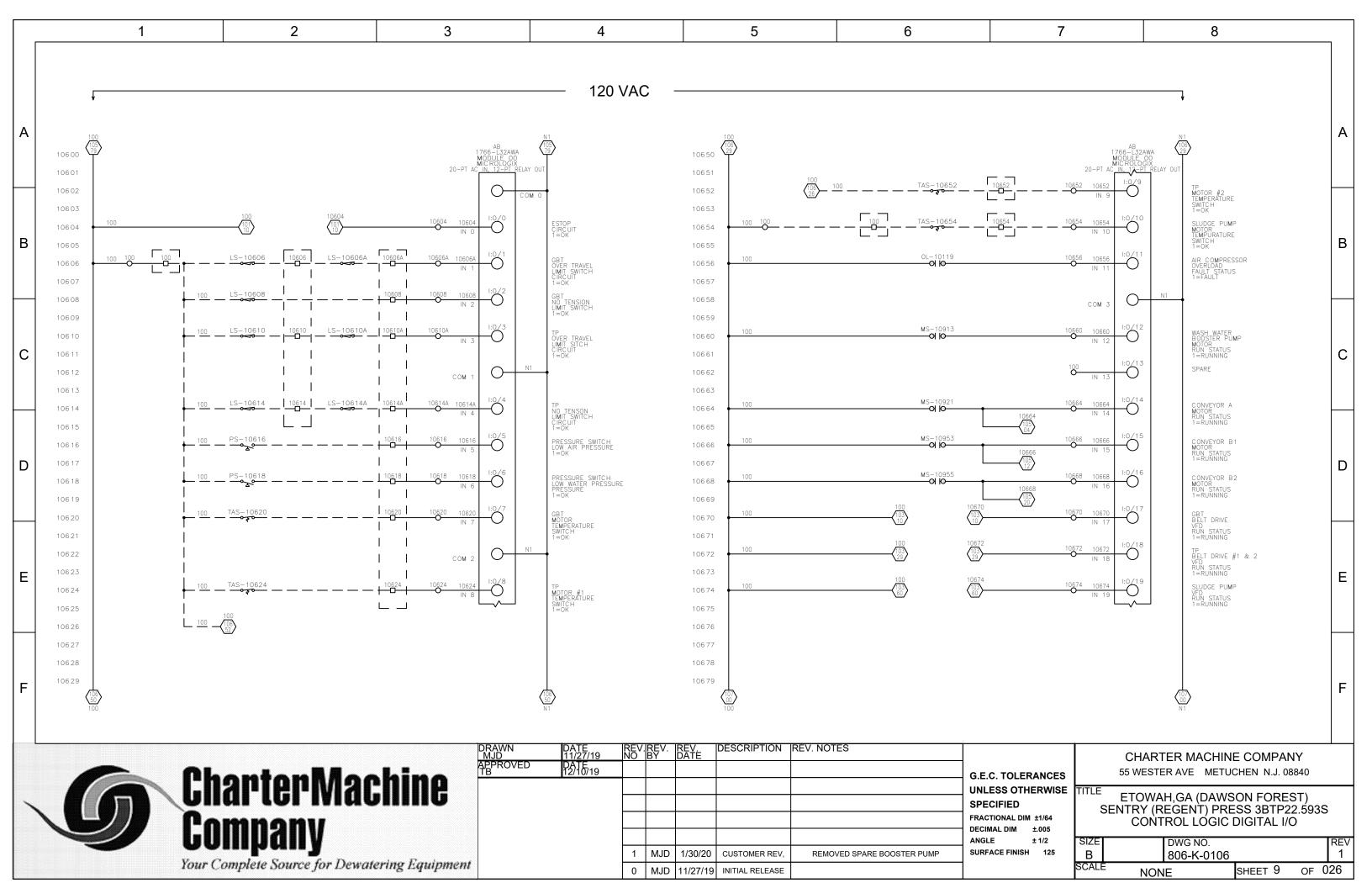




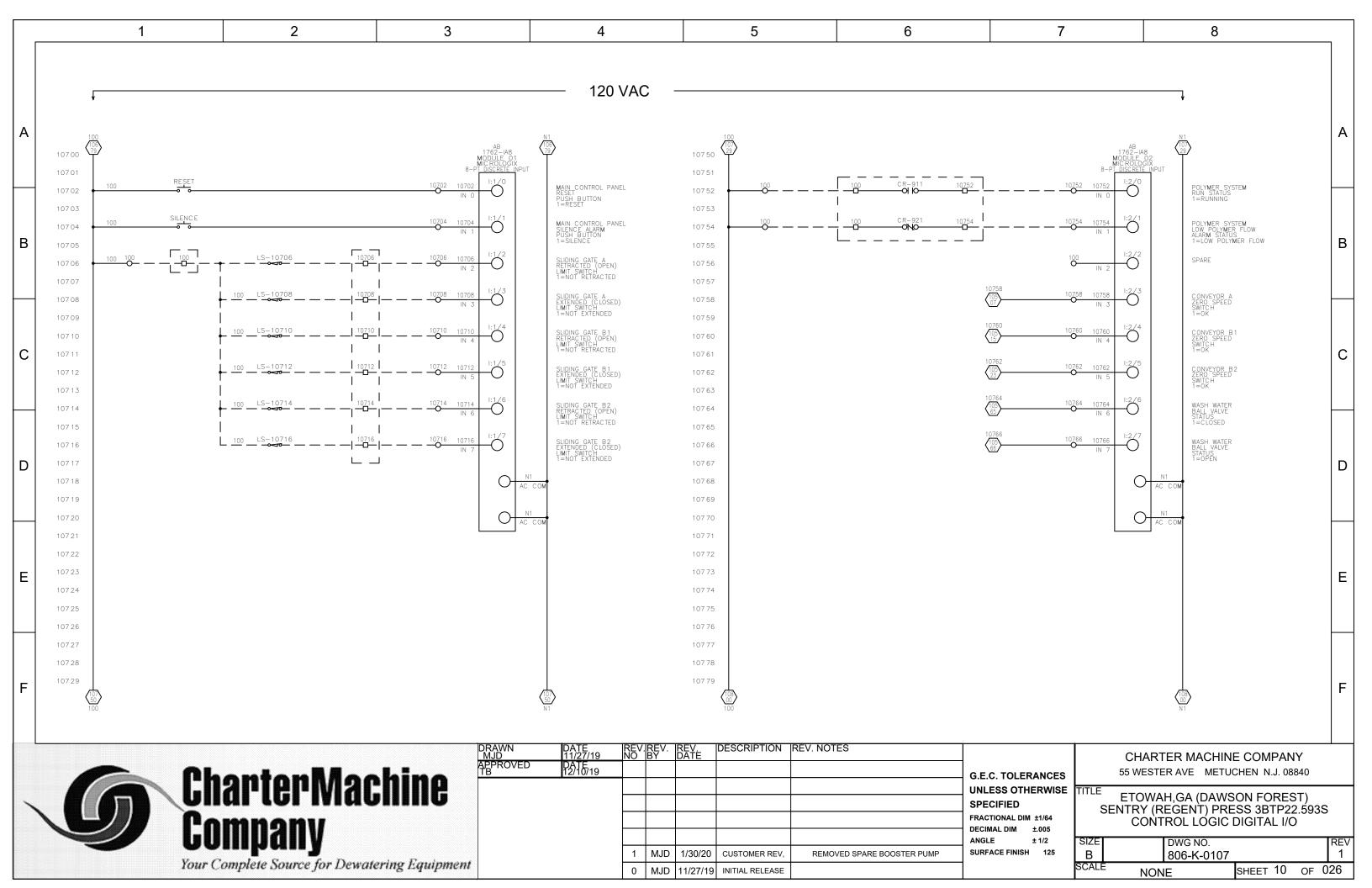




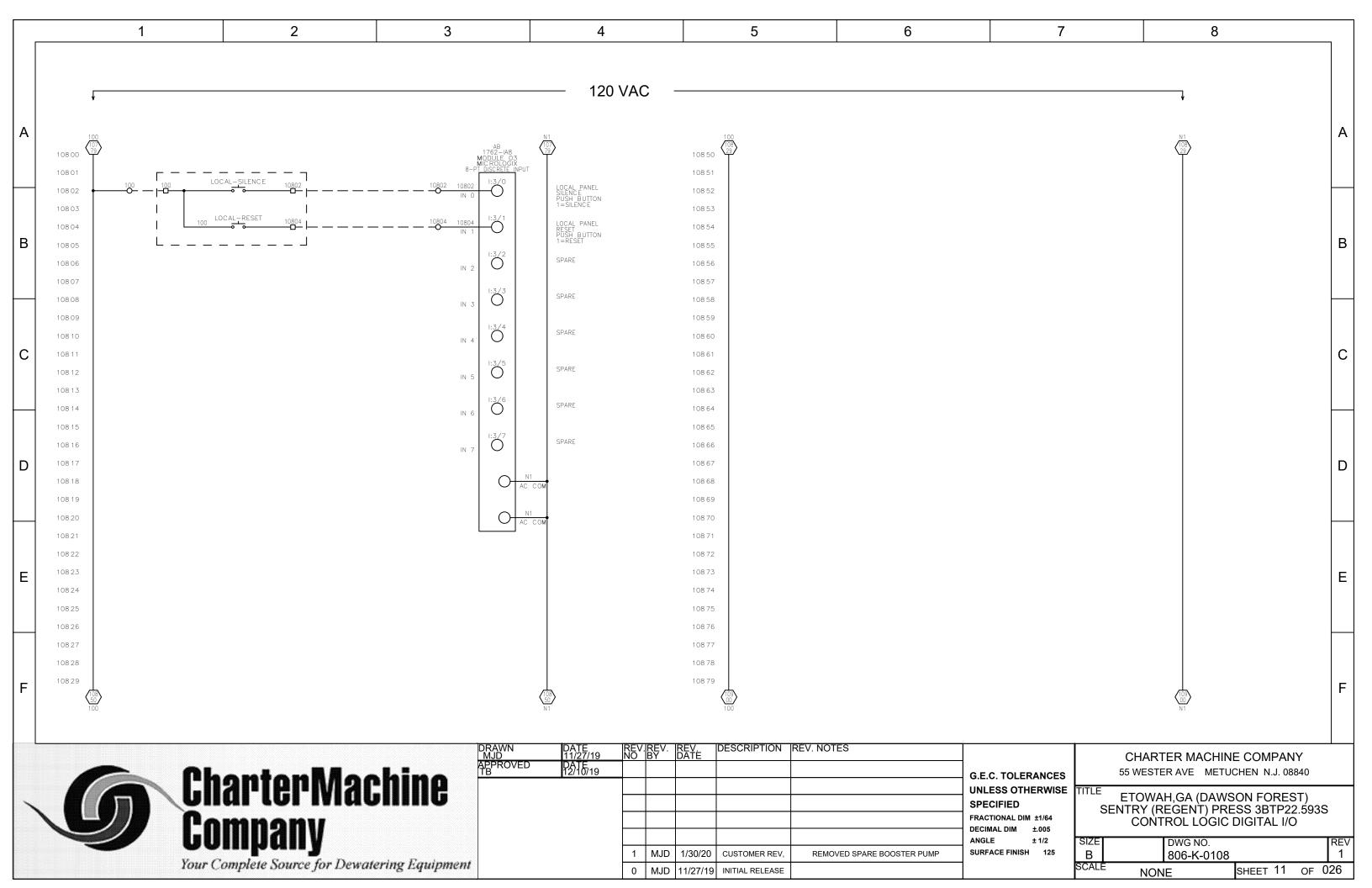




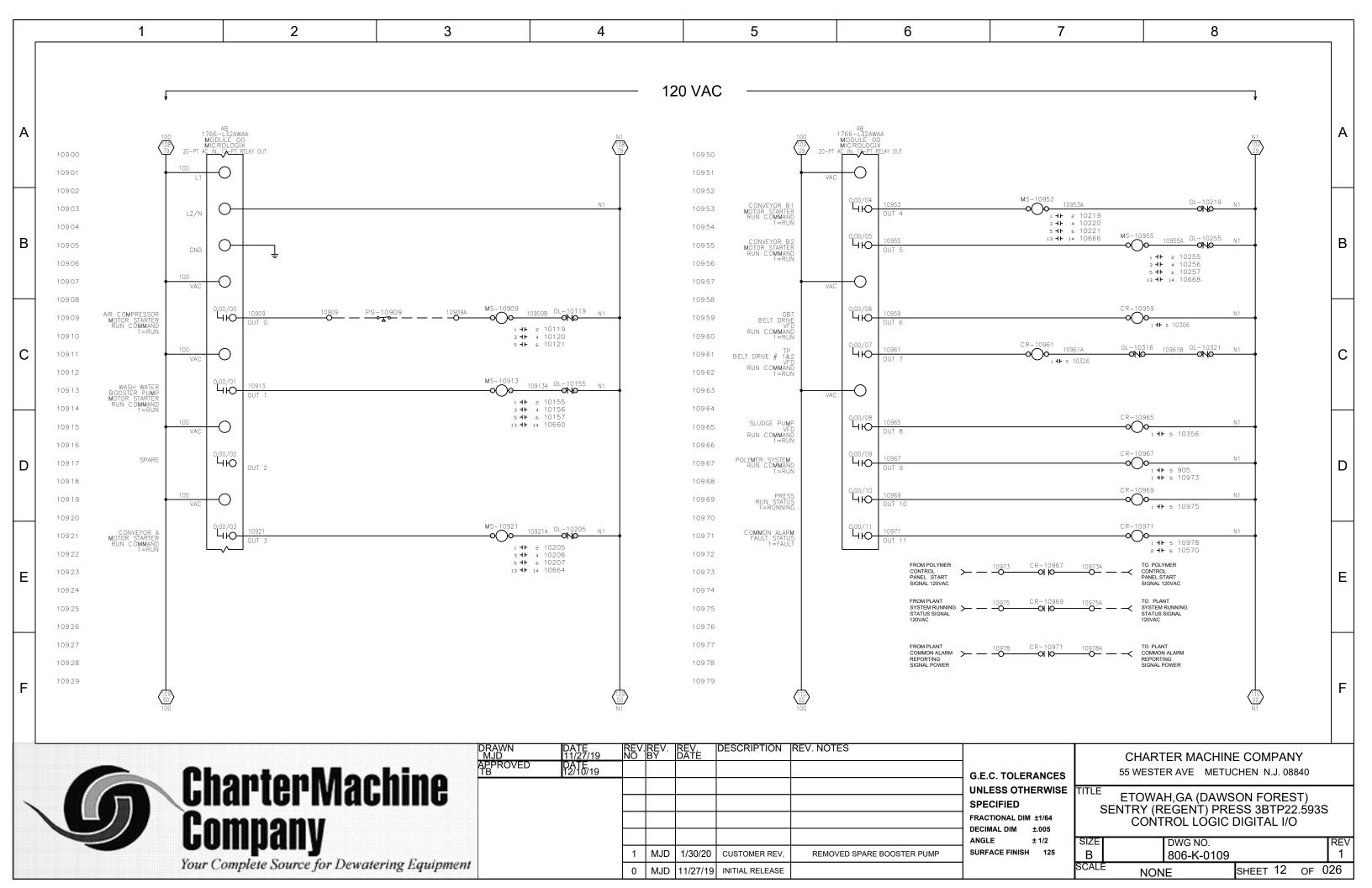




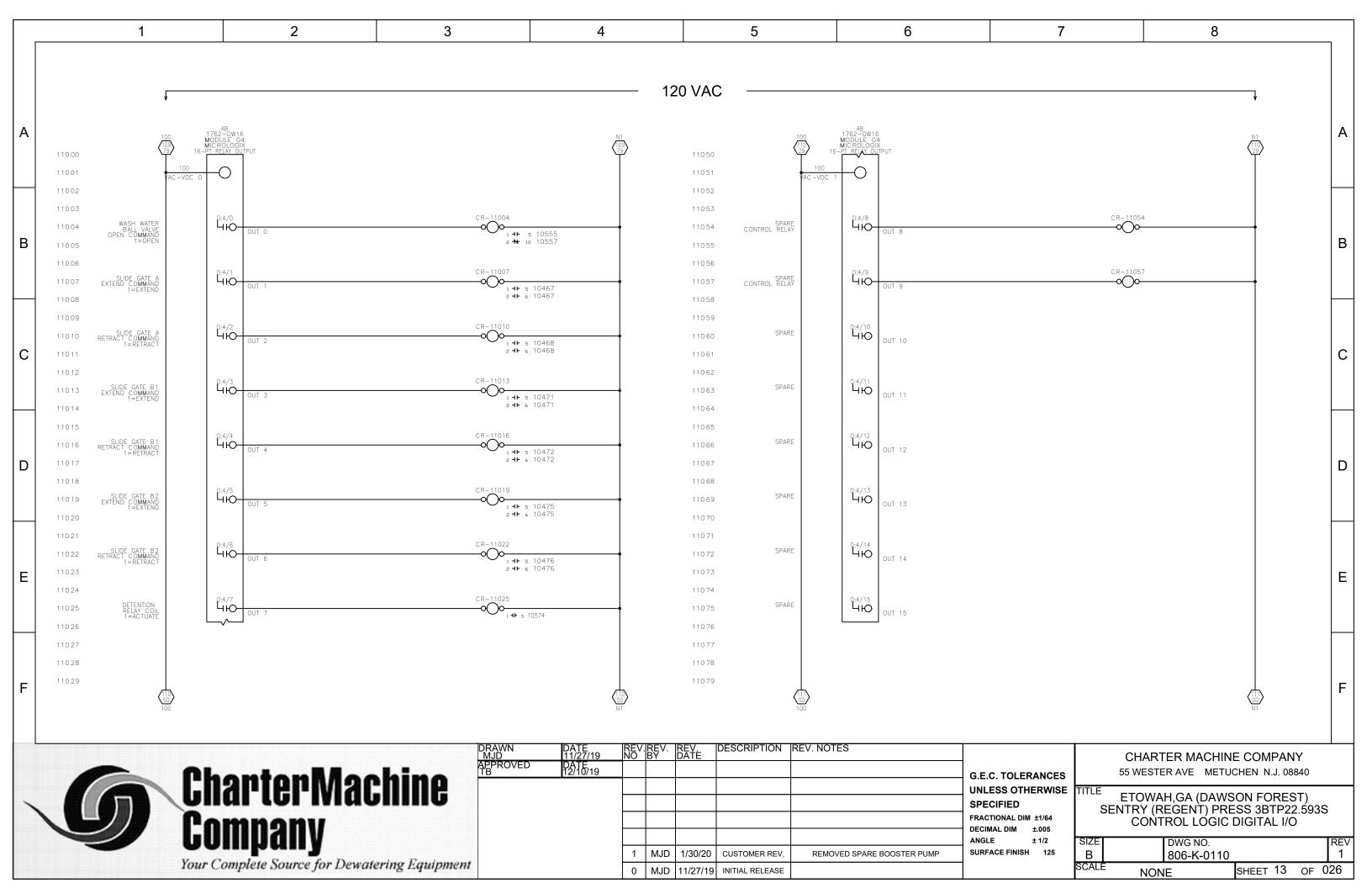




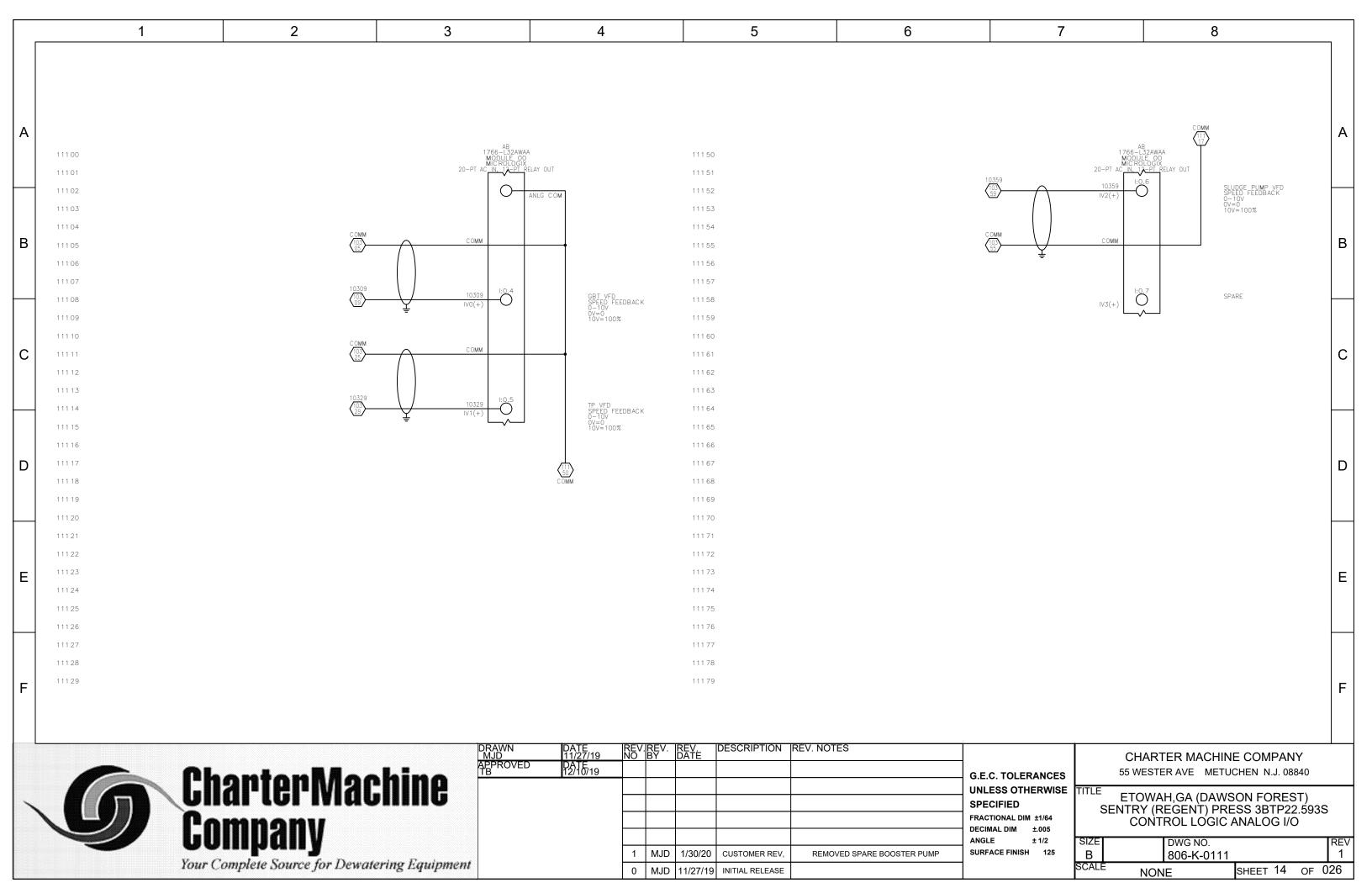




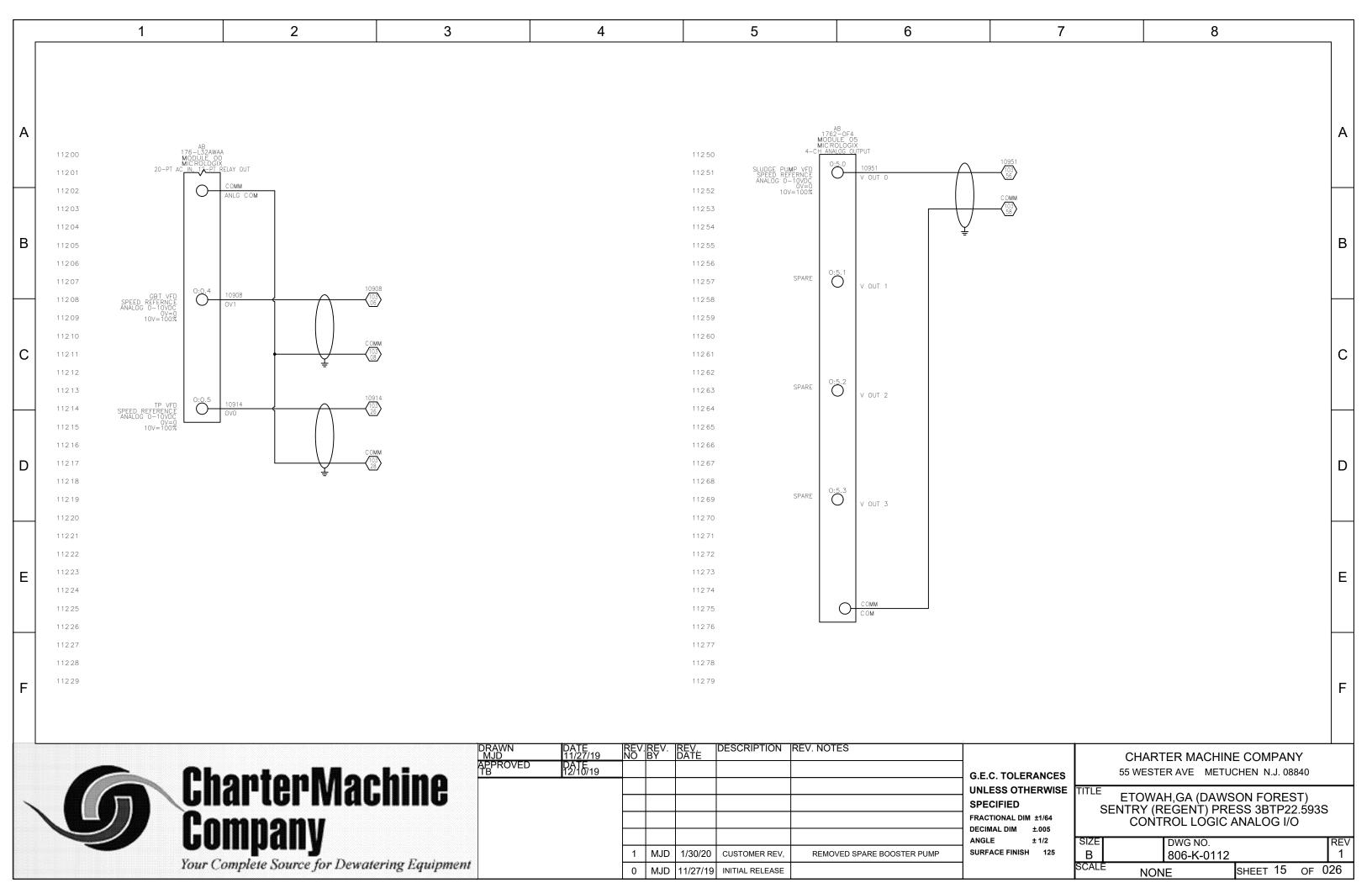




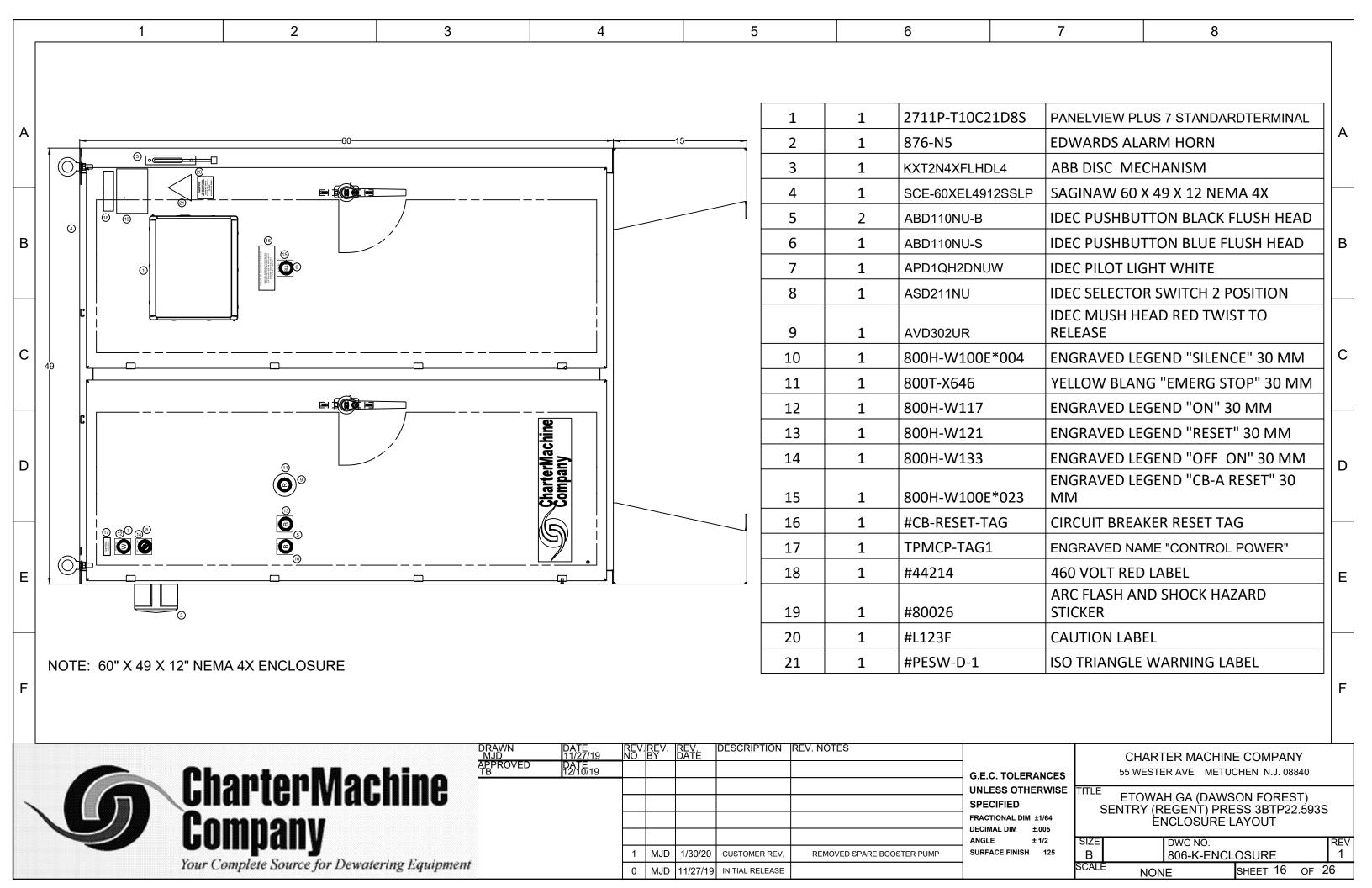




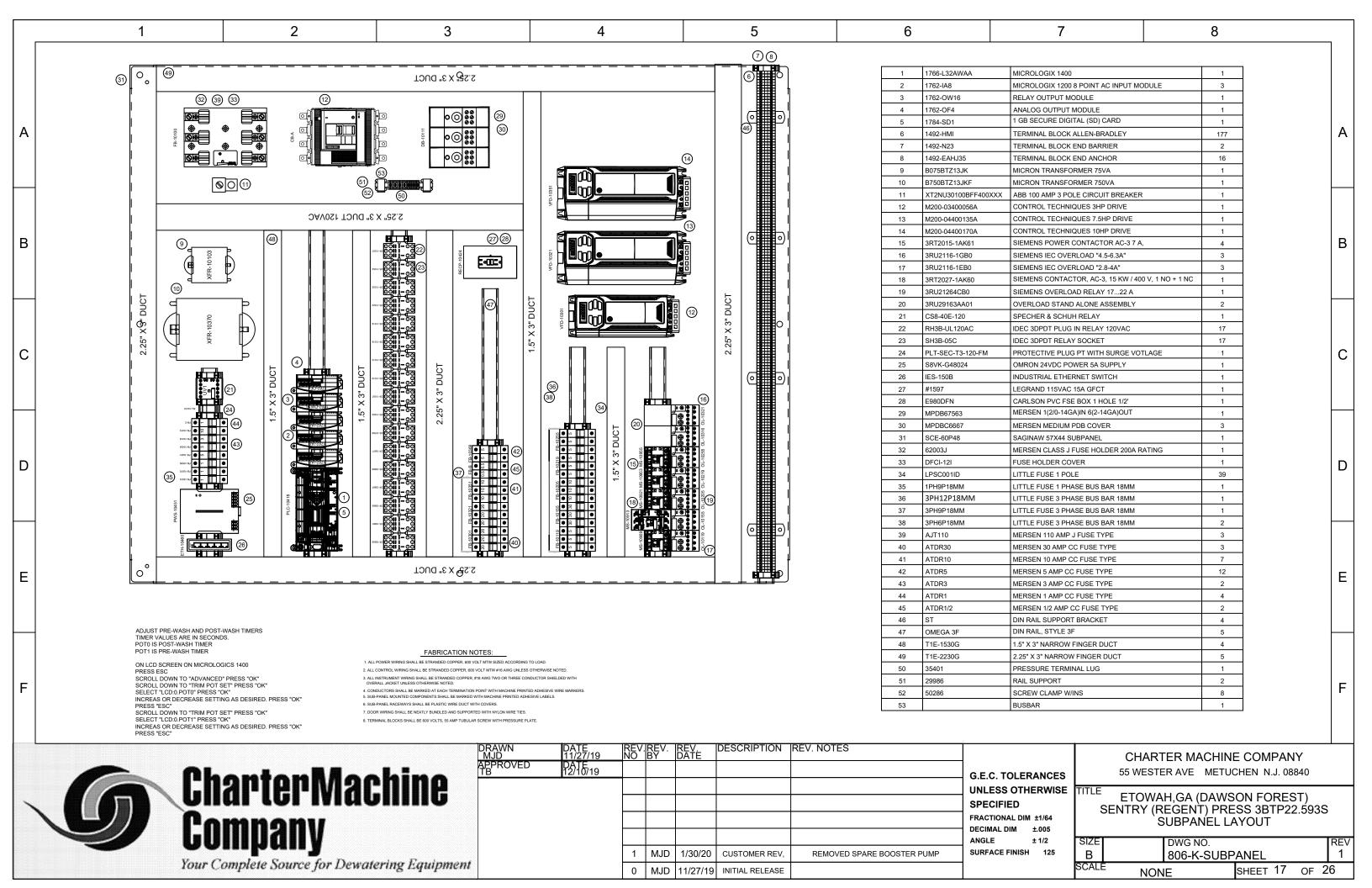




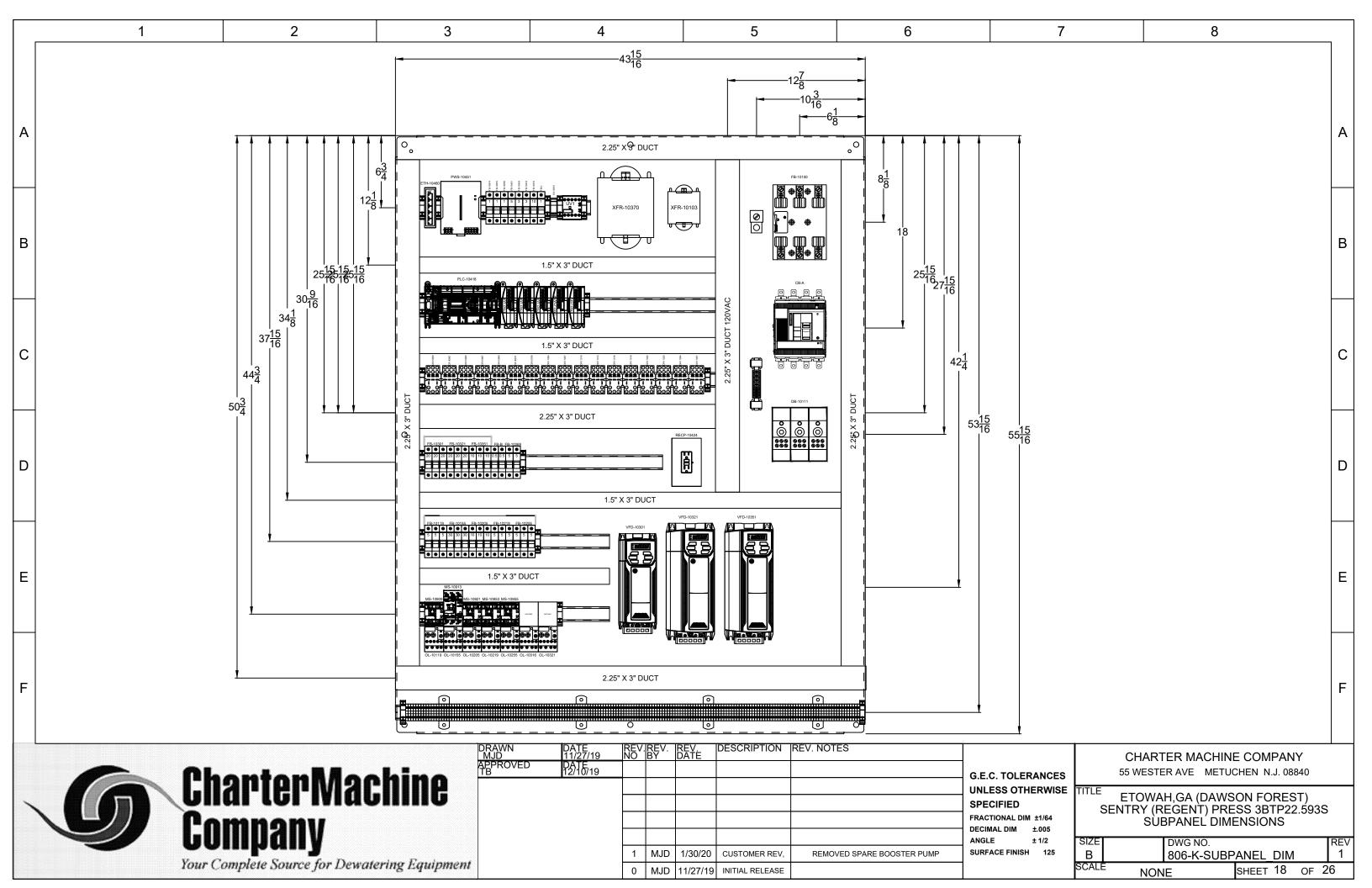




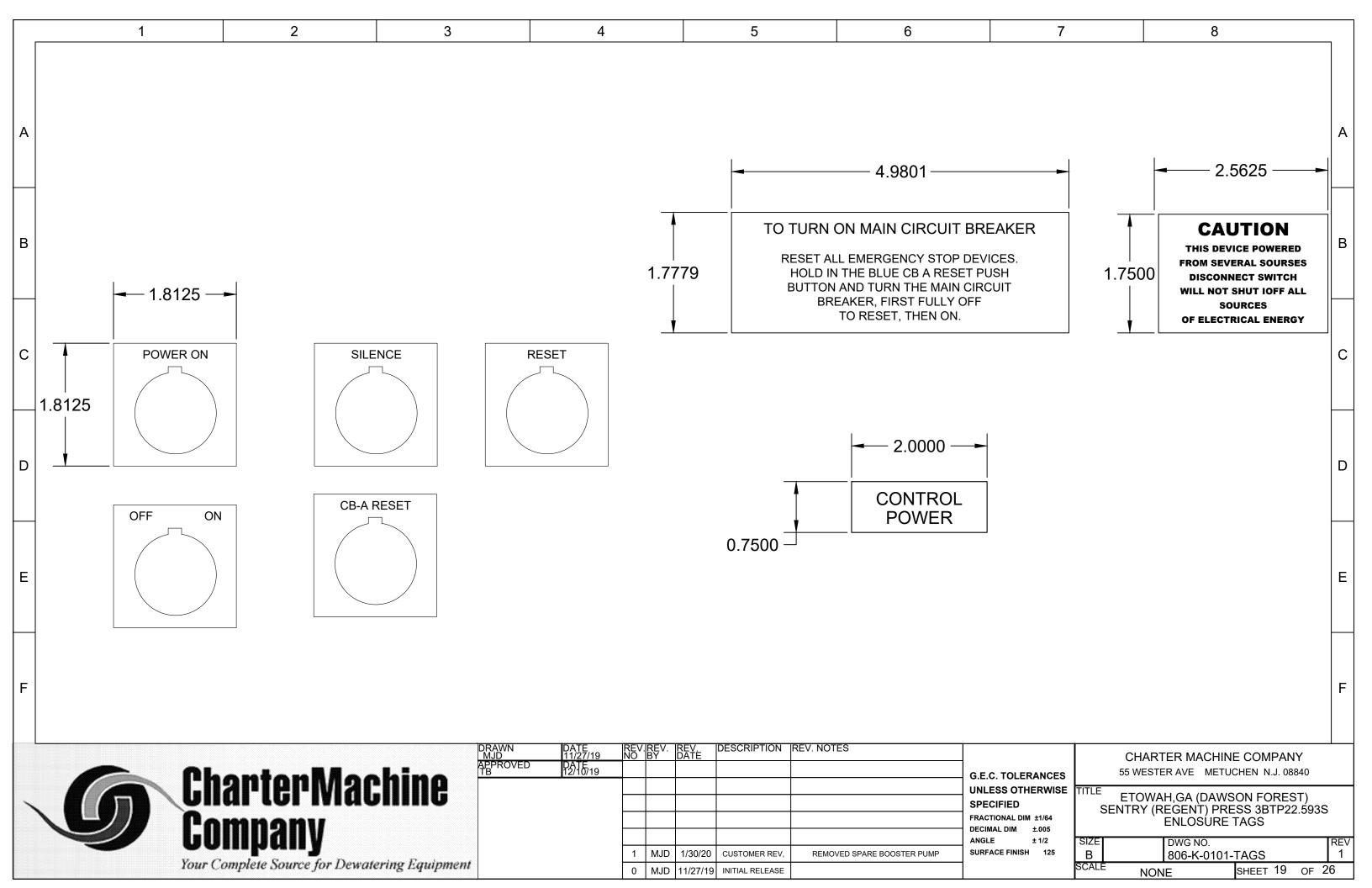




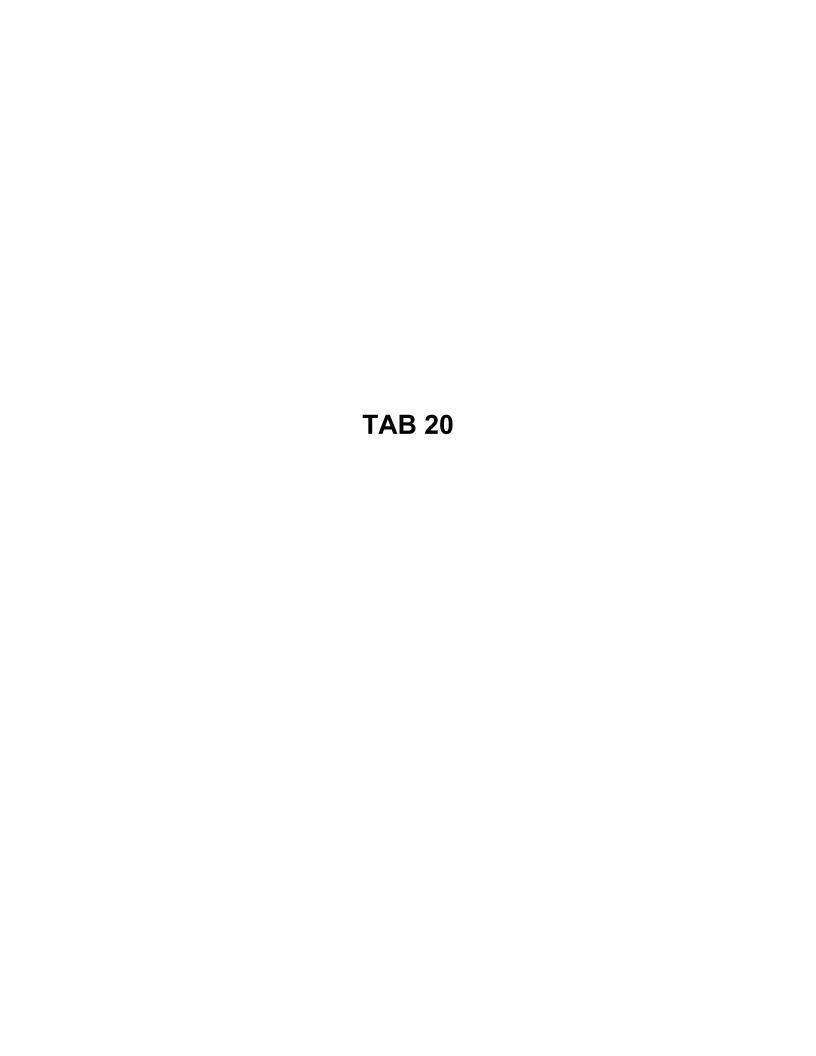














CHARTER MACHINE COMPANY SUMMARIZED BILL OF MATERIAL

REQ QTY PARENT ITEM# DESCRIPTION

1 806.L2.1 ETOWAH,GA (DAWSON FOREST)

L2.1 POLYMER SYSTEM

\//T #

| COMPONENT | COMPONENT | QTY | |
|--|--------------------------------------|----------|------|
| ITEM NUMBER | DESCRIPTION/COMMENT | REQUIRED | UM |
| TI EW NOWIDER | DECOMI TION/OOMMENT | KEQUIKED | Civi |
| #1492-HM1 | TERMINAL BLOCK ALLEN-BRADLEY | 25 | EA |
| | | | |
| #1492-N23 | TERMINAL BLOCK END ANCHOR | 2 | EA |
| | ALLEN-BRADLEY | | |
| #1492-EAHJ35 | TERMINAL BLOCK END BARRIER | 1 | EA |
| | | | |
| #700-FEA3TU23 | ALLEN-BRADLEY ON DELAY DIN RAIL | 1 | EA |
| | MOUNT TIMER | | |
| #RH2B-UL120AC | IDEC 2PDT PLUG IN RELAY 120V 10A | 1 | EA |
| | DIN RAIL MOUNT | | |
| #SH2B-05C | IDEC RELAY SOCKET 2PDT | 1 | EA |
| | DIN RAIL MOUNT | | |
| #RH3B-UL120AC | IDEC 3PDT PLUG IN RELAY 120V 10A | 1 | EA |
| | DIN RAIL MOUNT | | |
| #SH3B-05C | IDEC RELAY SOCKET 3PDT | 1 | EA |
| ,, = , , , , , , , , , , , , , , , , , | DIN RAIL MOUNT | | |
| 5SY4-101-7 | 1 AMP SIEMENS CIRCUIT BREAKER | 1 | EA |
| | 1 POLE CB | | |
| 5SY-110-7 | 10 AMP SIEMENS CIRCUIT BREAKER | 1 | EA |
| 001 110 1 | 1 POLE CB | | |
| 5SY4-111-7 | 5 AMP SIEMENS CIRCUIT BREAKER | 1 | EA |
| 3014-111-7 | 1 POLE CB | | LA |
| APD1QH2DNU-R | IDEC PILOT LIGHT RED | 1 | EA |
| AI DIQIIZDIVO-IV | 120VAC | - ' | LA |
| APD1QH2DNU-A | IDEC PILOT LIGHT AMBER | 1 | EA |
| AI DIQIIZDINO-A | 120VAC | - ' | LA |
| #ASD320NU | IDEC SELECTOR SWITCH 3 POSITION | 2 | EA |
| #ASDS20NO | 20 AMP | | LA |
| #LPSC001ID | LIT 1POLE CLASS CC FUSE HOLDER | 1 | EA |
| #LP3C0011D | LIGHTED | | EA |
| #ATDD 45 | | 1 | Γ. |
| #ATDR-15 | MERSEN CLASS CC FUSE | l I | EA |
| HBL5266C | HUBBELL 15A, 125V, 2 POLE, 3 WIRE | 1 | EA |
| HBL3200C | NEMA 5-20P | | EA |
| 800H-W123 | ENGRAVED LEGEND PLATE | 1 | EA |
| 800H-VV123 | | I | EA |
| 800H-W151 | (RUN) 30MM ENGRAVED LEGEND PLATE | 1 | EA |
| 800H-W151 | | 1 | EA |
| #000LL WOEE | (HAND OFF AUTO) 30MM | | Γ. |
| #800H-W055 | ENGRAVED LEGEND PLATE | 1 | EA |
| 144477 | (LOC OFF REM) 30MM | | |
| L1.1-K-TAGS | 3/4" X 2" CUSTOM ENGRAVED NAME | 3 | EA |
| 0.140400 | TAG SEE DRAWING FOR LEGEND | | |
| CJ12106 | CARLON ENCLOSURE 12x10x6 | 1 | EA |
| 15.40.40 | LOAD ON OTES OUR RESERVE | | |
| JP1210 | CARLON STEEL SUB-PLATE #10.75 X 8.87 | 1 | EA |
| DN 25C | 4" V 4 20" DINOCALID FINOED DUCT | | ^ |
| DN-35G | 1" X 1.38" DINOSAUR FINGER DUCT | 3 | EA |
| OMEON OF | DIAL DAIL OTALE OF | | _ ^ |
| OMEGA 3F | DIN RAIL, STYLE 3F | 1 | EA |





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Terminal Blocks, NEMA/EEMAC

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- Finger-Safe Terminal Blocks
- Panel Mount Blocks
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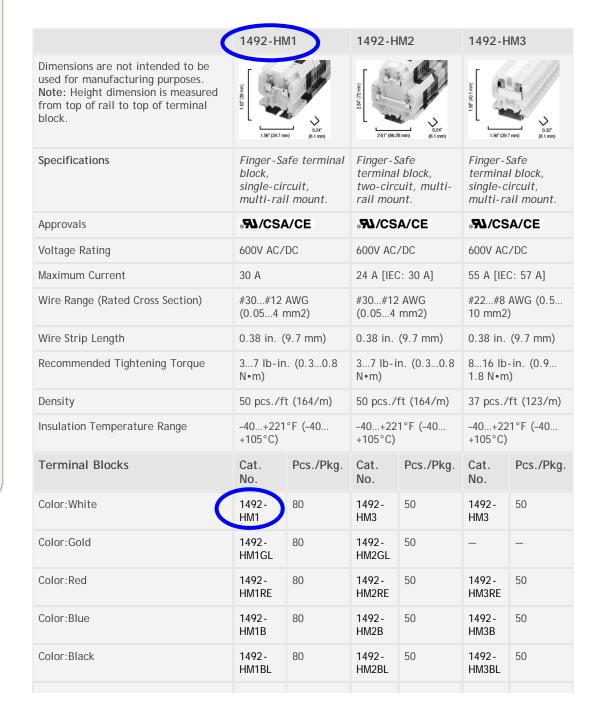
FINGER-SAFE TERMINAL BLOCKS

Introduction

High Density Blocks Fuse and Surge Suppressor Blocks Resistor, Voltage Indicating, and Component Blocks Short-Circuit Current Ratings



High Density Blocks



| Color:Green | 1492 - HM1G | 80 | 1492 - HM2G | 50 | 1492 - HM3G | 50 |
|---|--------------------|-----------|--------------------|-----------|--------------------|-----------|
| Color:Yellow | 1492 - HM1Y | 80 | 1492 - HM2Y | 50 | 1492 - HM3Y | 50 |
| Color:Brown | 1492 - HM1BR | 80 | 1492 - HM2BR | 50 | 1492 - HM3BR | 50 |
| Color:Violet | 1492 - HM1VT | 80 | 1492 - HM2VT | 50 | 1492 - HM3VT | 50 |
| Color:Grey | 1492- HM1GY | 80 | 1492 - HM2GY | 50 | 1492 - HM3GY | 50 |
| Color:Orange | 1492 - HM1OR | 80 | 1492 - HM2OR | 50 | 1492 - HM3OR | 50 |
| Accessories (<u>Accessories</u>) | Cat. No. | Pcs./Pkg. | Cat. No. | Pcs./Pkg. | Cat. No. | Pcs./Pkg. |
| Mounting Rails: A-B Rail | 1492 - N1 | 20 | 1492 - N1 | 20 | 1492 - N1 | 20 |
| 3 ft Rigid A-B Rail | 1492 - N22 | 20 | 1492 - N22 | 20 | 1492 - N22 | 20 |
| 3 ft High-Rise A-B Rail | 1492 - N44 | 2 | - | - | 1492 - N44 | - |
| Standoff Brackets (use every 12 in.) | 1492 - N25 | 2 | 1492 - N25 | 2 | 1492 - N25 | 2 |
| DIN Rail | 199- DR1 | 10 | 199- DR1 | 10 | 199- DR1 | 10 |
| 1 m Symmetrical DIN (Aluminum) | 1492 - DR5 | 10 | 1492 - DR5 | 10 | 1492 - DR5 | 10 |
| 1 m Hi-Rise Sym. DIN (Aluminum) | 1492 - DR6 | 2 | 1492 - DR6 | 2 | 1492 - DR6 | 2 |
| 1 m Angled Hi-Rise Sym. DIN (Steel) | 1492 - DR7 | 2 | 1492 - DR7 | 2 | 1492 - DR7 | 2 |
| End Barrier | 1492 - NM36 | 50 | 1492 - NM40 | 50 | 1492 - NM36 | 50 |
| End Anchors: A-B Rail | 1492- N23 | 10 | 1492 - N23 | 10 | 1492 - N23 | 10 |
| A-B Rail — Normal Duty | 1492 - N47 | 50 | - | _ | 1492 - N47 | 50 |
| A-B Rail — Retaining Clip — Light Duty | 1492 - N2 | 50 | _ | _ | - | _ |
| DIN Rail — Normal Duty | 1492 - EA35 | 50 | 1492 - EA35 | 50 | 1492 - EA35 | 50 |
| DIN Rail — Heavy Duty | 1492 - EAH35 | 10 | 1492 - EAH35 | 10 | 1492 - EAH35 | 10 |
| Color:=26,1165366 | 1492 - N42 | 50 | 1492 - N42 | 50 | - | 50 |
| Color:=23,1165366 | 1492 - SJ8 - 10 | 10 | 1492 - SJ6 - 10 | 10 | 1492 - SJ8 - 10 | 10 |
| 50-pole Uninsulated | 1492 - N39 | 10 | 1492 - N39 | 10 | - | - |
| Insulating Sleeve | 1492 - SJS | 10 | 1492 - SJS | 10 | - | - |
| Marking System | 1492- | 5 | 1492- | 5 | 1492- | 5 |

| Standard Feed-Through Bit | JCKS | | | | | | | | | | |
|---|-------------------------------------|------------------------|--------------------------------------|--------------|------------------------------------|--|-------------------------------------|------------------------|-----------------------|-------------------------------------|--|
| | 1492 | 2-J3 | | | 149 | 2-J4 | | 149 | 2-J6 | | |
| Dimensions are not intended to be used for manufacturing purposes. Note: Height dimension is measured from top of rail to top of terminal block. | (5.1 mm) | | mm) | (E.1 mm) | | (a) (a) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c | | | | | |
| Specifications | Feed-through t | | | | | terminal I | | Feed-through | | _ | |
| Certifications | FL CSA | | ATEX | <i>71</i> | CSA | IEC | ATEX | SA CSA | IEC | ATEX | |
| Voltage Rating | | | 550V AC/DC | | AC/DC | 800V AC/DC | 690V AC/DC | 600V AC/DC | 800V AC/DC | 550V AC/DC | |
| Maximum Current | 25 A 20 A | 24 A | 21 A | 35 A | 25 A | 32 A | 28 A | 50 A | 41 A | 36 A | |
| Wire Range (Rated Cross Section) | #2212 #2612 AWG AWG | 2.5 mm ² (# | 2.5 mm ² #2014 AWG) | #2210 AWG | #2610 AWG | 4 mm ² | 4 mm ² (#2012 AWG) | #228 AWG | 6 mm ² | 6 mm ² (#2010 AWG) | |
| Wire Strip Length | 0.39 in. (| (10 mm) | | | 0.39 in. | (10 mm) | | 0.47 in. | (12 mm) | | |
| Recommended Tightening Torque | 4.57.1 lb•in (0 | 0.50.8 N | •m) | | 9.0 lb•in | (1.0 N•m) | | 14.2 lb•in | ı (1.6 N∙m | 1) | |
| Density | 59 pcs/ft (1 | 96 pcs/m) | | | 49 pcs/ft (| 163 pcs/n | n) | 37 pcs/ft (| 37 pcs/ft (123 pcs/m) | | |
| Housing Temperature Range | -58+248 °F (- | -50+120 | °C) | -58. | | (-50+12 | (0 °C) | -58+248 °F | (-50+12 | 20 °C) | |
| Short-Circuit Current Rating | | | | | See pa | ge 12-42 | | | | | |
| Township of Display | 0-4 N- | | N Ob | | 0-4 N- | | DI Ot | 0-4 N- | | DI Ot | |
| Terminal Blocks | Cat. No. 1492-J3 | Р | kg Qty. | | Cat. No. 1492-J4 | | Pkg Qty. | Cat. No. 1492-J6 | | Pkg Qty. | |
| Color: Grey | 1492-J3-RE | | 100 | | 492-J4-R | _ | 100 | 1492-J6 1492-J6-Ri | | 100 | |
| Red | 1492-J3-RE 1492-J3-B | | 100 | | 492-J4-R 1492-J4-E | | 100 | 1492-J6-R | | 100 | |
| Blue | 1492-J3-B 1492-J3-BL | | 100 | | | | 100 | 1492-J6-B | | 100 | |
| Black | | | 100 | | 492-J4-B | | 100 | | | 100 | |
| Green Yellow | 1492-J3-G 1492-J3-Y | | 100 | | 1492-J4-0 1492-J4-Y | | 100 | 1492-J6-G 1492-J6-Y | | 100 | |
| - | | | 100 | | | | 100 | | | 100 | |
| Orange | 1492-J3-OR | | 100 | | 492-J4-O | | 100 | 1492-J6-O | | 100 | |
| Brown White | 1492-J3-BR 1492-J3-W | | 100 | | 492-J4-B 1492-J4-W | | 100 | 1492-J6-BR | | 100 | |
| Violet | 1492-J3-W | | 100 | | 1492-J4-V 1492-J4-V | | 100 | 1492-J6-W | <u>'</u> | 100 | |
| Mounting Rails: | 1492-J3-V | | 100 | | 1492-J4-V | <u>'</u> | 100 | | | | |
| 1 m Symmetrical DIN (Steel) | 199-DR1 | | 10 | | 199-DR1 | | 10 | 199-DR1 | | 10 | |
| 1 m Symmetrical DIN (Aluminum) | 1492-DR5 | | 10 | 1492-DR5 | | 10 | 1492-DR5 | | 10 | | |
| 1 m Hi-Rise Sym. DIN (Aluminum) | 1492-DR6 | | 2 | | 1492-DR6 | | 2 | 1492-DR6 | | 2 | |
| 1 m Angled Hi-Rise Sym. DIN (Steel) | 1492-DR7 | | 2 | 1492-DR7 | | 2 | 1492-DR7 | | 2 | | |
| End Barriers Grey | 1492-EBJ3 | | 50 | 1492-EBJ3 | | 50 | 1492-EBJ3 | 3 | 50 | | |
| Blue | 1492-EBJ3-B | 3 | 50 | 1492-EBJ3-B | | 50 | 1492-EBJ3- | В | 50 | | |
| Yellow | 1492-EBJ3-Y | 1 | 50 | 14 | 492-EBJ3- | -Υ | 50 | 1492-EBJ3- | ·Y | 50 | |
| End Anchors and Retainers: | 1492-EAJ35 | | 100 | - | 492-EAJ3 | 5 | 100 | 1492-EAJ3 | 5 | 100 | |
| DIN Rail — Normal Duty | | | 100 | | | 100 | | | 100 | | |
| DIN Rail — Heavy Duty | 1492-EAHJ35 | | 50 | 14 | 192-EAHJ | 35 | 50 | 1492-EAHJ35 | | 50 | |
| Screwless End Retainer | 1492-ERL35 | i | 20 | 1 | 492-ERL3 | 5 | 20 | 1492-ERL35 | | 20 | |
| Jumpers:* Screw Center Jumper — 10-pole | 1492-CJJ5-10 | | 20 | | 92-CJJ6- | | 20 | 1492-CJJ8-10 | | 20 | |
| Screw Center Jumper — 4-pole | 1492-CJJ5-4 | | 50 | | 492-CJJ6- | | 50 | 1492-CJJ8-4 | | 50 | |
| Screw Center Jumper — 3-pole | 1492-CJJ5-3 | | 50 | | 492-CJJ6- | | 50 | 1492-CJJ8-3 | | 50 | |
| Screw Center Jumper — 2-pole Plug-in Center Jumper — 50-Pole | 1492-CJJ5-2 | | 50 10 | | 492-CJJ6 JLJ6-41 (4 | | 50 10 | 1492-CJJ8- | -2 | 50 | |
| Plug-in Center Jumper — 30-Pole | 1492-CJLJ5-5 | | 20 | | , | | 20 | _ | | | |
| Plug-in Center Jumper — 10-Pole Plug-in Center Jumper — 9-Pole | 1492-CJLJ5-1 1492-CJLJ5-9 | | 20 | 14 | 92-CJLJ6 | -10 | | | | | |
| Plug-in Center Jumper — 8-Pole | 1492-CJLJ5-8 | | 20 | | | | | _ | | | |
| Plug-in Center Jumper — 7-Pole | 1492-CJLJ5- | | 20 | | | | | _ | | | |
| Plug-in Center Jumper — 6-Pole | 1492-CJLJ5-0 | | 20 | | _ | | _ | _ | | <u> </u> | |
| Plug-in Center Jumper — 5-Pole | 1492-CJLJ5- | | 20 | | _ | | _ | _ | | T - | |
| Plug-in Center Jumper — 4-Pole | 1492-CJLJ5-4 | | 60 | 14 | 92-CJLJ6 | i-4 | 60 | _ | | _ | |
| Plug-in Center Jumper — 3-Pole | 1492-CJLJ5-3 | 3 | 60 | | | 60 | _ | | T - | | |
| Plug-in Center Jumper — 2-Pole | 1492-CJLJ5-2 | 2 | 60 | | | 60 | _ | | _ | | |
| Insulated Side Jumper — 24-Pole | 1492-SJ5B-24 50 — | | _ | | | _ | | | | | |
| Insulated Side Jumper — 10-Pole | 1492-SJ5B-10 | 5J5B-10 50 — | | _ | | | _ | | | | |
| Screw Type Jumper Notching Tool | 1492-T1 | | 1 | | 1492-T1 | | 1 | 1492-T1 | | 1 | |
| Other Accessories: | 1492-EBJ16 | | 20 | 1 | 492-EBJ1 | 6 | 20 | 0 1492-EBJ16 | | 20 | |
| Partition Plate | | | | | | | | | | | |
| Test Plug Socket | 1492-TPS23 | | 20 | | 192-TPS23 | | 50 | 1492-TPS23 | | 50 | |
| Test Plug (Stockable) | 1492-TP23 | | 20 | | 1492-TP23 | | 20 | 1492-TP23 | • | 20 | |
| Test Plug (Stackable) Electrical Warning Plate | 1492-TPJ5 1492-EWPJ5 | | 25 25 | | 1492-TPJ6 492-EWP֊ | | 25 25 | 1492-EWPJ | IΩ | 50 | |
| Marking Systems: | 1492-EWPJ5 | | 5 | | 492-EWP 16X12 (12 | | 5 | 1492-MR8X12 (8 | | 5 | |
| Snap-in Marker Cards | 1492-M5X5 (200/ | | 5 | | M6X5 (200 | | 5 | 1492-M8X5 (160 | | 5 | |
| - Shap in Markor Oardo | 1492-IVIOAO (200/ | caru) | J | 1492- | 10A3 (200 | , caru) | J | 1702-IVIOAO (100 | , caru) | | |

 $[\]star$ Use of center jumpers may affect spacings, requiring derating of terminal blocks. See page 12-83 for details.



Economy Timing Relays

A-B

(Catalog Number 700-FE)

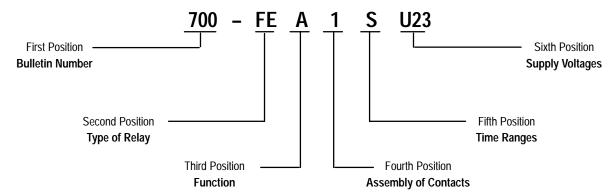
Product Data



The Bulletin 700–FE Economy Timing Relays consist of Multi–Function, Single Function, and Special Function designs. These products are offered in a compact, DIN rail mountable package to meet the customers timing needs at an economical price.

- 17.5mm (11/16 inch) Wide
 - 24V AC/DC (1 NO only) 110–240V AC
 - 24–48V DC (SPDT only) 24–240V AC
- DIN Rail Mounting
- Finger Safe Terminals
- 1 Normally Open Output Contact
 - Multi–Function (On–Delay, Off–Delay, One Shot, Flasher, with 4 Timing Ranges)
 - Single Function (On–Delay, Off–Delay, One Shot, Flasher, with 4 Timing Ranges)
- Single Pull Double Throw (SPDT) Contact Configuration
 - Multi–Function (On–Delay, Off–Delay, One Shot, Flasher, with 6 Timing Ranges)
 - Single Function (On–Delay, Off– Delay, One Shot, Flasher, Fleeting Off–Delay, Pulse Converter, with 6 Timing Ranges)
 - Special Function (Star–Delta with 4 Timing Ranges)

Catalog Number Explanation



| Multi-Fund | ction Economy Relays | | | |
|-------------|--|---|------------------------------------|---|
| 700-FE | M | 1 | R | U23 |
| | Function | Assembly of contacts | Time ranges | Supply voltages |
| | M Multi-function timing relays with a Single-function: A, B, D | 1 1 normally open contact 1 N.O. | R 0.5 s 1 h (4 settings) | U22 24V AC/DC❶ 110240 V 50/60 Hz |
| and F | | 3 1 Changeover contact 1 C/O (SPDT) | T 0.05 s10 h (6 settings) | U23 2448 VDC 24240 V 50/60 Hz |
| Single Fund | ction Economy Relays | | | |
| 700-FE | Α | 1 | S | U23 |
| | Function | Assembly of contacts | Time ranges | Supply voltages |
| | A On-delay D One shot E Fleeting off-delay | Functions A, B, D, F: 1 normally open contact 1 N.O. | S 0.75 s1 h (4 settings) | U22 24V AC/DC 0 110240 V 50/60 Hz |
| | F Flasher (repeat cycle starting with pulse)L Pulse converter | All functions: 3 1 Changeover contact 1 C/O (SPDT) | T 0.05 s10 h (6 settings) | U23 2448 VDC 24240 V 50/60 Hz |
| Special Fun | action Economy Relays | | | |
| 700-FE | Υ | 2 | Q | U23 |
| | Function | Assembly of contacts | Time ranges | Supply voltages |
| | Y Star-delta timing relays | 2 2 normally open contacts 2 N.O.1 side common | Q 0.15 s10 min (4 settings) | U23 2448 VDC 24240 V 50/60 Hz |

[•] Voltage is either 24V DC or 24V AC 50/60 Hz.

Technical Data

700-FEM Multi-Function Economy Relays

| De | \ | 1 NO | | SPDT | | | |
|---|----------------------------|------|------------------|--|-------|---|---------|
| Multi-function timing relays 700-FEM includes 4 selectable functions: (A) On-delay Off-delay One shot / watch dog Flasher (Repeat Cycle) starting with pulse | | | | 0.510 s 360 s 0.510 min 360 m | | setting ranges 5 s10 h 0.051 s 0.510 s 0.051 min 0.510 min 0.051 h 0.510 h | |
| | Supply voltage | | | Cat | . No. | C | at. No. |
| | U22 110240 VA 24V AC/DC | | A1/A2) A3/A2) | 700-FEM1RU22 | | _ | |
| | U23 2448 VDC 24240 VAC | | A1/A2) A1/A2) | _ | | 700-FEM3TU2 | 3 |

700-FE Single Function Economy Relays

| Description | \ 1 NO | ⊾ SPDT | | |
|---|--|--|--|--|
| | Multi-time setting ranges 0.75 s60 m (15s) 0.7515 s (60s) 360 s (8m) 0.48 m (60m) 360 m | Multi-time setting ranges 0.05 s10 h (1s) 0.051 s (10s) 0.510 s (1m) 0.051 m (10m) 0.510 m (1h) 0.051 h (10h) 0.510 h | | |
| 400 | Supply voltage U22 24V AC/DC | Supply voltage U23 2448 VDC (A1/A2) 24240 VAC, 50/60 Hz (A1/A2) | | |
| Also See 700–FE Timing Charts | Cat. No. | Cat. No. | | |
| (A) On-delay | 700-FEA1SU22 | _ | | |
| The output contact changes state after the time delay is completed. | _ | 700-FEA3TU23 | | |
| (B) Off-delay Input power must be supplied to terminal (A1/A2) continuously. The output contact changes state when switch "S" is closed. When switch | 700-FEB1SU22 | _ | | |
| "S" is opened, the time delay begins. After the time delay is completed, the contact returns to shelf state. | _ | 700-FEB3TU23 | | |
| (D) One shot | 700-FED1SU22 | _ | | |
| The output contact changes state when the relay is energized. The output contact returns to shelf state when the time delay is completed. | _ | 700-FED3TU23 | | |
| (F) Flasher (repeat cycle starting with pulse) The output contact changes state when the power is applied. At the end | 700-FEF1SU22 | _ | | |
| of the time delay, the output contact returns to shelf state. This cycle continues until the power is removed. | _ | 700-FEF3TU23 | | |
| (E) Fleeting off-delay Input power must be supplied to terminal (A1/A2) continuously. The output contact changes state after closing and opening switch "S". After the time delay is completed, the contact returns to shelf state. | _ | 700-FEE3TU23 | | |
| (L) Pulse converter Input power must be supplied to terminal (A1/A2) continuously. When switch "S" is closed, the output contact changes state. When the time delay is complete, the output contact returns to shelf state. The time "t" is not influenced by the duration of the control pulse. | _ | 700-FEL3TU23 | | |

Technical Data, Continued

700-FEY Special Function Economy Relays

| Description | 2 NO w/common |
|--|--|
| 000 | Multi-time setting ranges 0.15 s10 m |
| ATT OF THE PARTY O | (3s) 0.153 s (10s) 0.510 s (1m) 0.051 min (10m) 0.510 min |
| - D | Supply voltage U23 2448 VDC (A1/A2) 24240 VAC, 50/60 Hz (A1/A2) |
| Also See 700–FE Timing Charts | Cat. No. |
| (Y) Star-delta timing relay When power is applied, the output contact 17/18(Y) changes state. After the time setting, the output contact 17/18(Y) returns to shelf state. After the fixed time (50 to 65 ms), the output contact 17/28\Delta changes state. The output contact returns to shelf state after the power is removed. | 700-FEY2QU23 |

Specifications

Time characteristics (according to VDE 0435, part 2021)

| | \ 1 NO | \ SPDT | | | |
|---------------------------------------|--|---|--|--|--|
| Setting accuracy | ± 5% o | f full scale | | | |
| Repeatability | ± 1% of se | etting (typical) | | | |
| Tolerance | by voltage: $\pm0.01\%/\%\Delta U$ by temperature: $\pm0.25\%/^{\circ}C$ | by voltage: $\pm 0.001\%/\Delta U$ by temperature: $\pm 0.025\%/^{\circ}C$ | | | |
| Supply | | | | | |
| Supply voltage | 24V AC/DC and 110240VAC, 50/60 Hz | 2448 VDC and 24240VAC, 50/60 Hz | | | |
| Voltage tolerance | -15%/+20% (DC |), -15%/+10% (AC) | | | |
| Power consumption | 0.5 W at 24 VDC, 9 VA at 240 VAC | 0.5 W at 24 VDC, 5 VA at 240 VAC | | | |
| Time energized | 10 | 00% | | | |
| Reset time | 250 ms | 100 ms | | | |
| Cable length (supply voltage control) | max. 100 m (30 feet) | max. 250 m (75 feet) | | | |
| Pulse control (B1) | | | | | |
| Impulse duration | ≥ 250 ms | \geq 50 ms (AC), \geq 30 ms (DC) | | | |
| Input voltage | supply voltage range | | | | |
| Input current | 1 mA | | | | |
| Cable length | max. 250 m without parallel load between B1 and A2 max. 50 m with load ($<$ 3 k Ω) between B1 and A2 | | | | |
| Outputs | | | | | |
| Contact type | 1 NO contact | 1 Form C – SPDT contact | | | |
| Switching capacity | Power: 1250 VA According to IEC 947-5-1: AC1 – 5A/250 VAC (resistive load) AC14 – 1 A/250 VAC (inductive load) DC13 – 1 A/24 VDC (inductive load) According to UL 508: NEMA D300 – 1A/300VAC | | | | |
| Short-circuit protection | 6 A gL (Fast Blow Fuse) | | | | |
| Life | mechanical: 20 Mil. of operations electrical operations: 0.4 Mil. at 1 A/250 VAC, resistive 0.4 Mil. at 0.5 A/250 VAC, $\cos \varphi = 0.4$ 0.4 Mil. at 1 A/24 VDC, resistive | | | | |
| State indicator | 1 LED | 1 Bi-Color LED (Supply; Relay) | | | |

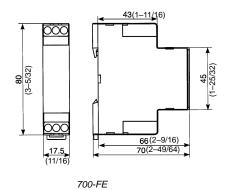
Specifications, Continued

General Specifications

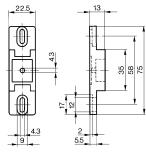
| | \ 1 NO | L√I SPDT | | | | |
|-------------------------------|---|---|--|--|--|--|
| Insulation characteristics | | to IEC 947-1 between all inputs and outputs | | | | |
| EMC/Interference immunity | The following requirements are fulfilled: Surge capacity of the supply voltage according to IEC 1000-4-5: Level 3 (A1–A2) 110240 VAC according to IEC 1000-4-5: Level 2 (A3–A2) 24 V AC/DC❶ Burst according to IEC 1000-4-4: Level 3 ESD discharge according to IEC 1000-4-2: Level 3 | The following requirements are fulfilled: Surge capacity of the supply voltage according to IEC 1000-4-5: Level 3 Burst according to IEC 1000-4-4: Level 3 ESD discharge according to IEC 1000-4-2: Level 3 | | | | |
| EMC/Emmission | electromagnetical fields acco | ording to EN 55 022: Class B | | | | |
| Safe isolation | according to VD | DE 106, Part 101 | | | | |
| Climatic withstand | 56 cycles (24 h) at 2540°C and 95% rel. hun | nidity according to IEC 68-2-30 and IEC 68-2-3 | | | | |
| Vibration resistance | 4 g in 3 axis at 10500 Hz, te | 4 g in 3 axis at 10500 Hz, test FC according to IEC 68-2-6 | | | | |
| Shock resistance | 50 g according | 50 g according to IEC 68-2-27 | | | | |
| Protection class IEC 947–1 | Enclosure: Terminal: | IP 40 IP 20 | | | | |
| Weight | 60 g | 60 g | | | | |
| Approvals | UL, C-UL, CE Certified | UL, C-UL, Germanischer Lloyd, CE Certified | | | | |
| Ambient temperature | Open: -25°C +60°C Enclosed: -25°C +45°C Storage: -40°C +85°C | | | | | |
| Connections | Screw terminal M3 for Pozidriv No.1, Philips and slotted screws No.2. suitable for power screw-driver. Rated tightening torque 8.8 LB–IN (max. 1.0 Nm) For terminal cross-sections of 1 x 0.5 mm ² 2 x 1.5 mm ² (solid) or 2 x 1.5 mm ² (stranded with sleeve), AWG 2014. Finger protection according to VDE 0106 | | | | | |
| Mounting | For surface mounting in any position; snap-on mounting | g on 35 mm DIN rail or by adapter and 2 screws M4 type | | | | |
| Disposal | Synthetic materials without dioxin according to EC/EFTA- | Notification No. 93/0141/D electrical contacts are AgCdO | | | | |

• Voltage is either 24V DC or 24V AC 50/60 Hz.

Approximate Dimensions
Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

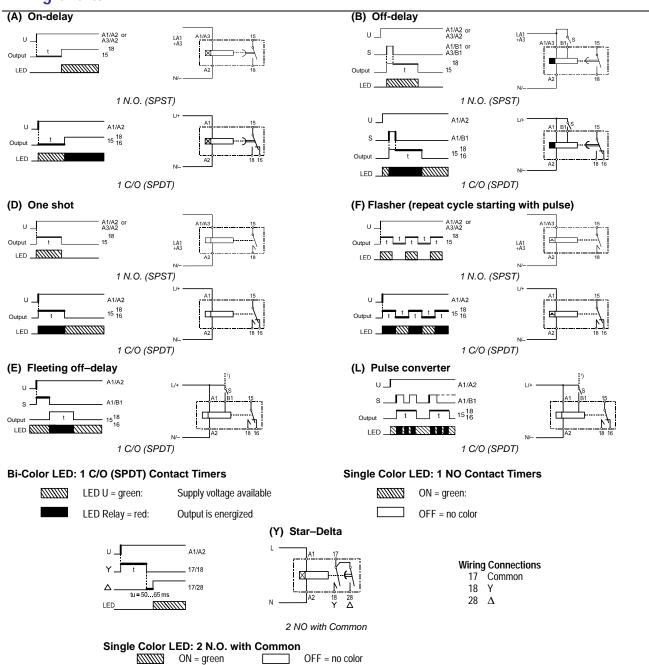


For panel mounting, Use the 199–FSA Panel Mounting Adapter.



199-FSA

Timing Charts



NOTE: For the initiate control contact B1, any external power within the supply voltage range can be used. For B1, a different voltage compared to the supply voltage A1/A3–A2 can also be used. For example: A1–A2 = 230 VAC 50/60 Hz, B1–A2 = 24 VDC, where A2 is the common connection.

Applications

| Sequence | Description | Wiring Diagram |
|---|--|---|
| On-Delay (A) Motor Starting | Pushing the Start Button energizes both the Starter Coil (1M) and the Timer Coil (TR). The Hold-In Contact (1M) closes to maintain the circuit after the Start Button is released. When the time delay is complete, the contact (TR) closes which energizes coil 2M. Therefor Motor 2M is always started after Motor 1M. | Motor 2M starts after Motor 1M Stop Start O.L. 1M A1/A3 TR O.L. 15 18 |
| Off-Delay (B) Motor Stopping | Pushing the Start Button energizes both 1M and 2M. Pushing the Stop Button de–energizes 1M and the Timer (TR) de–energizes 2M after the time delay. This allows Motor 2M to remain energized for a predetermined time after 1M is stopped | Motor 2M runs for a predetermined time after 1M is stopped Stop Start O.L. 1M 1M A1/A3 A2 O.L. 15 18 |
| One Shot (D) Motor On for a Predetermined Time | Each time the Float Switch is closed, Motor 1M will run for the predetermined time that is set on the one shot timer. | Float SW A1/A3 TR A2 TR O.L. |
| Fleeting Off-Delay (E) Motor On for a Predetermined Time After a Stop | Pushing the Start Button and then the Stop Button to energize and de–energize Motor 1M, will cause Motor 2M to be energized for a set time delay. | Turning 1M and Timer TR on and off will cause 2M to run for at least the predetermined time setting on TR Stop Start 1M 1M TR A1 O.L. TR 15 18 |

Applications, Continued

| Sequence | Description | Wiring Diagram |
|---|--|---|
| Flasher (Repeat Cycle Starting with Pulse) (F) Flashing a Pilot Light | When Limit Switch (1LS) closes, the Timer (TR) will be energized to close and open the contact for the time delay setting, causing the Pilot Light to flash. | Flashing a Pilot Light ILS A1/A3 TR A2 |
| | | TR 15 18 Pilot Light |
| Pulse Converter (L) Pulses Are Turned Into a Set or Predetermined Output | When the Photo Switch closes, the contact TR closes to energize Motor 1M for the predetermined time setting. Time setting is 0.05s to 10h. The timer will not be reset by the opening or pulsing of the photo switch until the time delay is completed. | When the photo SW closes, or closes and opens, the Motor 1M will run for the time setting Photo SW B1 TR A1 O.L. TR 15 |
| Star-Delta (Y) Starting a Star-Delta Motor | Pushing the Start Button energizes the relay CR and the timer TR. Both will hold in through CR. Contact 17–18 will close energizing the Star Contactor (Y), and starting the motor for the predetermined time. Then contact 17–18 will open and 50ms to 65ms later contact 17–28 will close to energize the Delta Contactor (Δ). | Starting a Star-Delta motor L1 Stop Start CR CR A1 TR A2 TR 18 Y=Star △=Delta |

Rockwell Automation

Allen-Bradley

Allen-Bradley, a Rockwell Automation Business, has been helping its customers in productivity and quality for more than 90 years. We design, manufacture and support a range of automation products worldwide. They include logic processors, power and motion a devices, operator interfaces, sensors and a variety of software. Rockwell is one of the valeading technology companies.

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Allen-Bradley Headquarters, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414 382-2000 Fax: (1) 414 382-4444

RH Series Compact Power Relays

Key features

- SPDT through 4PDT, 10A contacts
- Compact power type relays
- Miniature power relays with a large capacity
- 10A contact capacity
- Compact size saves space











Part Number Selection

| | | Part N | Number | |
|--|---|-------------------|--------------|--|
| Contact | Model | Blade Terminal | PCB Terminal | Coil Voltage Code (Standard Stock in bold) |
| | Standard | RH1B-U □ | RH1V2-U □ | |
| SPDT | With Indicator | RH1B-UL □ | _ | AC6V, AC12V, AC24V , AC110V, AC120V , |
| 1 C. C. | With Check Button | RH1B-UC □ | _ | AC220V, AC240V DC6V, DC12V, DC24V, |
| | With Indicator and Check Button | RH1B-ULC □ | _ | DC48V, DC110V |
| TOUR LINE | Top Bracket Mounting | RH1B-UT □ | _ | |
| (000. | With Diode (DC coil only) | RH1B-UD □ | RH1V2-UD □ | DC6V, DC12V , DC24V , DC48V, DC110V |
| | With Indicator and Diode (DC coil only) | RH1B-ULD □ | _ | DC12V, DC24V, DC48V, DC110V |
| DDDT | Standard | RH2B-U □ | RH2V2-U □ | |
| DPDT | With Indicator | RH2B-UL □ | RH2V2-UL □ | AC6V, AC12V, AC24V , 4C110-120V , |
| PATER | With Check Button | RH2B-UC □ | _ | AC220-240V |
| | With Indicator and Check Button | RH2B-ULC □ | _ | DC6V, DC12V , DC24V , DC48V, DC100-110V |
| | Top Bracket Mounting | RH2B-UT □ | _ | |
| | With Diode (DC coil only) | RH2B-UD □ | RH2V2-UD □ | DC6V, DC12V , DC24V , DC48V, DC100-110V |
| | With Indicator and Diode (DC coil only) | RH2B-ULD □ | RH2V2-ULD □ | DC8V, DC12V, DC24V, DC48V, DC100-110V |
| 3PDT | Standard | RH3B-U □ | RH3V2-U □ | |
| טרט ו | With Indicator | RH3B-UL □ | RH3V2-UL □ | AC6V, AC12V, AC24V , AC1 QV, AC120V , |
| W. Commercial Commerci | With Check Button | RH3B-UC □ | _ | AC220V, AC240V DC6V, DC12V, DC24V, |
| The Break | With Indicator and Check Button | RH3B-ULC □ | _ | DC48V, DC110V |
| THE REAL PROPERTY. | Top Bracket Mounting | RH3B-UT □ | _ | |
| and the same of th | With Diode (DC coil only) | RH3B-UD □ | _ | DC6V, DC12V, DC24V, DC48V, DC110V |
| | With Indicator and Diode (DC coil only) | RH3B-ULD □ | _ | DC6V, DC12V, DC24V, DC46V, DC110V |
| 4PDT | Standard | RH4B-U □ | RH4V2-U □ | |
| 4FD1 | With Indicator | RH4B-UL □ | RH4V2-UL □ | AC6V, AC12V, AC24V , AC110V, AC120V , |
| Water on leave | With Check Button | RH4B-UC □ | _ | AC220V, AC240V DC6V, DC12V , DC24V , DC48V, |
| | With Indicator and Check Button | RH4B-ULC □ | _ | DC110V |
| A STATE OF THE PARTY OF THE PAR | Top Bracket Mounting | RH4B-UT □ | _ | |
| | With Diode (DC coil only) | RH4B-UD □ | RH4V2-UD □ | DC6V, DC12V, DC24V, DC48V, DC110V |
| | With Indicator and Diode (DC coil only) | RH4B-ULD □ | _ | DGOV, DG1ZV, DG24V, DG46V, DG110V |



PCB terminal relays are designed to mount directly to a circuit board without any socket.

Ordering Information

When ordering, specify the Part No. and coil voltage code:

(example) RH3B-U

RH3B-U AC120V



Coil Voltage Code



Switches & Pilot Lights

Sockets (for Blade Terminal Models)

| Relays | Standard DIN Rail Mount 1 | Finger-safe DIN Rail Mount ¹ | Through Panel Mount | PCB Mount |
|--------|---------------------------|---|---------------------|-----------|
| RH1B | SH1B-05 | SH1B-05C | SH1B-51 | SH1B-62 |
| RH2B | SH2B-05 | SH2B-05C | SH2B-51 | SH2B-62 |
| RH3B | SH3B-05 | SH3B-05C | SH3B-51 | SH3B-62 |
| RH4B | SH4B-05 | SH4B-05C | SH4B-51 | SH4B-62 |
| | | | No. | |

Relays & Sockets

1. DIN Rail mount socket comes with two horseshoe clips. Do not use unless you plan to insert pullover wire spring. Replacement horseshoe clip part number is Y778-011.

Hold Down Springs & Clips

| | Appearance | Item | Relay | For DIN Mount Socket | For Through Panel & PCB Mount Socket | |
|-----|----------------------|--------------------------|------------------------|-------------------------|--------------------------------------|--|
| | \wedge | | RH1B | SY2S-02F1 ² | | |
| < > | Dullayar Wire Caring | RH2B | SY4S-02F1 ² | SY4S-51F1 | 4 | |
| | Pullover Wire Spring | RH3B | SH3B-05F1 ² | 3143-3171 | | |
| | | | RH4B | SH4B-02F1 ² | | |
| | All B | Leaf Spring (side latch) | RH1B, RH2B, RH3B, RH4B | SFA-202 ³ | SFA-302 ³ | |
| | - | Leaf Spring (top latch) | RH1B, RH2B, RH3B, RH4B | SFA-101 ³ | SFA-301 ³ | |

2. Must use horseshoe clip when mounting in DIN mount socket. Replacement horseshoe clip

part number is Y778-011. 3. Two required per relay.

AC Coil Ratings

| | | | Rated C | Current (m | nA) ±15% | at 20°C | | | | Coil Resis | stance (Ω) | | Operation Characteristics | | |
|---------|------|-----------------|---------|------------|----------|---------|------|------|--------------|------------|------------|-------|------------------------------------|-------------------|--------------------|
| Voltage | | AC 50Hz AC 60Hz | | | | | | | ±10% at 20°C | | | | (against rated values at 20°C) | | |
| (V) | SPDT | DPDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | Max. Continuous Applied Voltage | Pickup Voltage | Dropout Voltage |
| 6 | 170 | 240 | 330 | 387 | 150 | 200 | 280 | 330 | 330 | 9.4 | 6.4 | 5.4 | | | |
| 12 | 86 | 121 | 165 | 196 | 75 | 100 | 140 | 165 | 165 | 39.3 | 25.3 | 21.2 | | | |
| 24 | 42 | 60.5 | 81 | 98 | 37 | 50 | 70 | 83 | 83 | 153 | 103 | 84.5 | | | |
| 110 | 9.6 | _ | 18.1 | 21.6 | 8.4 | _ | 15.5 | 18.2 | 18.2 | _ | 2,200 | 1,800 | | | |
| 110-120 | _ | 9.4- 10.8 | _ | _ | _ | 8.0-9.2 | _ | _ | _ | _ | _ | _ | 110% | 80% maximum | 30% minimum |
| 120 | 8.6 | _ | 16.4 | 19.5 | 7.5 | _ | 14.2 | 16.5 | 16.5 | _ | 10,800 | 7,360 | | | |
| 220 | 4.7 | _ | 8.8 | 10.7 | 4.1 | _ | 7.7 | 9.1 | 9.1 | _ | 10,800 | 7,360 | | | |
| 220-240 | _ | 4.7-5.4 | _ | _ | _ | 4.0-4.6 | _ | | _ | 18,820 | _ | _ | | | |
| 240 | 4.9 | _ | 8.2 | 9.8 | 4.3 | _ | 7.1 | 8.3 | 8.3 | _ | 12,100 | 9,120 | | | |

DC Coil Ratings

| Voltage | Rated Current (mA) ±15% at 20°C | | | | Coil Resistance (Ω) ±10% at 20°C | | | | Operation Characteristics (against rated values at 20°C) | | | |
|---------|---------------------------------|---------|------|------|-------------------------------------|--------|-------|-------|---|-------------------|--------------------|--|
| (V) | SPDT | DPDT | 3PDT | 4PDT | SPDT | DPDT | 3PDT | 4PDT | Max. Continuous Applied Voltage | Pickup Voltage | Dropout Voltage | |
| 6 | 128 | 150 | 240 | 250 | 47 | 40 | 25 | 24 | | | 10% minimum | |
| 12 | 64 | 75 | 120 | 125 | 188 | 160 | 100 | 96 | | 80% maximum | | |
| 24 | 32 | 36.9 | 60 | 62 | 750 | 650 | 400 | 388 | 1100/ | | | |
| 48 | 18 | 18.5 | 30 | 31 | 2,660 | 2,600 | 1,600 | 1,550 | 110% | | | |
| 100-110 | _ | 8.2-9.0 | _ | _ | _ | 12,250 | _ | _ | | | | |
| 110 | 8 | _ | 12.8 | 15 | 13,800 | _ | 8,600 | 7,340 | | | | |

Standard coil voltages are in BOLD. Signaling Lights

Contact Ratings

| | Maximum Contact Capacity | | | | | | | | | | |
|----------|--------------------------|----------------------|----------------------|----------------|--------------|--------------|--|--|--|--|--|
| | Continuous Current | Allowable Co | ontact Power | Rated Load | | | | | | | |
| Model | | Resistive Load | Inductive Load | Voltage (V) | Res. Load | Ind. Load | | | | | |
| SPDT 10A | | | | 110 AC | 10A | 7A | | | | | |
| | 10A | 1540VA 300W | 990VA 210W | 220 AC | 7A | 4.5A | | | | | |
| | | | | 30 DC | 10A | 7A | | | | | |
| DPDT | | | | 110 AC | 10A | 7.5A | | | | | |
| 3PDT | 10A | 1650VA 300W | 1100VA 225W | 220 AC | 7.5A | 5A | | | | | |
| 4PDT | | 00011 | 22011 | 30 DC | 10A | 7.5A | | | | | |
| A No | te: Inductive load | for the rated load - | — cos ø = 0.3, L/R : | = 7 ms | | | | | | | |

Note: made no read for the n

TÜV Ratings

| • | | | | |
|---------|-----|-----|------|------|
| Voltage | RH1 | RH2 | RH3 | RH4 |
| 240V AC | 10A | 10A | 7.5A | 7.5A |
| 30V DC | 10A | 10A | 10A | 10A |

A '

AC: cos ø = 1.0, DC: L/R = 0 ms

UL Ratings

| | Resistive | | | Ge | neral Us | e | Horsepower Rating | | |
|---------|------------|------|------|------------|----------|------|-------------------|--------|-----|
| Voltage | RH1 RH2 | RH3 | RH4 | RH1 RH2 | RH3 | RH4 | RH1 RH2 | RH3 | RH4 |
| 240V AC | 10A | 7.5A | 7.5A | 7A | 6.5A | 5A | 1/3 HP | 1/3 HP | _ |
| 120V AC | _ | 10A | 10A | _ | 7.5A | 7.5A | 1/6 HP | 1/6 HP | _ |
| 30V DC | 10A | 10A | _ | 7A | _ | _ | _ | _ | _ |
| 28V DC | _ | _ | 10A | _ | _ | _ | _ | _ | — |

CSA Ratings

| Voltage | | Resi | stive | | General Use | | | | Horse- power Rating |
|---------|-----|------|-------|------|-------------|------|-----|------|---------------------------|
| | RH1 | RH2 | RH3 | RH4 | RH1 | RH2 | RH3 | RH4 | RH1, 2, 3 |
| 240V AC | 10A | 10A | _ | 7.5A | 7A | 7A | 7A | 5A | 1/3 HP |
| 120V AC | 10A | 10A | 10A | 10A | 7.5A | 7.5A | _ | 7.5A | 1/6 HP |
| 30V DC | 10A | 10A | 10A | 10A | 7A | 7.5A | _ | _ | _ |

Socket Specifications

| | Sockets | Terminal | Electrical Rating | Wire Size | Torque |
|-------------------------------------|--|---|-------------------|------------------------|---------------------------------------|
| DIN Rail | SH1B-05 | (Coil) M3 screws (contact) M3.5 screws with captive wire clamp | 250V, 10A | Maximum up to 2—#12AWG | 5.5 - 9 in • lbs 9 - 11.5 in • lbs |
| Mount Sockets | SH2B-05 SH3B-05 SH4B-05 | M3.5 screws with captive wire clamp | 300V, 10A | Maximum up to 2—#12AWG | 9 - 11.5 in • lbs |
| Finger-safe | SH1B-05C | (coil) M3 screws (contact) M3.5 screws with captive wire clamp, fingersafe | 250V, 10A | Maximum up to 2—#12AWG | 5.5 - 9 in • lbs 9 - 11.5 in • lbs |
| DIN Rail Mount | SH2B-05C SH3B-05C SH4B-05C | M3.5 screws with captive wire clamp, fingersafe | 300V, 10A | Maximum up to 2—#12AWG | 9 - 11.5 in • lbs |
| Through Panel Mount Socket | SH1B-51 SH2B-51 SH3B-51 SH4B-51 | Solder | 300V, 10A | _ | _ |
| | SH1B-62 | PCB mount | 250V, 10A | _ | _ |
| PCB Mount Socket | SH2B-62 SH3B-62 SH4B-62 | PCB mount | 300V, 10A | _ | _ |

Accessories

| Item | Appearance | Use with | Part No. | Remarks |
|---|------------|--|----------|---|
| Aluminum DIN Rail (1 meter length) | | All DIN rail sockets | BNDN1000 | The BNDN1000 is designed to accommodate DIN mount sockets. Made of durable extruded aluminum, the BNDN1000 measures 0.413 (10.5mm) in height and 1.37 (35mm) in width (DIN standard). Standard length is 39" (1,000mm). |
| DIN Rail End Stop | A COLOR | DIN rail | BNL5 | 9.1 mm wide. |
| Replacement Hold-Down Spring Anchor | | DIN mount sockets and hold down springs. | Y778-011 | For use on DIN rail mount socket when using pullover wire hold down spring. 2 pieces included with each socket. |



Switches & Pilot Lights

Specifications

| Specifications | | | | | | |
|---------------------------------------|------------------------------|---|--|---|--|--|
| Contact Material | | Silver cadmium oxide | | | | |
| Contact Resistance ¹ | | 50mΩ maximum | | | | |
| Minimum Applicable Load | | 24V DC, 30 mA; 5V DC, 1 | 00 mA (refe | erence value) | | |
| Operating Time ² | SPDT DPDT | 20ms maximum | | | | |
| operating fillie | 3PDT 4PDT | 25ms maximum | | | | |
| Release Time ² | SPDT DPDT | 20ms maximum | | | | |
| Tielease fillie | 3PDT 4PDT | 25ms maximum | | | | |
| | SPDT | AC: 1.1VA (50Hz), 1VA (6 | OHz) | DC: 0.8W | | |
| Power Consumption | DPDT | AC: 1.4VA (50Hz), 1.2VA | (60Hz) | DC: 0.9W | | |
| (approx.) | 3PDT | AC: 2VA (50Hz), 1.7VA (6 | OHz) | DC: 1.5W | | |
| | 4PDT | AC: 2.5VA (50Hz), 2VA (6 | OHz) | DC: 1.5W | | |
| Insulation Resistance | | 100MΩ minimum (500V DC megger) | | | | |
| | SPDT | Between live and dead p Between contact and co Between contacts of the | il: | 2,000V AC, 1 minute 2,000V AC, 1 minute 1,000V AC, 1 minute | | |
| Dielectric Strength ³ | DPDT 3PDT 4PDT | Between live and dead p Between contact and co Between contacts of diff Between contacts of the | il: erent poles: | | | |
| Operating Frequency | | Electrical: Mechanical: | | ations/hour maximum rations/hour maximum | | |
| Vibration Resistance | | Damage limits: Operating extremes: | 10 to 55Hz, amplitude 0.5 mm : 10 to 55Hz, amplitude 0.5 mm | | | |
| Shock Resistance | | Damage limits: 1,000m/s² (100G) Operating extremes: 200m/s² (20G - SPDT, DPDT) 100m/s² (10G - 3PDT, 4PDT) | | OG - SPDT, DPDT) | | |
| Mechanical Life | | 50,000,000 operations minimum | | | | |
| | DPDT | 500,000 operations minimum (120V AC, 10A) | | | | |
| Electrical Life SPDT 3PDT 4PDT | | 200,000 operations minimum (120V AC, 10A) | | | | |
| Operating Temperature ⁴ | SPDT DPDT 3PDT 4PDT | −25 to +70°C (no freezing) | | | | |
| Operating Humidity | | 45 to 85% RH (no conde | nsation) | | | |
| Weight (approx.) | | SPDT: 24g, DPDT: 37g, 3l | PDT: 50g, 4P | PDT: 74g | | |
| <u> </u> | | | | | | |

Relays & Sockets



Note: Above values are initial values.

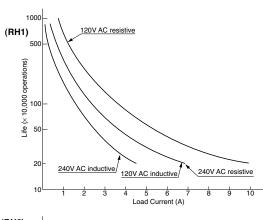
- 1. Measured using 5V DC, 1A voltage drop method
- 2. Measured at the rated voltage (at 20°C), excluding contact bouncing Release time of relays with diode: 40 ms maximum
- 3. Relays with indicator or diode: 1000V AC, 1 minute
- 4. For use under different temperature conditions, refer to Continuous Load Current vs. Operating Temperature Curve. The operating temperature range of relays with indicator or diode is -25 to +40 °C.

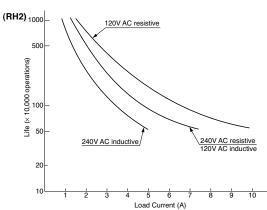
Signaling Lights

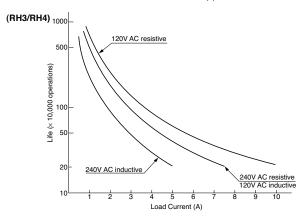
Characteristics (Reference Data)

Electrical Life Curves

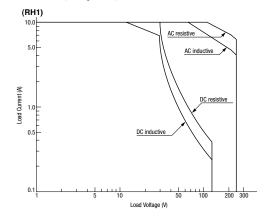




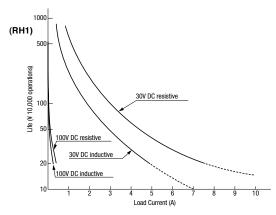


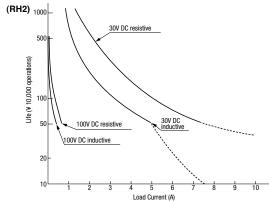


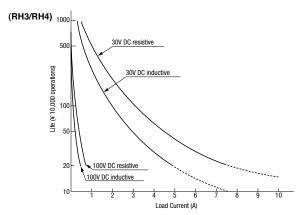
Maximum Switching Capacity

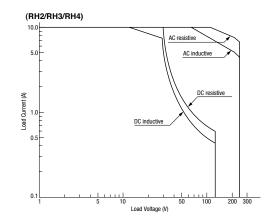




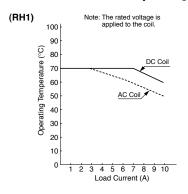


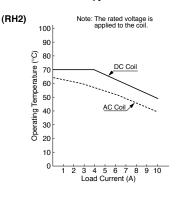


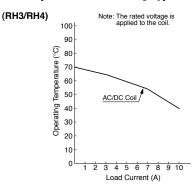




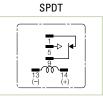
Continuous Load Current vs. Operating Temperature Curve (Basic Type, With Check Button, and Top Bracket Mounting Type)

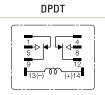


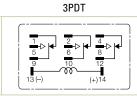


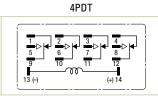


Internal Connection (View from Bottom) Basic Type







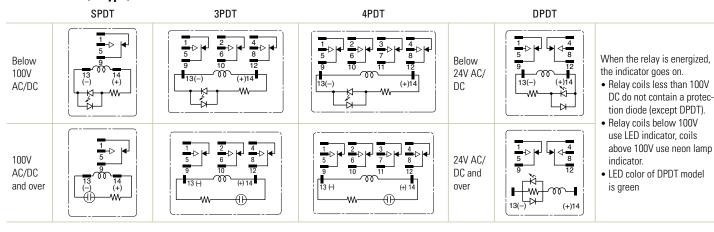


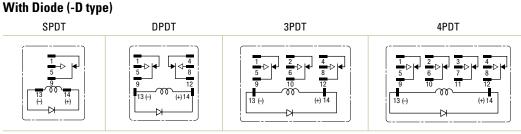
With Check Button



Contacts can be operated by pressing the check button.

With Indicator (-L type)



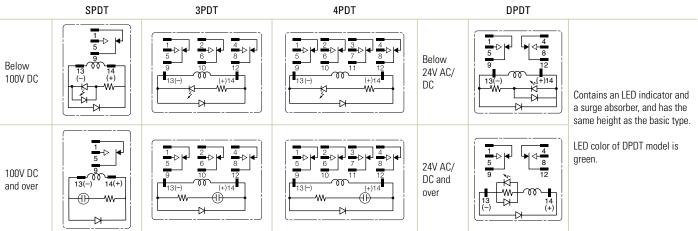


Contains a diode to absorb the back emf generated when the coil is de-energized. The release time is slightly longer. Available for DC

coil only. • Diode Characteristics Reverse withstand voltage: 1,000V Forward current: 1A

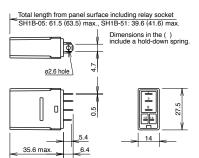
Signaling Lights

With Indicator LED & Diode (-LD type)

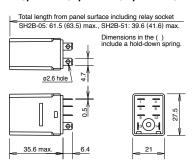


Dimensions (mm)

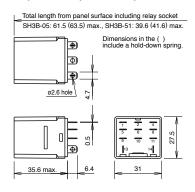
RH1B-U/RH1B-UL/RH1B-UD/RH1B-ULD



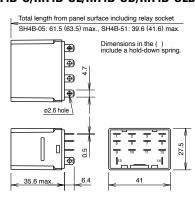
RH2B-U/RH2B-UL/RH2B-UD/RH2B-ULD



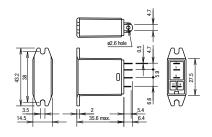
RH3B-U/RH3B-UL/RH3B-UD/RH3B-ULD



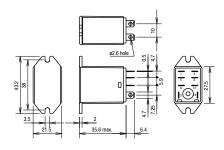
RH4B-U/RH4B-UL/RH4B-UD/RH4B-ULD



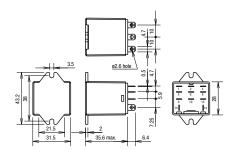
RH1B-UT



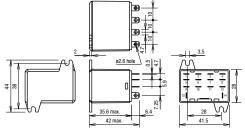
RH2B-UT



RH3B-UT

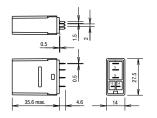


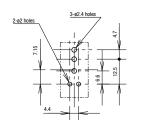
RH4B-UT



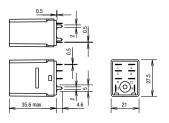
Dimensions con't (mm)

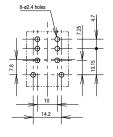
RH1V2-U/RH1V2-UD



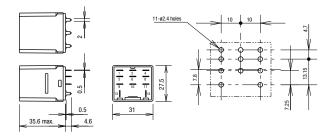


RH2V2-U/RH2V2-UL/RH2V2-UD

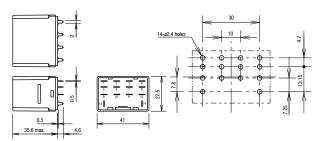




RH3V2-U/RH3V2-UL/RH3V2-D

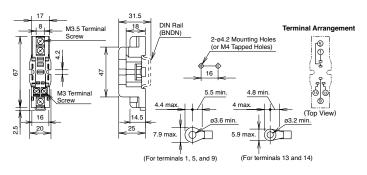


RH4V2-U/RH4V2-UL/RH4V2-UD

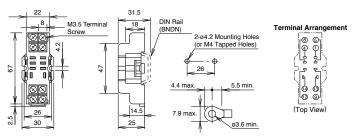


Standard DIN Rail Mount Sockets

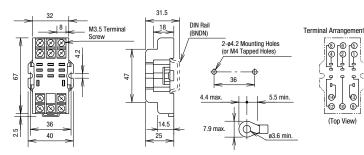
SH1B-05



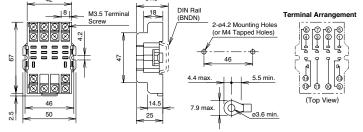
SH2B-05



SH3B-05



SH4B-05

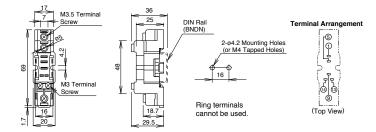


Timers

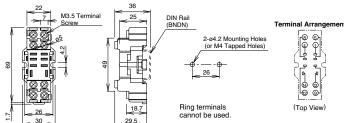
Dimensions con't (mm)

Finger-safe DIN Rail Mount Sockets

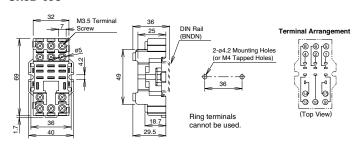
SH1B-05C



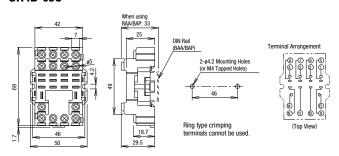
SH2B-05C



SH3B-05C

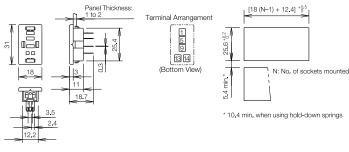


SH4B-05C

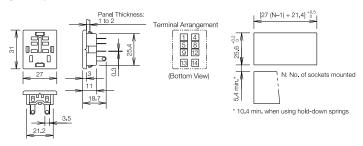


Through Panel Mount Socket

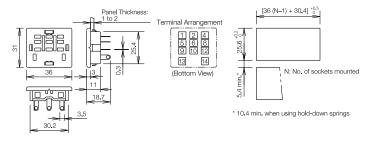
SH1B-51



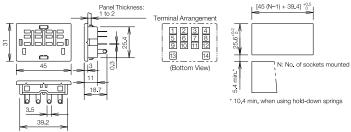
SH2B-51



SH3B-51



SH4B-51



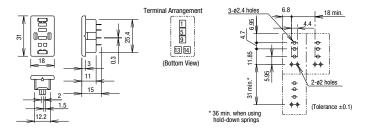


Dimensions con't (mm)

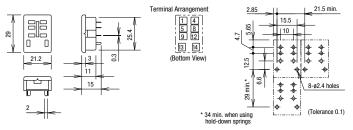
Relays & Sockets

PCB Mount Sockets

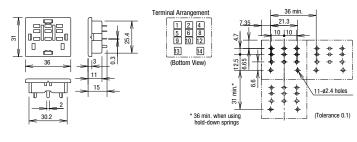
SH1B-62



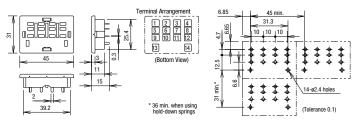
SH2B-62



SH3B-62



SH4B-62



SIEMENS

Product data sheet 5SY4101-7



CIRCUIT BREAKER 230/400V 10KA, 1-POLE, C, 1A, D=70MM

| Technical data: | | |
|---|----|-------|
| Overvoltage class | | 3 |
| type of voltage | | AC/DC |
| Tripping characteristic class | | С |
| Degree of pollution | | 3 |
| Mounting depth | mm | 70 |
| Energy limiting class | | 3 |
| Number of poles | | 1 |
| Number of pitch units for width | | 1 |
| Product function / n-switching | | No |
| Supply voltage frequency / rated value | Hz | 50 |
| Breaking capacity current / [nicht versorgt - nach IEC 60947-2] / [nicht versorgt - Bemessungswert] | kA | 15 |
| Breaking capacity current / acc. to EN 60898 / rated value | kA | 10 |
| Supply voltage / for AC / rated value | V | 400 |
| Current / for AC / rated value | Α | 1 |
| Protection class IP | | IP 20 |
| Product extension / can be installed / supplementary device | | Yes |

Further information:

Information- and Downloadcenter (Catalogs, Brochures,...)

http://www.siemens.com/lowvoltage/catalogs

Global Industry Mall (Online ordering system)

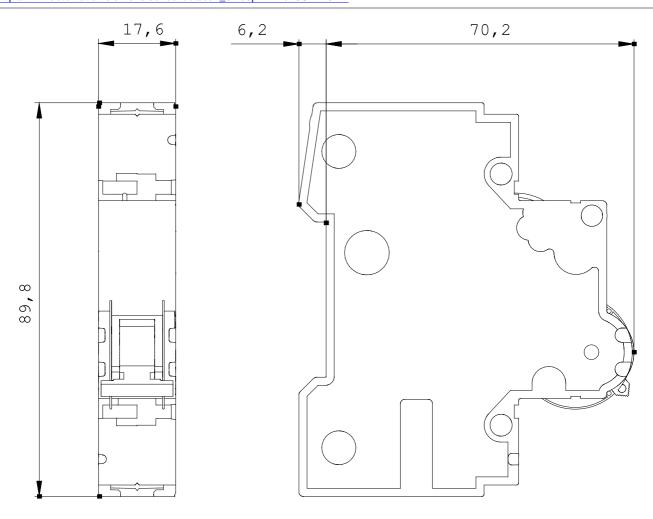
http://www.siemens.com/lowvoltage/mall

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)

http://support.automation.siemens.com/WW/view/en/5SY4101-7/all

Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, ...)

http://www.automation.siemens.com/bilddb/cax_en.aspx?mlfb=5SY4101-7



last change: Dec 21, 2010

SIEMENS

Product data sheet 5SY4110-7



CIRCUIT BREAKER 230/400V 10KA, 1-POLE, C, 10A, D=70MM

Similar to image

| Technical data: | | |
|--|----|-----------------------|
| Type of mounting | | Quick assembly system |
| type of voltage | | AC/DC |
| Height | mm | 90 |
| Width | mm | 18 |
| Depth | mm | 76 |
| mounting position | | any |
| Mounting depth | mm | 70 |
| Current / for AC / rated value | А | 10 |
| Tripping characteristic class | | С |
| Supply voltage | | |
| • for AC / rated value | V | 400 |
| • with single-phase operation / with AC / rated value | V | 230 |
| • with multi-phase operation / with AC / rated value | V | 400 |
| Switching capacity current | | |
| • in accordance with IEC 60947-2 / rated value | kA | 20 |
| • with DC / in accordance with IEC 60947-2 / rated value | kA | 15 |
| • acc. to EN 60898 / rated value | kA | 10 |
| Breaking capacity short-circuit current (Icn) | | |

| with DC / in accordance with EN 60898-2 | kA | 10 |
|---|--------|---------------------------|
| • with AC / in accordance with UL 1077 and CSA C22.2 No.235 | kA | 5 |
| Active power loss / at rated value current / with AC / in warm operating state / per pole | W | 1.4 |
| Number of pitch units for width | | 1 |
| Product feature / sealable | | Yes |
| Degree of pollution | | 3 |
| Ambient temperature | °C | -25 +55 |
| Ambient temperature | | |
| during storage | °C | -40 +7 5 |
| Position / of power supply cord | | Any |
| Product property / properties for main switches in accordance with EN 60204-1 | | Yes |
| Mechanical operating cycles as operating time / typical | | 20,000 |
| Overvoltage class | | 3 |
| Product equipment / touch-protection | | Yes |
| Resistance against shock / according to IEC 60068-2-27 | | 150m/s² at 11ms half-sine |
| Insulation voltage | | |
| • with single-phase operation / with AC / rated value | V | 250 |
| with multi-phase operation / with AC / rated value | V | 440 |
| AWG number | | |
| as encoded connectable conductor cross-section | | 14 4 |
| Section de conducteur raccordable | | |
| • solid | mm² | 0.75 35 |
| • multibrin | mm² | 0.75 35 |
| finely stranded | | |
| with wire end processing | mm² | 0.75 25 |
| Product component | | |
| combined terminal top | | Yes |
| combined terminal bottom | | Yes |
| Tightening torque | | |
| with screw-type terminals | N⋅m | 2.5 3 |
| Tightening torque (lbf-in) | | |
| with screw connection | lbf-in | 22 26 |
| Product feature | | |
| • silicon-free | | Yes |
| halogen-free | | Yes |
| Number of test cycles / for environmental testing / in accordance with IEC 60068-2-30 | | 6 |
| Item designation / according to DIN EN 61346-2 | | F |

Certificates/approvals:

General Product Approval













Declaration of Conformity

Test Certificates



Special Test Certificate

Certificate

Shipping Approval













other other

Further information:

Information- and Downloadcenter (Catalogs, Brochures,...)

http://www.siemens.com/lowvoltage/catalogs

Industry Mall (Online ordering system)

http://www.siemens.com/lowvoltage/mall

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)

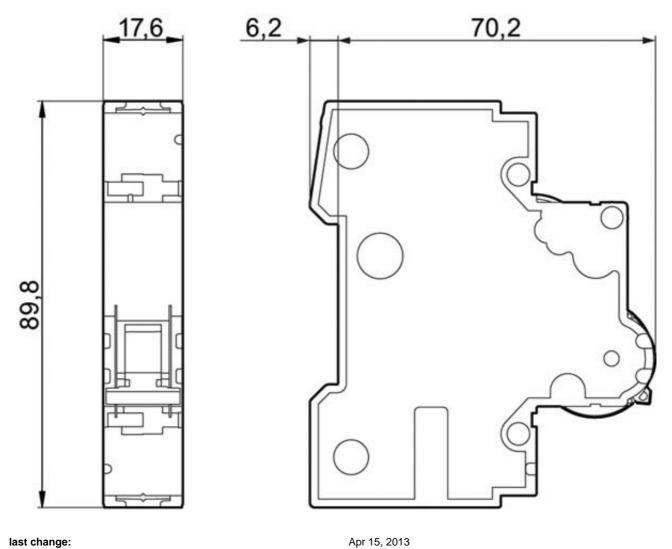
http://support.automation.siemens.com/WW/view/en/5SY4110-7/all

Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, ...)

http://www.automation.siemens.com/bilddb/cax_en.aspx?mlfb=5SY4110-7

CAx-Online-Generator

http://www.siemens.com/cax



SIEMENS

Product data sheet 5SY4111-7



CIRCUIT BREAKER 230/400V 10KA, 1-POLE, C, 5A, D=70MM

Similar to image

| Technical data: | | |
|--|----|-----------------------|
| Type of mounting | | Quick assembly system |
| type of voltage | | AC/DC |
| Height | mm | 90 |
| Width | mm | 18 |
| Depth | mm | 76 |
| mounting position | | any |
| Mounting depth | mm | 70 |
| Current / for AC / rated value | Α | 5 |
| Tripping characteristic class | | С |
| Supply voltage | | |
| • for AC / rated value | V | 400 |
| • with single-phase operation / with AC / rated value | V | 230 |
| • with multi-phase operation / with AC / rated value | V | 400 |
| Switching capacity current | | |
| • in accordance with IEC 60947-2 / rated value | kA | 35 |
| • with DC / in accordance with IEC 60947-2 / rated value | kA | 15 |
| acc. to EN 60898 / rated value | kA | 10 |
| Breaking capacity short-circuit current (Icn) | | |

| • with DC / in accordance with EN 60898-2 | kA | 10 |
|---|--------|---------------------------|
| • with AC / in accordance with UL 1077 and CSA C22.2 No.235 | kA | 5 |
| Active power loss / at rated value current / with AC / in warm operating state / per pole | W | 0.9 |
| Number of pitch units for width | | 1 |
| Product feature / sealable | | Yes |
| Degree of pollution | | 3 |
| Ambient temperature | °C | -25 +55 |
| Ambient temperature | | |
| during storage | °C | -40 +7 5 |
| Position / of power supply cord | | Any |
| Product property / properties for main switches in accordance with EN 60204-1 | | Yes |
| Mechanical operating cycles as operating time / typical | | 20,000 |
| Overvoltage class | | 3 |
| Product equipment / touch-protection | | Yes |
| Resistance against shock / according to IEC 60068-2-27 | | 150m/s² at 11ms half-sine |
| Insulation voltage | | |
| • with single-phase operation / with AC / rated value | V | 250 |
| with multi-phase operation / with AC / rated value | V | 440 |
| AWG number | | |
| as encoded connectable conductor cross-section | | 14 4 |
| Section de conducteur raccordable | | |
| • solid | mm² | 0.75 35 |
| • multibrin | mm² | 0.75 35 |
| finely stranded | | |
| with wire end processing | mm² | 0.75 25 |
| Product component | | |
| combined terminal top | | Yes |
| combined terminal bottom | | Yes |
| Tightening torque | | |
| with screw-type terminals | N⋅m | 2.5 3 |
| Tightening torque (lbf-in) | | |
| with screw connection | lbf-in | 22 26 |
| Product feature | | |
| • [not supplied - silicon-free] | | Yes |
| halogen-free | | Yes |
| Number of test cycles / for environmental testing / in accordance with IEC 60068-2-30 | | 6 |
| Item designation / according to DIN EN 61346-2 | | F |

Certificates/approvals:

General Product Approval

Declaration of Conformity













Shipping Approval











other other

Further information:

Information- and Downloadcenter (Catalogs, Brochures,...)

http://www.siemens.com/lowvoltage/catalogs

Industry Mall (Online ordering system)

http://www.siemens.com/lowvoltage/mall

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)

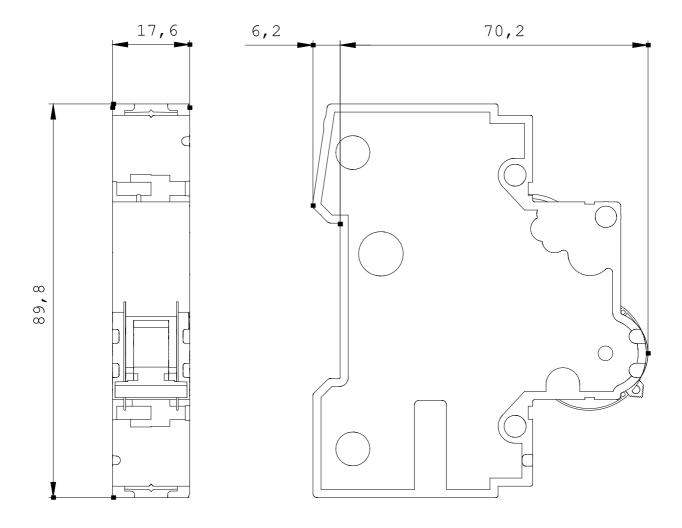
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CAx-Online-Generator

http://www.siemens.com/cax



last change: Dec 31, 2012

New TWND Series – Full Size NEMA Pushbuttons



New! TWND Series: Heavy duty switches built to last Key features:

- Variety of button sizes up to 2 9/16" (65mm)
- Rugged construction includes chrome plated zinc locking ring die cast zinc mounting thread
- LED illumination
- Transformer or full voltage
- Slow make, double break wiping contacts
- Modular construction for maximum flexibility
- Available assembled or as sub-components
- UL Type 4X, 13 and IP65 watertight/oiltight panel

The rugged series of TWND switches offers both variety and durability in an attractive design.

With button sizes up to 2 9/16" (65mm), chrome plated zinc locking rings, die cast zinc mounting threads, steel anti-rotation rings, and self cleaning contacts, the TWNDs are here to stay.

The TWND series also offers LED illumination in full voltage and transformer models.

Regardless of your switching needs, the NEW TWND series provides the kind of long lasting, industrial strength quality you've come to expect from IDEC.











Specifications

746

| Conforming to Standards | EN60947-5-1, UL508, CSA C22-2 No.14 |
|--|---|
| Approvals | CSA: pushbuttons and selector switches: A600 pilot lights and illuminated pushbuttons, direct supply pilot lights and illuminated pushbuttons with integral transformer (100/110, 115, 120, 200/220, 230, 240, 380, 400/440, 480V) UL: pushbuttons and selector switches: A600 pilot lights and illuminated pushbuttons, direct supply pilot lights and illuminated pushbuttons with integral transformer (100/110, 115, 120, 200/220, 230, 240, 380, 400/440, 480V) TÜV: pushbuttons and selector switches: A600 pilot lights and illuminated pushbuttons, direct supply pilot lights and illuminated pushbuttons with integral transformer (100/110, 115, 120, 200/220, 230, 240, 380, 400/440, 480V) |
| Operating Temperature | Operation: -25 to $+50$ °C (illuminated versions) $-25 \sim +70$ C non-illuminated Storage: -40 to $+80$ °C (without freezing) C-> °C |
| Vibration Resistance | 5 to 55Hz, 98m/sec ² (10g) conforming to IEC60068-2-6 |
| Shock Resistance | 980m/sec ² (100g) conforming to IEC60068-2-27 |
| Electric Shock Protection | Class 2 conforming to IEC60664-1 |
| Degree of Protection | IP65 (from front of the panel) (conforming to IEC60529) UL Type 1, 2, 3, 3R, 3S, 4, 4X, 5, 12, 13 (conforming to NEMA ICS6-110) |
| Mechanical Life | Momentary pushbuttons: 5,000,000 (1800 operations per hour) All other switches: 500,000 |
| Pollution Degree (conforming to IEC60947-1) | 3 |

Mechanical-Electrical Specifications

| Rated Operational Characteristics | AC-15: A600 | | | | | | | |
|---|---|---|--|-----------------|---------------------------------------|----------------|--|--|
| Rated Insulation Voltage | 600V | | | | | | | |
| Rated Impulse Withstanding Voltage øDielectric Strength | Between live and dead meta 2.5kV AC, 1 minute | Between live and dead metal parts 2.5kV AC, 1 minute | | | | | | |
| Rated Thermal Current | 10 Amp | | | | | | | |
| Minimum Switching Capacity | 5 mA at 3V AC/DC (applicab | le range may var | y with operating conditions and load | types) | | | | |
| Contact Operation | Slow break NC or NO | | | | | | | |
| Operating Force | Flush and extended pushbut Additional contacts—1NO of | | or 1NC contact: 6.2±2N (momentary), | , 9.0±1.5N | | | | |
| | Unit | | Wire | Number of Wires | Recommended Tightening Torque (Nm) | Terminal Screw | | |
| | | | Crimping Terminal | 2 | 1.0 to 1.3 | | | |
| | | Solid Wire | ø0.5 to 1.6 mm (AWG14 to 22) | 2 | 1.0 to 1.3 | | | |
| D 1 1 7 1 7 | HW-U Contact Block | Sulu vviie | ø1.7 to 2.0 mm (AWG12) | 1 | 1.2 to 1.3 | M3.5 | | |
| Recommended Terminal Torque | | Stranded Wire | 0.3 to 2.0 mm ² (AWG14 to 22) | 2 | 1.0 to 1.3 | | | |
| | | | 2.1 to 3.5 mm ² (AWG12) | 1 | 1.2 to 1.3 | | | |
| | | Crimping Terminal | | | | | | |
| | Illuminated Unit (*1) | Solid Wire | ø0.5 to 1.6 mm (AWG14 to 22) | 2 | 1.0 to 1.3 | M3.5 | | |
| | | Stranded Wire | 0.3 to 2.0 mm (AWG14 to 22) | | | | | |
| | | Crimping Terminal | | | 0.6 to 1.0 (M3.0) | | | |
| Applicable Wire Size | Pilot Light | Solid Wire | ø0.5 to 1.6 mm (AWG14 to 22) | 2 | 1.0 +- 1.0 (M.0.5) | | | |
| | | Stranded Wire | ø0.3 to 2.0 mm (AWG14 to 22) | | 1.0 to 1.3 (M3.5) | | | |
| | * refers to the lamp terminals of the illuminated push buttons and selector switches. | | | | | | | |
| Contact Resistance | Initial contact resistance of | 50mΩ or less | | | | | | |
| Contact Gap | 4mm (NO and NC) 2mm (NO-EM and NC-LB) | | | | | | | |
| LED Ratings | LEDs: 6V: 8mA, 12V: 11mA, 24V: 11mA, 120V: 8.8mA, 240V: 8.6mA | | | | | | | |
| Contact Material | Silver | | | | | | | |
| | | | | | | | | |

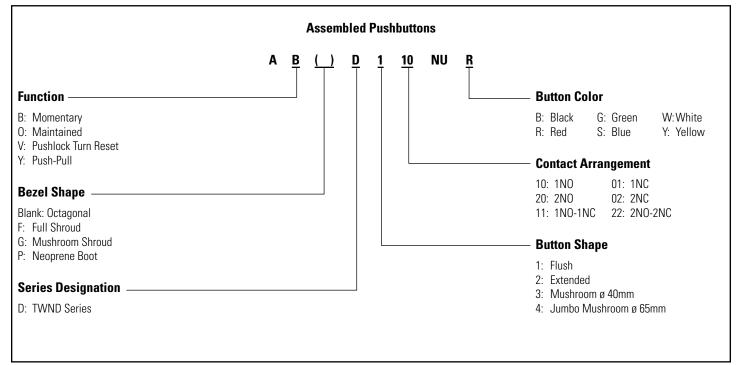
Contact Ratings

| Contact Ratings by Utilization Category IEC 60947-5-1 | | AC-15 (A600) | | | | | | | |
|---|------------------------------------|---|--------------------------------|-----|-----|-----|------|------|------|
| | | DC-13 (P600) | | | | | | | |
| | | Contact R | atings by Utilization Category | | | | | | |
| Operational Voltage | | | | 24V | 48V | 50V | 110V | 220V | 440V |
| AC 50/60 Hz | | oads | 10A | _ | 10A | 10A | 6A | 2A | |
| Operation Current | AC 50/00 HZ | AC-15 Control of electromagnetic loads (> 72VA) | | 10A | - | 7A | 5A | 3A | 1A |
| | | DC-12 Control of resistive loads & solid state lo | oads | 10A | 5A | _ | 2.2A | 1.1A | _ |
| | DC DC-13 Control of electromagnets | | | 5A | 2A | _ | 1.1A | 0.6A | _ |



Non-Illuminated Pushbuttons (Assembled)







- 1. Use only when interpreting part numbers. Do not use for developing part numbers.
- 2. Custom contact configurations available, contact IDEC for details.

Non-Illuminated Pushbuttons (Assembled)

Non-Illuminated Pushbuttons

| iton mammacou i a | Style | Contacts | Momentary | Maintained |
|--|-------|-------------------------------------|---|--|
| Flush | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD110NU® ABD101NU® ABD111NU® ABD120NU® ABD102NU® | AOD110NU® AOD101NU® AOD111NU® AOD120NU® AOD102NU® |
| Extended | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD210NU® ABD201NU® ABD211NU® ABD220NU® ABD202NU® | AOD210NU® AOD201NU® AOD211NU® AOD220NU® AOD202NU® |
| Extended with Neoprene Boot [†] | | 1NO 1NC 1NO-1NC 2NO 2NC | ABPD210NU® ABPD201NU® ABPD211NU® ABPD220NU® ABPD220NU® | AOPD210NU® AOPD201NU® AOPD211NU® AOPD220NU® AOPD202NU® |
| Recessed | | 1NO 1NC 1NO-1NC 2NO 2NC | ABFD110NU® ABFD101NU® ABFD111NU® ABFD120NU® ABFD102NU® | AOFD110NU® AOFD101NU® AOFD111NU® AOFD120NU® AOFD102NU® |
| Extended with Full Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABFD210NU® ABFD201NU® ABFD211NU® ABFD220NU® ABFD220NU® | AOFD210NU® AOFD201NU® AOFD211NU® AOFD220NU® AOFD202NU® |
| ø 40mm Mushroom Head | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD310NU® ABD301NU® ABD311NU® ABD320NU® ABD302NU® | AOD310NU® AOD301NU® AOD311NU® AOD320NU® AOD320NU® |
| ø 40mm Mushroom Head with Full Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABGD310NU® ABGD301NU® ABGD311NU® ABGD320NU® ABGD302NU® | AOGD310NU® AOGD301NU® AOGD311NU® AOGD320NU® AOGD302NU® |
| ø 65mm Jumbo Mushroom Head | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD410NU® ABD401NU® ABD411NU® ABD420NU® ABD420NU® | AOD410NU® AOD401NU® AOD411NU® AOD420NU® AOD402NU® |
| ø 65mm Jumbo Mushroom Head with Shallow Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABGD410NU® ABGD401NU® ABGD411NU® ABGD420NU® ABGD402NU® | AOGD410NU® AOGD401NU® AOGD411NU® AOGD420NU® AOGD402NU® |
| ø 65mm Jumbo Mushroom Head With Deep Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABFD410NU® ABFD401NU® ABFD411NU® ABFD420NU® ABFD402NU® | AOFD410NU® AOFD401NU® AOFD411NU® AOFD420NU® AOFD402NU® |

① Button Color Codes

| Color | Code |
|--------|------|
| Black | В |
| Green | G |
| Red | R |
| Blue | S |
| Yellow | Υ |
| White | W |

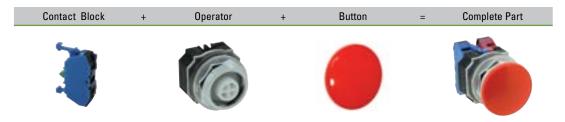


- 1. 65mm Jumbo mushroom not available in white.
- 2. Neoprene boot is not available in blue or white.

1. In place of ①, specify the Button Color Code.

For sub-assembly part numbers, see next page.
 Neoprene boot available only in Black (B), Green (G), Red (R) and Yellow (Y).

Non-Illuminated Pushbuttons (Sub-Assembled)



Operators

| Uperators | | | |
|---|-------------|------------|-------------|
| | Part Number | | |
| | Style | Momentary | Maintained |
| Flush/Extended | | ABD1200T8 | AOD1200T8 |
| Extended with Full Shroud | | ALFD2300T8 | AOLFD2300T8 |
| ø 40mm Mushroom/ø 65mm Jumbo Mushroom | 6 | ABD3400T8 | A0D3400T8 |
| ø 40mm Mushroom with Full Shroud | | ABGD-300T | AOGD-300T |
| ø 65mm Jumbo Mushroom with Shallow Shroud | 0 | ABGD-400T | AOGD-400T |
| ø 65mm Jumbo Mushroom with Deep Shroud | | ABFD-400T | AOFD-400T |

Buttons and Lenses

| | Style | Part Number |
|--------------------------|-------|-------------|
| Flush | | ABD1BN-⊕ |
| Extended | | ABD2BN-⊕ |
| ø 40mm Mushroom | | ABD3BN-⊕ |
| ø 65mm Jumbo Mushroom | | ABD4BN-⊕ |



In place of ①, specify the Button Color Code. (See table previous page)

Contact Blocks

| Style | | Part Number | | |
|-------------------|-------|---------------------------------------|---------------------------------------|--|
| | Style | | 1NC | |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) | |
| Dummy Block | | HW | -DB | |

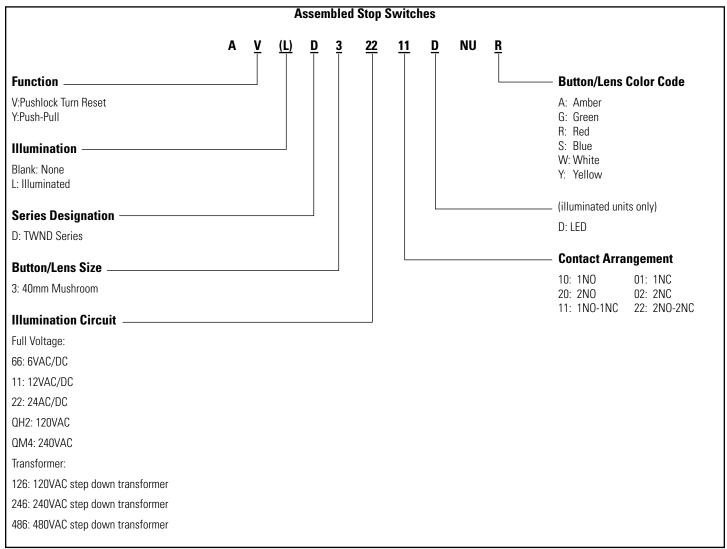


Dummy blocks (no contacts) are used with an odd number of contact blocks.

Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or closed, when switch is moved between two positions).

Stop Switches (Assembled)







[.] Use only when interpreting part numbers. Do not use for developing part numbers.

Custom contact configurations available, contact IDEC for details.

Stop Switches (Assembled)

Stop Switches

| Style | | Contacts | Part Number |
|--|-----------------|-------------------------------------|--|
| ø 40mm Pushlock Turn Reset | Non-Illuminated | 1NO 1NC 1NO-1NC 2NO 2NC | AVD310NUR* AVD301NUR* AVD311NUR* AVD320NUR* AVD302NUR* |
| ø 40mm Illuminated Pushlock Turn Reset | Full Voltage | 1NO-1NC 2NO 2NC | AVLD3®11DNUR* AVLD3®20DNUR* AVLD3®02DNUR* |
| | Transformer | 1NO-1NC 2NO 2NC | AVLD3 ① 11DNUR* AVLD3 ① 20DNUR* AVLD3 ② 02DNUR* |
| ø 40mm Push-Pull | Non-Illuminated | 1NO 1NC 1NO-1NC 2NO 2NC | AYD310NU® AYD301NU® AYD311NU® AYD320NU® AYD302NU® |
| ø 40mm Illuminated Push-Pull | Full Voltage | 1NO-1NC 2NO 2NC | AYLD3③11DNU② ** AYLD3③20DNU② ** AYLD3③02DNU② ** |
| | Transformer | 1NO-1NC 2NO 2NC | AYLD3 |



- 1. In place of ①, specify the button color code
- 2. In place of ②, specify the lens color code.
- 3. In place of ③, specify the Full Voltage (lamp voltage) Code.
- 5. In place of ②, specify the transformer voltage code.
 5. In place of ③, specify the transformer voltage code.
 6. **Not available in blue.
- 7. For sub-assembly part numbers, see next page.
- 8. For nameplates and accessories, see page 769 and page 767.
- 9. For dimensions, see page 772.

① Button Color Codes

| Color | Code |
|--------|------|
| Black | В |
| Green | G |
| Red | R |
| Blue | S |
| Yellow | Υ |

2 Lens Color Codes

| Color | Code |
|--------|------|
| Amber | Α |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Y |

3 Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |

4 Transformer Voltage Codes

| Voltage | Code |
|---------|------|
| 120VAC | 126 |
| 240VAC | 246 |
| 480VAC | 486 |



Transformers step down to 6V.

Stop Switches (Sub-Assembled)

| Transformer* | + | Operator | + | Lamp | + | Button/Lens | = | Complete Part |
|--------------|---|----------|---|------|---|-------------|---|---------------|
| P | | 6 | | | | | | |

^{*} Not required for full voltage units.

Operators

| Style | | Part Number |
|---|---|-------------|
| ø40mm Illuminated and Non-illuminated Pushlock Turn Reset | 6 | AVD000T8 |
| ø 40mm Illuminated and Non-illuminated Push-Pull | 6 | AYD000T8 |

Buttons and Lenses

| St | Part Number | |
|--|-------------|-----------|
| Button for Pushlock Turn Reset Stop Switches (ø40mm, red only) | | AVN3B-R |
| Lens for Illuminated Pushlock Turn Reset Stop Switches (ø40mm, red only) | | AVLN3LU-R |
| Button for Push-Pull Stop Switches (ø40mm) | | AYD3BN-⊕ |
| Lens for Illuminated Push-Pull Stop Switches (ø40mm) | 2 pos* | AYLD3L-② |



- 1. In place of ①, specify the Button Color Code. (See table below)
- In place of ②, specify the LED Color Code.
 *Not available in blue.

Lamp Circuit Components

| Style | Application | Part Number |
|------------------|--|-------------|
| Long Lamp Holder | Used with Full-size Transformer and two contact blocks Used with Full Voltage Adaptor and two contact blocks | TW-LH2 |
| Lead Holder | Used with TW-LH2 holder when using four contact blocks | HW-LH3 |

Lamps

| Style | Voltage | Part Number |
|-------|-----------|-------------|
| IFD | 6V AC/DC | LSTD-6③ |
| LED | 12V AC/DC | LSTD-13 |
| | 24V AC/DC | LSTD-23 |
| | 120V AC | LSTD-H2® |
| | 240V AC | LSTD-M43 |



1. In place of ②, specify the LED color code. 2. The LED contains a current-limiting resistor and a protection diode.

① Button Color Codes

| Color | Code |
|--------|------|
| Black | В |
| Green | G |
| Red | R |
| Blue | S |
| Yellow | Υ |

② Lens Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| | |

③ LED Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| | |

Contact Blocks

| Style | | Part Number | |
|-------------------|-------|---------------------------------------|---------------------------------------|
| | | 1N0 | 1NC |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) |
| Dummy Block | HW-DB | | -DB |



- Dummy blocks (no contacts) are used with an odd number of contact blocks.
 Combining HW-U10R-F and HW-U01R-F result in overlapping contacts.

Transformers

| Style | Primary Voltage (50/60Hz) | Part Number |
|-------|------------------------------|-------------|
| - | 120V AC | TW-F126B |
| | 240V AC | TW-F246B |
| - | 480V AC | HW-L486 |



6V secondary voltage (uses 6V LED).

Full Voltage Modules

| | Style | | Description | Part Number |
|--|-------|---------------------------------------|-------------|-------------|
| Dummy Block with Full Voltage Adaptor | | For use with odd number of contacts. | Finger-Safe | HW-DA1FBN |
| Full Voltage Adaptor | | For use with even number of contacts. | Finger-Safe | TW-DA1FB |

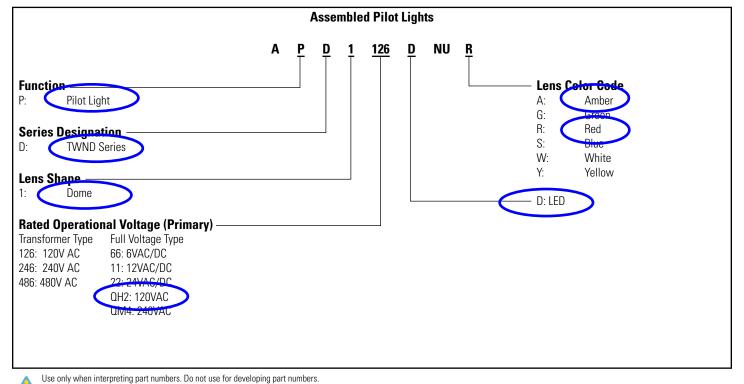


All Transformers step down to 6V (use 6V lamp).



Pilot Lights (Assembled)







| Style | Operating | Part Number |
|-------------------|-------------------------------|---|
| Style Style | Voltage | LED |
| Transformer Dome | | |
| 16 | 120V AC 240V AC 480V AC | APD1126DNU@ APD1246DNU@ APD1486DNU@ |
| Full Voltage Dome | _ | APD1@DNU@ |



- 1. In place of $\ensuremath{@}$, specify the Lens/LED Color Code.
- 2. In place of ③, specify the Full Voltage Code (LED voltage).
- 3. Yellow pilot light comes with white LED.

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |
| | |

$\ensuremath{\mathfrak{G}}$ Full Voltage Codes

| _ | |
|-----------|------|
| Voltage | Code |
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |
| | |

Pilot Lights (Sub-Assembled)



plus

APD09ST8

| Operators | | |
|-----------|-------|-------------|
| | Style | Part Number |
| | | |

One Each from Left Column

Full Voltage Clips

| Primary Voltage (50/60Hz) | Part Number |
|---------------------------|-------------|
| Per | APD-F |

One Selection from Right Column

Required for all full voltage models. Two pieces each. 2 clips required for full voltage pilot lights

Transformers (only for Pilot Lights)

| Style | Primary Voltage (50/60Hz) | Part N | umber |
|-------|------------------------------|----------|----------|
| | | 120V AC | TWD-0126 |
| LED | 240V AC | TWD-0246 | |
| | 480V AC | TWD-0486 | |



6V secondary voltage (use 6V lamp).

Lenses

Transformer or

FULL Voltage

| | Style | Part Number |
|-----------|-------|-------------|
| Dome Lens | | APN106LN-@ |



1. In place of ②, specify the Lens Color Code.

Lamps

| Style | | Part Number |
|-------|------------------|---|
| | 6V AC/DC | LSTD-6® |
| LED | 12V AC/DC | LSTD-1® |
| | 24V AC/DC | LSTD-23 |
| | 120V AC | LSTD-H2③ |
| | 240V AC LSTD-M40 | LSTD-M43 |
| | Style | 6V AC/DC 12V AC/DC 24V AC/DC 120V AC |



- 1. In place of ②, specify the LED color code.
- 2. The LED contains a current-limiting resistor and a protection diode.

2 Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

3 LED Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |

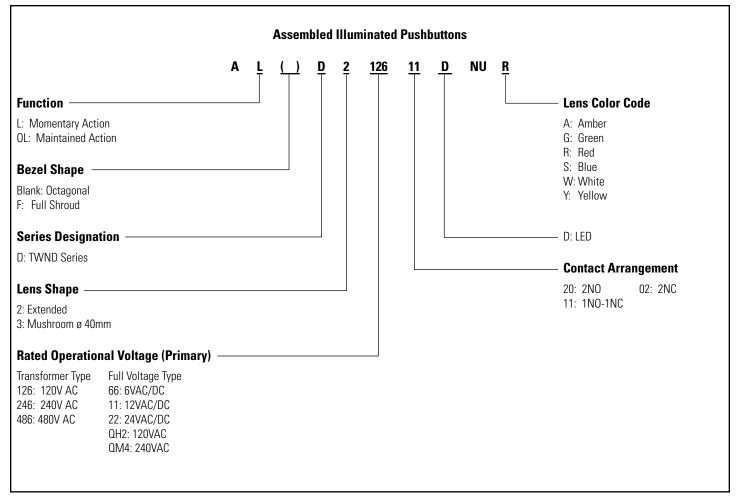


Yellow LED not available, use white LED with Yellow lens.



Illuminated Pushbuttons (Assembled)







- 1. Use only when interpreting part numbers. Do not use for developing part numbers.
- 2. All transformers step down to 6V.

Illuminated Pushbuttons (Assembled)

Illuminated Pushbuttons

| Style | | Contacts | Part N | umber | |
|--------------------------------|--------------|-----------------------|--|---|--|
| | | Contacts | Momentary | Maintained | |
| Extended Lens | Full Voltage | 1NO-1NC 2NO 2NC | ALD2@11DNU@ ALD2@20DNU@ ALD2@02DNU@ | AOLD2@11DNU@ AOLD2@20DNU@ AOLD2@02DNU@ | |
| | Transformer | 1NO-1NC 2NO 2NC | ALD2 ⊕ 11DNU② ALD2 ⊕ 20DNU② ALD2 ⊕ 02DNU② | AOLD2 @ 11DNU@ AOLD2 @ 20DNU@ AOLD2 @ 02DNU@ | |
| Extended Lens with Full Shroud | Full Voltage | 1NO-1NC 2NO 2NC | ALFD2@11DNU@ ALFD2@20DNU@ ALFD2@02DNU@ | AOLFD2③11DNU② AOLFD2③20DNU② AOLFD2③02DNU② | |
| | Transformer | 1NO-1NC 2NO 2NC | ALFD2 @ 11DNU@ ALFD2 @ 20DNU@ ALFD2 @ 02DNU@ | AOLFD2 @ 11DNU@ AOLFD2 @ 20DNU@ AOLFD2 @ 02DNU@ | |
| ø 40mm Mushroom Lens | Full Voltage | 1NO-1NC 2NO 2NC | ALD3@11DNU@ ALD3@20DNU@ ALD3@02DNU@ | AOLD3@11DNU@ AOLD3@20DNU@ AOLD3@02DNU@ | |
| | Transformer | 1NO-1NC 2NO 2NC | ALD3 ⊕ 11DNU@ ALD3 ⊕ 20DNU@ ALD3 ⊕ 02DNU@ | AOLD3 @ 11DNU@ AOLD3 @ 20DNU@ AOLD3 @ 02DNU@ | |

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | Α |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

3 Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |
| | |

4 Transformer Voltage Codes

| Voltage | Code |
|---------|------|
| 120VAC | 126 |
| 240VAC | 246 |
| 480VAC | 486 |



6V secondary voltage (uses 6V LED).

- 1. In place of ②, specify the Lens Color Code.
 - In place of ③, specify the Full Voltage Code (LED voltage).
 In place of ④, specify the Transformer Voltage Code.
 Light is independent of switch position.

 - 5. Yellow pushbutton comes with white LED only.

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Illuminated Pushbuttons (Sub-Assembled)



^{*}Not required for full voltage types.

Operators

| Style | | Part Number | |
|------------------------------|-------|-------------|-------------|
| | Style | Momentary | Maintained |
| Extended | 6 | ALD2300T8 | A0LD2300T8 |
| Extended with Full Shroud | | ALFD2300T8 | AOLFD2300T8 |
| 40mm Mushroom | 6 | ALD2300T8 | A0LD2300T8 |

Lamps

| Style | Voltage | Part Number |
|-------|-----------|-------------|
| IED | 6V AC/DC | LSTD-6® |
| LED | 12V AC/DC | LSTD-13 |
| | 24V AC/DC | LSTD-23 |
| | 120V AC | LSTD-H2® |
| | 240V AC | LSTD-M43 |



 In place of ②, specify the LED color code.
 The LED contains a current-limiting resistor and a protection diode.

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

3 LED Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |



Yellow lens only. Yellow LED not available, use white LED.

Lenses

| Style | | Part Number |
|-----------------|--|-------------|
| Extended | | ALN06LU-@ |
| ø 40mm Mushroom | | ALN3LU-@ |



In place of $\ensuremath{\mathfrak{D}}$, specify the Lens Color Code.

Lamp Circuit Components

| Style | Application | Part Number |
|------------------|--|-------------|
| Long Lamp Holder | Used with Full-size Transformer and two contact blocks Used with Full Voltage Adaptor and two contact blocks | TW-LH2 |
| Lead Holder | Used with TW-LH2 holder when using four contact blocks | HW-LH3 |

Contact Blocks

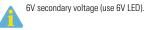
| Style | | Part Number | |
|-------------------|----------------|---------------------------|---------------------------|
| | | 1N0 | 1NC |
| All Control Units | 700 700 | HW-U10-F | HW-U01-F |
| All control onto | 3 | HW-U10R-F (early make) | HW-U01R-F (late break) |
| Dummy Block | | HW-DB | |



- 1. Dummy blocks (no contacts) are used with an odd number of contact blocks.
- Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or closed, when switch is moved between two positions).

Transformers

| | Style | Primary Voltage (50/60Hz) | Part Number |
|--------------|---------|------------------------------|-------------|
| Transformers | 120V AC | TW-F126B | |
| | | 240V AC | TW-F246B |
| | - | 480V AC | HW-L486 |



Full Voltage Modules

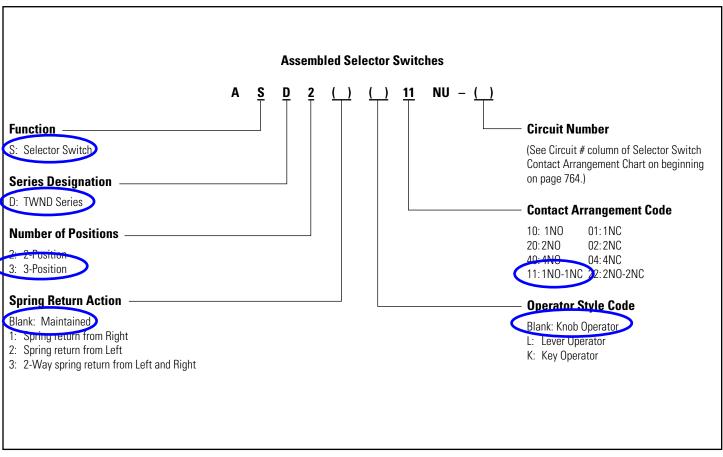
| | Style | | Description | Part Number |
|--|-------|---------------------------------------|-------------|-------------|
| Dummy Block with Full Voltage Adaptor | | For use with odd number of contacts. | Finger-Safe | HW-DA1FBN |
| Full Voltage Adaptor | | For use with even number of contacts. | Finger-Safe | TW-DA1FB |



All Transformers step down to 6V (use 6V lamp).

Non-Illuminated Selector Switches (Assembled)







- 1. Use only when interpreting part numbers. Do not use for developing part numbers.
- 2. Custom key removal codes available. Please contact IDEC for details.

Non-Illuminated Selector Switches (Assembled)

Non-Illuminated 2-Position Selector Switches

| Style | | | | | Part Number | | | |
|------------|------------------|------------------|------------------|----------------------|--|---|---|--|
| act | ıting | Ope Pos | rator ition | | Maintained | Spring Return from Right | Spring Return from Left | |
| Cont | Position L R | | | L R | L R | L. R | | |
| 1N0 | 1 2 | 0 0 | X 0 | Knob Lever Key | ASD210NU ASD2L10NU ASD2K10NU | ASD2110NU ASD21L10NU ASD21K10NU | ASD2210NU ASD22L10NU ASD22K10NU | |
| 1NC | 1 2 | X 0 | 0 0 | Knob Lever Key | ASD201NU ASD2L01NU ASD2K01NU | ASD2101NU ASD21L01NU ASD21K01NU | ASD2201NU ASD22L01NU ASD22K01NU | |
| 1NO 1NC | 1 2 | 0 X | X 0 | Knob Lever Key | ASD211NU ASD2L11NU ASD2K11NU | ASD2111NU ASD21L11NU ASD21K11NU | ASD2211NU ASD22L11NU ASD22K11NU | |
| 2N0 | 1 2 | 0 0 | X X | Knob Lever Key | ASD220NU ASD2L20NU ASD2K20NU | ASD2120NU ASD21L20NU ASD21K20NU | ASD2220NU ASD22L20NU ASD22K20NU | |
| 2NC | 1 2 | X X | 0 0 | Knob Lever Key | ASD202NU ASD2L02NU ASD2K02NU | ASD2102NU ASD21L02NU ASD21K02NU | ASD2202NU ASD22L02NU ASD22K02NU | |
| 2N0 2NC | 1 2 3 4 | 0 X 0 X | X 0 X 0 | Knob Lever Key | ASD222NU ASD2L22NU ASD2K22NU | ASD2122NU ASD21L22NU ASD21K22NU | ASD2222NU ASD22L22NU ASD22K22NU | |
| 2N0 2NC | 1 2 3 4 | 0 0 X X | X X 0 0 | Knob Lever Key | ASD222NU-111 ASD2L22NU-111 ASD2K22NU-111 | ASD2122NU-111 ASD21L22NU-111 ASD21K22NU-111 | ASD2222NU-111 ASD22L22NU-111 ASD22K22NU-111 | |



- The truth table indicates the operating position of contact block when the operator is switched to that position.
 - X = On (closed contacts) O = Off (open contacts)
 X—X = Overlapping Contacts: Remain on (closed contacts) when switch is moved between these two positions.
- All knob and lever selector switches come in black.
 Other colors are available by ordering the knob or lever separately.
- 3. Custom contact arrangements available, see page 764.

Non-Illuminated 3-Position Selector Switches

| Style | | | | | | Part Number | | | |
|------------|------------------|------------------|-------------------|--------------------|----------------------|--|---|---|---|
| + | <u>g</u> | Oper | ator Pos | sition | | Maintained | Spring Return from Right | Spring Return from Left | Spring Return Two-Way |
| Contact | Mounting | ▼ | C | R | | C R | L C R | L C R | L C R |
| 2N0 | 1 2 | X 0 | 0 | 0 X | Knob Lever Key | ASD320NU ASD3L20NU ASD3K20NU | ASD3120NU ASD31L20NU ASD31K20NU | ASD3220NU ASD32L20NU ASD32K20NU | ASD3320NU ASD33L20NU ASD33K20NU |
| 2NC | 1 2 | 0 X | X | —X 0 | Knob Lever Key | ASD302NU ASD3L02NU ASD3K02NU | ASD3102NU ASD31L02NU ASD31K02NU | ASD3202NU ASD32L02NU ASD32K02NU | ASD3302NU ASD33L02NU ASD33K02NU |
| 2N0 2NC | 1 2 3 4 | X 0 0 X | 0 0 X— X | 0 X —X 0 | Knob Lever Key | ASD322NU ASD3L22NU ASD3K22NU | ASD3122NU ASD31L22NU ASD31K22NU | ASD3222NU ASD32L22NU ASD32K22NU | ASD3322NU ASD33L22NU ASD33K22NU |
| 2N0 2NC | 1 2 3 4 | X X 0 0 | 0 —X X 0 | X 0 0 X | Knob Lever Key | ASD322NU-309 ASD3L22NU-309 ASD3K22NU-309 | ASD3122NU-309 ASD31L22NU-309 ASD31K22NU-309 | ASD3222NU-309 ASD32L22NU-309 ASD32K22NU-309 | ASD3322NU-309 ASD33L22NU-309 ASD33K22NU-309 |
| 2N0 2NC | 1 2 3 4 | 0 0 0 0 | X 0 X 0 | 0 X 0 X | Knob Lever Key | ASD322NU-310 ASD3L22NU-310 ASD3K22NU-310 | ASD3122NU-310 ASD31L22NU-310 ASD31K22NU-310 | ASD3222NU-310 ASD32L22NU-310 ASD32K22NU-310 | ASD3322NU-310 ASD33L22NU-310 ASD33K22NU-310 |
| 4N0 | 1 2 3 4 | X 0 X 0 | 0 0 0 0 | 0 X 0 X | Knob Lever Key | ASD340NU ASD3L40NU ASD3K40NU | ASD3140NU ASD31L40NU ASD31K40NU | ASD3240NU ASD32L40NU ASD32K40NU | ASD3340NU ASD33L40NU ASD33K40NU |
| 4NC | 1 2 3 4 | 0 X 0 X | X—X X—X | —X 0 —X 0 | Knob Lever Key | ASD304NU ASD3L04NU ASD3K04NU | ASD3104NU ASD31L04NU ASD31K04NU | ASD3204NU ASD32L04NU ASD32K04NU | ASD3304NU ASD33L04NU ASD33K04NU |

Non-Illuminated Selector Switches (Sub-Assembled)

| Contact Blocks | + | Operator | + | Knob or Lever* | + | Color Insert* | = | Complete Part [†] |
|----------------|---|----------|---|----------------|---|---------------|---|----------------------------|
| | | 6 | | | | | | |

ø30mm - TWND Series

*Not needed with key type switches.

†Knob type shown.

Operators

| Style | Position | Description | Part Number |
|------------|----------|--|----------------------------|
| | | Maintained | ASD0201T8 |
| | 2 | Spring return from right | ASD0213T8 |
| Knob/Lever | | Spring return from left | ASD0224T8 |
| KHOD/LEVE | | Maintained, Cam 1 Maintained, Cam 2 | ASD0302T8 ASD0306T8 |
| | 3 | Spring return from right, Cam 1 Spring return from right, Cam 2 | ASD0314T8 ASD0310T8 |
| | 3 | Spring return from left, Cam 1 Spring return from left, Cam 2 | ASD0323T8 ASD0328T8 |
| | | Spring return from left/right, Cam 1 Spring return from left/right, Cam 2 | ASD0335T8 ASD0339T8 |
| | | Maintained | ASD0201KT8 |
| | 2 | Spring return from right | ASD0213KT8 |
| Key | | Spring return from left | ASD0224KT8 |
| | | Maintained, Cam 1 Maintained, Cam 2 | ASD0302KT8 ASD0306KT8 |
| | 3 | Spring return from right, Cam 1 Spring return from right, Cam 2 | ASD0302KT8B ASD0310KT8B |
| | 3 | Spring return from left, Cam 1 Spring return from left, Cam 2 | ASD0323KT8 ASD0310KT8B |
| | | Spring return from left/right, Cam 1 Spring return from left/right, Cam 2 | ASD0335KT8 ASD3K339KT8 |



- 1. Order knobs, levers, color inserts separately (see below).
- 2. For key switches, keys are removable in all maintained positions. Other options available, contact IDEC for details.
- 3. See page 766 "Operator Truth Tables" for details of difference between cams.

① Color Codes

| Knob/Lever Color | Code |
|------------------|------|
| Black | В |
| Blue | S |
| Green | G |
| Red | R |
| Yellow | Υ |
| White | W |
| | |



- Knob/Lever not available in white.
- Color inserts not available in Black.
- 3. Lever not available in yellow.

Handles and Inserts

Switches & Pilot Devices

| | Style | | | | | |
|--------------|-------|-----------|--|--|--|--|
| Knob | | ASDHHY-① | | | | |
| Lever | | ASDHHL-⊕* | | | | |
| Color Insert | | TW-HC1-① | | | | |



1. In place of ①, specify the Color Code. *Not available in yellow.

Contact Blocks

| | Style | | | | | |
|-------------------|-------|---------------------------------------|---------------------------------------|--|--|--|
| | Style | 1N0 | 1NC | | | |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) | | | |
| Dummy Block | | HW | '-DB | | | |

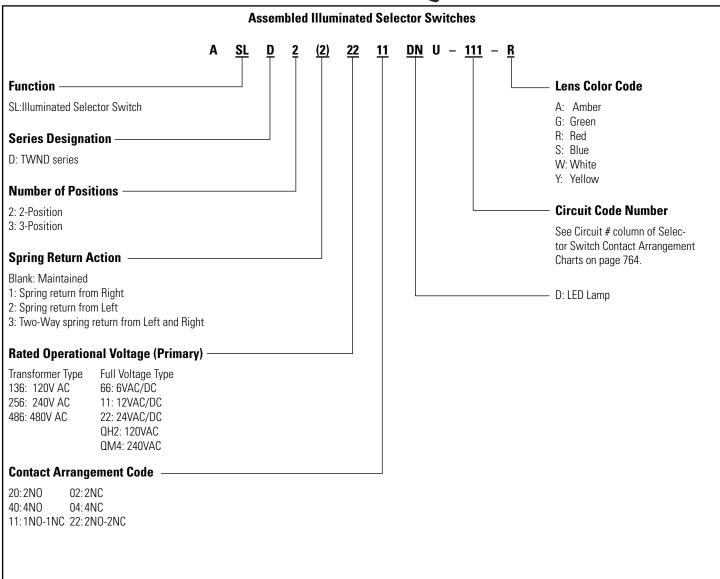


Dummy blocks (no contacts) are used with an odd number of contact blocks.
 Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or

closed, when switch is moved between two positions).

Illuminated Selector Switches (Assembled)







Use only when interpreting part numbers. Do not use for developing part numbers.

Illuminated Selector Switches (Assembled)

Illuminated 2-Position Selector Switches

| Style | | | | | Part Number | | | |
|------------|----------------------------|------------------|------------------|--|--------------------------------------|--|---|--|
| act | ting | | rator ition | Lamp | Maintained | Spring Return from Right | Spring Return from Left | |
| Contact | Position Lamp Circuit Type | | L\R | L\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\ | L ^C R | | | |
| 1NO 1NC | 1 2 | 0 X | X 0 | Transformer Full Voltage | ASLD2 @11DNU@ ASLD2@11DNU@ | ASLD21 @11DNU@ ASLD21@11DNU@ | ASLD22 @11DNU@ ASLD22@11DNU@ | |
| 2N0 | 1 2 | 0 0 | X X | Transformer Full Voltage | ASLD2 @20DNU@ ASLD2 @20DNU@ | ASLD21 @20DNU@ ASLD21 @20DNU@ | ASLD22 @20DNU@ ASLD22 @20DNU@ | |
| 2NC | 1 2 | X | 0 0 | Transformer Full Voltage | ASLD2 @02DNU-@ ASLD2 @02DNU-104-@ | ASLD21 | ASLD22 | |
| 2N0 2NC | 1 2 3 4 | 0 X 0 X | X 0 X 0 | Transformer Full Voltage | ASLD2 @22DNU@ ASLD2 @22DNU@ | ASLD21 @22DNU@ ASLD21 @22DNU@ | ASLD22 ⊕22DNU@ ASLD22③22DNU@ | |
| 2N0 2NC | 1 2 3 4 | 0 0 X X | X X 0 0 | Transformer Full Voltage | ASLD2 | ASLD21 @22DNU-111-@ ASLD21 @22DNU-111-@ | ASLD22 ⊕22DNU-111-@ ASLD22③22DNU-111-@ | |

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

③ Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |

Illuminated 3-Position Selector Switches, Maintained and Spring Return

| Style | | | | | | Part Number | | | | |
|------------|------------------|------------------|--------------------|--------------------|-----------------------------|--|--|--|--|--|
| + | бı | Oper | ator Po | sition | | Maintained | Spring Return From Right | Spring Return from Left | Spring Return Two-Way | |
| Contact | Mounting | L | C | R | Lamp Circuit Type | C R | L C R | L C R | L C R | |
| 2N0 | 1 2 | X 0 | 0 0 | 0 X | Transformer Full Voltage | ASLD3 ⊕ 20DNU@ ASLD3@20DNU@ | ASLD31 @ 20DNU@ ASLD31@20DNU@ | ASLD32 @ 20DNU@ ASLD32@20DNU@ | ASLD33 ⊕ 20DNU@ ASLD33③20DNU@ | |
| 2NC | 1 2 | 0 X— | X— —X | —X 0 | Transformer Full Voltage | ASLD3 @ 02DNU@ ASLD3@02DNU@ | ASLD31 @ 02DNU@ ASLD31@02DNU@ | ASLD32 @ 02DNU@ ASLD32@02DNU@ | ASLD33 ⊕ 02DNU@ ASLD33③02DNU@ | |
| 2NO 2NC | 1 2 3 4 | X 0 0 X | 0 0 X— —X | 0 X X 0 | Transformer Full Voltage | ASLD3 @ 22DNU@ ASLD3@22DNU@ | ASLD31 @ 22DNU@ ASLD31 @ 22DNU@ | ASLD32 | ASLD33 @ 22DNU@ ASLD33@22DNU@ | |
| 2N0 2NC | 1 2 3 4 | X X 0 0 | 0 —X X 0 | X 0 0 X | Transformer Full Voltage | ASLD3 @ 22DNU-309-@ ASLD3 @ 22DNU-309-@ | ASLD31 @ 22DNU-309-@ ASLD31@22@DNU-309-@ | ASLD32 @ 22DNU-309-@ ASLD32 @ 22DNU-309-@ | ASLD33 @ 22DNU-309-@ ASLD33@22DNU-309-@ | |
| 2NO 2NC | 1 2 3 4 | 0 0 0 0 | X 0 X 0 | 0 X 0 X | Transformer Full Voltage | ASLD3 @ 22DNU-310-@ ASLD3@22DNU-310-@ | ASLD31 @ 22DNU-310-@ ASLD31 @ 22DNU-310-@ | ASLD32 @ 22DNU-310-@ ASLD32 @ 22DNU-310-@ | ASLD33 @ 22DNU-310-@ ASLD33 @ 22DNU-310-@ | |
| 4N0 | 1 2 3 4 | X 0 X 0 | 0 0 0 0 | 0 X 0 X | Transformer Full Voltage | ASLD3 @ 40DNU@ ASLD3 @ 40DNU@ | ASLD31 @ 40DNU@ ASLD31 @ 40DNU@ | ASLD32 | ASLD33 | |
| 4NC | 1 2 3 4 | 0 X 0 X | X— X X— X | —X 0 —X 0 | Transformer Full Voltage | ASLD3 @ 04DNU@ ASLD3@04DNU@ | ASLD31 @ 04DNU@ ASLD31 @ 04DNU@ | ASLD32 @ 04DNU@ ASLD32 @ 04DNU@ | ASLD33 | |



- In place of ③, specify the Lens/LED Color Code, in place of ③, specify the Full Voltage (LED voltage) Code, in place of ④, specify the Transformer Voltage Code.
- The truth table indicates the operating position of contact block when the operator is switched to that position.

X = On (Closed Contacts) O = Off (Open Contacts)

 $X\!\!-\!\!X=$ Overlapping Contacts: Remain on (closed contacts) when switch is moved between these positions

3. Yellow selector switch comes with white LED.

4 Transformer Voltage Codes

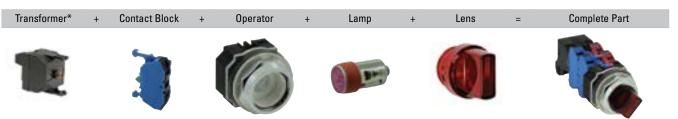
| Voltage | Code |
|---------|------|
| 120VAC | 136 |
| 240VAC | 256 |
| 480VAC | 486 |



Transformers step down to 6V (use 6V LED).



Illuminated Selector Switches (Sub-Assembled)





*Not required for full voltage units.

Operators

| Style | Position | Description | Part Number |
|----------|----------|--|--------------------------|
| | 2 | Maintained | ASLD0201T8 |
| Operator | 3 | Maintained, Cam 1 Maintained, Cam 2 | ASLD0302T8 ASLD0306T8 |
| Орогасог | 2 | Spring return from right | ASLD0213T8 |
| 500 | Z | Spring return from left | ASLD0224T8 |
| | | Spring return from right, Cam 1 Spring return from right, Cam 2 | ASLD0314T8 ASLD0310T8 |
| | 3 | Spring return from left, Cam 1 Spring return from left, Cam 2 | ASLD0323T8 ASLD0328T8 |
| | | Spring return from left/right, Cam 1 Spring return from left/right, Cam 2 | ASLD0335T8 ASLD0339T8 |

Lenses

| | Part Number | | | |
|------|-------------|------------|--|--|
| Knob | | ASLNHU-③ ② | | |

Lamps

| Style | Voltage | Part Number | | |
|--------|-----------|-------------|--|--|
| | 6V AC/DC | LSTD-6③ | | |
| LED | 12V AC/DC | LSTD-13 | | |
| A BANK | 24V AC/DC | LSTD-2③ | | |
| | 120V AC | LSTD-H2® | | |
| | 240V AC | LSTD-M43 | | |



- 1. In place of ②, specify the LED color code.
- 2. The LED contains a current-limiting resistor and a protection diode.

Contact Blocks

| | Part Number | | | | |
|-------------------|-------------|---------------------------------------|---------------------------------------|--|--|
| | 1N0 | 1NC | | | |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U10-F HW-U10R-F (late break) | | |
| Dummy Block | | HW | '-DB | | |



Dummy blocks (no contacts) are used with an odd number of contact blocks.
 Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remains).

Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or closed, when switch is moved between two positions).

Lamp Circuit Components

| Style | Application | Part Number |
|------------------|---|-------------|
| Long Lamp Holder | Used with Full-size Transformer and two contact blocks Used with Full Voltage Adaptor and two contact blocks | TW-LH2 |
| Lead Holder | Used with TW-LH2 holder when using four contact blocks | HW-LH3 |

Full Voltage Modules

| J | | | | |
|--|-------|---------------------------------------|-------------|-----------|
| | Style | Description | Part Number | |
| Dummy Block with Full Voltage Adaptor | | For use with odd number of contacts. | Finger-Safe | HW-DA1FBN |
| Full Voltage Adaptor | | For use with even number of contacts. | Finger-Safe | TW-DA1FB |



All Transformers step down to 6V (use 6V lamp).

Transformers

| | Style | Primary Voltage (50/60Hz) | Part Number |
|--------------|-------|------------------------------|-------------|
| Transformers | | 120V AC | TW-F126B |
| | | 240V AC | TW-F126B |
| | | 480V AC | HW-L486 |



6V secondary voltage.

2 Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

3 LED Color Codes

| C | olor | Code | | | | | | |
|----------|------------------------|------|--|--|--|--|--|--|
| Ar | nber | А | | | | | | |
| Gr | reen | G | | | | | | |
| F | Red | R | | | | | | |
| В | lue | S | | | | | | |
| W | hite | W | | | | | | |
| <u> </u> | Yellow lens only. Yell | | | | | | | |



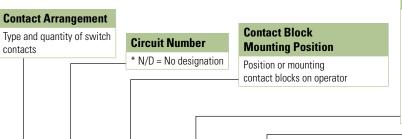
Yellow lens only. Yellov LED not available, use white LED. Relays & Sockets

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Contact Arrangement Charts

How to Read Contact Arrangement Charts

To determine contact block mounting position, first make sure the selector switch is oriented as shown on the right



Contact Arrangement Chart: 2-Position Selector Switches

Operator Position

Truth table indicates the operating position of contact block when operator is switched to that position.

X = On (Closed Contacts)

0 = Off (Open Contacts)

X—X = Overlapping Contacts: Remain on (closed) when switch is moved between these two positions

Contact Block Part Number

Part number to use when ordering sub-assembly contact blocks, as required for use with corresponding mounting position

| Style | | Operator | | | | Operator Part Number | | | |
|---------|---------|----------------------|--------|--------|------------------------------|-------------------------|--------------------------|--------------------------|--------------------------|
| | Circuit | Mounting Position | | ition | Contact Block Part Number | Description | Maintained | Spring Return from Right | Spring Return from Left |
| Contact | Number | i osition | L | R | i art ivallibei | | L R | L R | L [*] R |
| | | 1 | 0 | Х | HW-U10-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 |
| 1NO | N/D | 2 | 0 | 0 | HW-DB | Key Illuminated Knob | ASD0201KT8 ASLD0201T8 | ASD0213KT8 ASLD0213T8 | ASD0224KT8 ASLD0224T8 |
| 1NC | N/D | 1 | Χ | 0 | HW-U01-F | Knob/Lever | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 |
| INC | N/D | 2 | 0 | 0 | HW-DB | Key Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASD0224K18 ASLD0224T8 |
| | N/D | 1 | 0 | Χ | HW-U10-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 |
| 1NO | N/D | 2 | Χ | 0 | HW-U01-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224K18 |
| 1NC | 103 | 1 | Χ | 0 | HW-U01-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 |
| | 100 | 2 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 |
| | 600 | 1 | 0 | Χ | HW-U10R-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 |
| 1NO-EM | | 2 | X | 0 | HW-U01R-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 |
| 1NC-LB | 601 | 1 | Χ | 0 | HW-U01R-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 |
| | | 2 | 0 | Χ | HW-U10R-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 |
| 2N0 | N/D | 1 | 0 | Χ | HW-U10-F | Knob/Lever Kev | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 |
| | .,,5 | 2 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 |
| 2NC | N/D | 1 | Χ | 0 | HW-U01-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 |
| | , | 2 | X | 0 | HW-U01-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 |
| | N/D | 1 2 | 0 X | X 0 | HW-U10-F HW-U01-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 |
| | N/D | 3 4 | 0 X | X 0 | HW-U10-F HW-U01-F | Illuminated Knob | ASLD0201R18 | ASLD0213T8 | ASLD0224R18 |
| | | 1 | Χ | 0 | HW-U01-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 |
| 2N0 | 110 | 2 | 0 X | X 0 | HW-U10-F | Key | ASD020118 | ASD021310 | ASD0224KT8 |
| 2NC | | 4 | 0 | X | HW-U01-F HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 |
| | | 1 | 0 | Χ | HW-U10-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 |
| | 111 | 2 3 | 0 X | X 0 | HW-U10-F HW-U01-F | Key | ASD0201KT8 | ASD0213KT8 | ASD0224KT8 |
| | | 4 | X | 0 | HW-U01-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 |
| | | 1 | 0 | Χ | HW-U10-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 |
| 4N0 | N/D | 2 | 0 | X | HW-U10-F HW-U10-F | Key | ASD0201KT8 | ASD0213KT8 | ASD0224KT8 |
| | | 4 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 |

Contact Arrangement Chart: 3-Position Selector Switches

| St | yle | | | | | | | | | art Number | | |
|------------|---------|----------|--------|---------------|---------|----------------------|-------------------------|--------------------------|-----------------------------|--------------------------|-------------------------|-----------|
| | Circuit | Mounting | Oper | ator Pos | sition | Contact Block | Description | Maintained | Spring Return from Right | Spring Return from Left | Two-Way | |
| Contact | Number | Position | L | C ♠ | R | Part Number | Beschiption | L C R | L C R | L C R | L C | |
| 20 | 000 | 1 | Х | 0 | 0 | HW-U10-F | Knob/Lever | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 | |
| | 202 | 2 | X | —X | 0 | HW-U01-F | Key Illuminated Knob | ASD0302KT8 ASLD0302T8 | ASD0314KT8 ASLD0314T8 | ASD0323KT8 ASLD0323T8 | ASD0335KT8 ASD0335T8 | |
| | 203 | 1 | 0 | X | —X | HW-U01-F | Knob/Lever Kev | ASD0302T8 ASD0302KT8 | ASD0314T8 ASD0314KT8 | ASD0323T8 ASD0323KT8 | ASD0335T8 ASD0335KT8 | |
| NO | 203 | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 | |
| NC | 302 | 1 | Х | 0 | Χ | HW-U10-F | Knob/Lever Key | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 | |
| | 302 | 2 | X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |
| | 303 | 1 | 0 | Χ | 0 | HW-U01-F | Knob/Lever Kev | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 | |
| 300 | 303 | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0323T8 | ASLD0339T8 | |
| N/D 2NO | N/D | 1 | Х | 0 | 0 | HW-U10-F | Knob/Lever Key | ASD0302T8 ASD0302KT8 | ASD0314T8 ASD0314KT8 | ASD0323T8 ASD0323KT8 | ASD0335T8 ASD0335KT8 | |
| | 14/5 | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 | |
| | 301 | 1 | Х | 0 | Χ | HW-U10-F | Knob/Lever Key | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 | |
| | 00. | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |
| | 304 | 1 | 0 | Χ | 0 | HW-U01-F | Knob/Lever Key | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 | |
| NC | | 2 | X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |
| | N/D | 1 | 0 | X | X | HW-U01-F | Knob/Lever Key | ASD0302T8 ASD0302KT8 | ASD0314T8 ASD0314KT8 | ASD0323T8 ASD0323KT8 | ASD0335T8 ASD0335KT8 | |
| | | 2 | X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 | |
| | 11/5 | 1 2 | X 0 | 0 | 0 X | HW-U10-F HW-U10-F | Knob/Lever | | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 |
| | N/D | 3 | 0 | Χ | —X | HW-U01-F | Key Illuminated Knob | ASD0302KT8 ASLD0302T8 | ASD0314KT8 ASLD0314T8 | ASD0323KT8 ASLD0323T8 | ASD0335KT8 ASD0335T8 | |
| | | 4 | X | X | 0 | HW-U01-F | mummatcu Knob | AGEDOSOZIO | AULDUSTATO | A0LD032010 | A0D000010 | |
| | | 1 2 | 0 | X | —X X | HW-U01-F HW-U10-F | Knob/Lever | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 | |
| | 210 | 3 | 0 | X | X | HW-U01-F | Key | ASD0302KT8 | ASD0314KT8 | ASD0323KT8 | ASD0335KT8 | |
| | | 4 | 0 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 | |
| | | | X | 0 | X | HW-U10-F | | | | | | |
| 10 | | 2 | X— | —X | 0 | HW-U01-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASD0339T8 | |
| VC | 308 | 3 | X | 0 | Х | HW-U10-F | Key | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 | |
| | | 4 | X X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |
| | | 1 | X | 0 | Х | HW-U10-F | | | | | | |
| | | 2 | Χ— | —X | 0 | HW-U01-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASD0339T8 | |
| | 309 | 3 | 0 | X | 0 | HW-U01-F | Key | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 | |
| | | 4 | 0 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |
| | | 1 | 0 | Х | 0 | HW-U01-F | | | | | | |
| | 8/- | 2 | 0 | 0 | X | HW-U10-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASD0339T8 | |
| | 310 | 3 | 0 | X | 0 | HW-U01-F | Key | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 | |
| | | 4 | 0 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |



Each operator sub-assembly is available as an "02" and an "06" for 3-position selector switches. The internal cam of an "02" is different from that of an "06". This results in designated combinations of open and closed contacts in the various operator positions.

^{2.} N/D = No circuit number designation required in assembled part number.

^{3.} X = On (closed contacts) 0 = Off (open contacts). X—X Overlapping contacts remain on (closed) when switch is moved between these two positions.

Contact Arrangement Chart: 3-Position Selector Switches

| St | yle | | | | | Operator Part Number | | | | | | | |
|---------------------------|---------|----------|----------|---------------|------|----------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------|---------|
| Contact Circuit Number | Circuit | Mounting | Mounting | Mounting | Oper | ator Pos | sition | Contact Block | Description | Maintained | Spring Return from Right | Spring Return from Left | Two-Way |
| | | Position | L | C ≜ | R | Part Number | Description | C R | L C | L C | L C R | | |
| | | 1 | Χ | 0 | 0 | HW-U10-F | | | | | | | |
| | N/D | 2 | 0 | 0 | Χ | HW-U10-F | Knob/Lever | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 | | |
| N/D | N/D | 3 | Χ | 0 | 0 | HW-U10-F | Key Illuminated Knob | ASD0302KT8 ASLD0302T8 | ASD0314KT8 ASLD0314T8 | ASD0323KT8 ASLD0323T8 | ASD0335KT8 ASD0335T8 | | |
| 4N0 | | 4 | 0 | 0 | Χ | HW-U10-F | mammatou Knob | 71022000210 | | | | | |
| 4110 | | 1 | Χ | 0 | Χ | HW-U10-F | Knob/Lever Key Illuminated Knob | ASD0306T8 ASD0306KT8 ASLD0306T8 | ASD0310T8 ASD0301KT8 ASLD0310T8 | ASD0328T8 ASD0328KT8 ASLD0328T8 | ASD0339T8 ASD0339KT8 ASLD0339T8 | | |
| | 305 | 2 | 0 | 0 | Χ | HW-U10-F | | | | | | | |
| | 300 | 3 | Χ | 0 | Χ | HW-U10-F | | | | | | | |
| | | 4 | 0 | 0 | Χ | HW-U10-F | | | | | | | |
| | | 1 | 0 | Χ— | X | HW-U01-F | | ASD0302T8 | ASD0314T8 ASD0314KT8 | ASD0323T8 | | | |
| | N/D | 2 | Χ— | —X | 0 | HW-U01-F | Knob/Lever Key | | | | ASD0335T8 ASD0335T8 | | |
| | IN/ D | 3 | 0 | Х | X | HW-U01-F | Illuminated Knob | ASD0302KT8 ASLD0302T8 | ASLD0314K18 | ASD0323KT8 ASLD0323T8 | ASD0335T8 | | |
| | | 4 | X | —X | 0 | HW-U01-F | aatou ruros | 7.0250002.0 | 7.022001110 | 7.0250020.0 | 7.02000010 | | |
| 4NC | | 1 | 0 | Χ | 0 | HW-U01-F | | | | | | | |
| | | 2 | X | —X | 0 | HW-U01-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASLD0339T8 | | |
| | 314 | 3 | 0 | Χ | 0 | HW-U01-F | Key Illuminated Knob | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 ASLD0339T8 | | |
| | | 4 | X— | X | 0 | HW-U01-F | or switches. The internal ca | ASLD0306T8 | ASLD0301T8 | ASLD0328T8 | | | |



- Each operator sub-assembly is available as an "02" and an "06" for 3-position selector switches. The internal cam of an "02" is different from that of an "06". This results in designated combinations of open and closed contacts in the various operator positions.

 2. N/D = No circuit number designation required in assembled part number.
- 3. X = On (closed contacts) 0 = Off (open contacts). X—X Overlapping contacts remain on (closed) when switch is moved between these two positions.

Operator Truth Tables

Use the following tables to build custom selector switches.

2 Position Selector Switches

| | Contact | Mounting | Operator Position | |
|--------------|-----------------------|----------|-------------------|----------------|
| | Contact | Position | Left | Right |
| | HW-U10-F (N0) | L | 0 | Χ |
| | HVV-010-F (INO) | R | 0 | Χ |
| | UNA/ LIO1 E (NIC) | L | Χ | 0 |
| A CL DO201TO | HW-U01-F (NC) | R | Χ | 0 |
| ASLD0201T8 | HW-U10R-F (NO-EM) | L | 0 | -X- |
| | HVV-UTUN-F (INU-EIVI) | R | 0 | -X- |
| | LIM/ LIG1D E (NIC LD) | L | -X- | 0 |
| | HW-U01R-F (NC-LB) | R | -X- | 0 |

3 Position Selector Switches

| | Contact | Mounting | Operator Position | | | |
|--------------------------|-----------------------|----------|-------------------|--------|-------|--|
| | Contact | Position | Left | Center | Right | |
| | HW-U10-F (NO) | L | Χ | 0 | 0 | |
| | HVV-010-F (INO) | R | 0 | 0 | Χ | |
| | LIVA/ LIQ4 E (NIQ) | L | 0 | Χ | X | |
| ASD0302T8 | HW-U01-F (NC) | R | Χ | X | 0 | |
| ASLD0302T8 ASD0302KT8 | 11)A/ 1140D E /NO EM) | L | X | . 0 | 0 | |
| | HW-U10R-F (NO-EM) | R | 0 | _0_ | Χ | |
| | UNATION FAMOUR | L | 0 | X | —X | |
| | HW-U10R-F (NC-LB) | R | X | X | 0 | |

| | Contact | Mounting | | Operator Position | | | |
|--------------------------|-------------------------|----------|------|-------------------|---------------|--|--|
| | Contact | Position | Left | Center | Right | | |
| | HW-U10-F (NO) | L | Χ | 0 | Χ | | |
| | HVV-010-F (IVO) | R | 0 | 0 | Χ | | |
| | LIVA/ LIQ1 E (NIC) | L | 0 | Χ | 0 | | |
| ASD0306T8 | HW-U01-F (NC) | R | X | X | 0 | | |
| ASLD0306T8 ASD0306KT8 | HW-U10R-F (NO-EM) | L | X | . 0 | X | | |
| | TIVV-OTOII-I (IVO-LIVI) | R | 0 | 0 | Χ | | |
| | HW-U01R-F (NC-LB) | L | 0 | X | 0 | | |
| | HVV-UUTN-F (IVU-LD) | R | Χ | X | 0 | | |

Accessories — TWND Series

| Item | Appearance | | Part Number | | |
|----------------------|-------------|---|---|--|--|
| Lamp Removal Tool | | Rubber tool used to install or rer | move LED's | OR-55 | |
| Metal Bezel | 0 | Replacement locking ring/ bezel | Standard octagonal units (chrome-pl.). Extended, non-illuminated (chrome-pl.). Extended, illuminated (chrome-pl.). Jumbo Mushroom Shallow Shroud Jumbo Mushroom Deep Shroud | OG-81 OG-82 OG-83L ABN4G ABN4F | |
| Plastic Bezel | 0 | Black plastic locking ring/bezel | | OGP11B | |
| Boot/Cover | | Used to cover and protect pushbuttons | In place of ①, specify Neoprene Rubber Boot color: B (black), G (green), R (red), Y (yellow) Flush units (clear plastic -40° to +60°C). | 0C-11 ① 0C-121 | |
| | | Plastic washer For nameplates or panels that sh | Extended units (clear plastic -40° to +60°C). hould not be scratched. | OC-122 OGL-D1T | |
| Anti-Rotation Ring | | Thrust washer/Anti-rotation ring | OGL-D1S | | |
| Mounting Hole Plug | | Plugs used to fill unused 30mm panel cutouts. | Plastic with locking nut attached. Metal with locking nut attached Grey rubber (-5° to +60°C) | OBP-11 OB-11 OB-13 | |
| Terminal Tab Adaptor | | Tab #250 17/64" x 3/64" (6.35m | m x 0.8mm): Single tab | TW-FA4 | |
| Long Lamp Holder | | Used with Transformer and two | | TW-LH2 | |
| Lead Holder | - | Used with TW-LH2 holder whe | Used with TW-LH2 holder when using four contact blocks | | |
| Lock Out Adaptor | (90) | Used to provide lockout protection 1-13/64" (30mm) | Used to provide lockout protection for TWTD pushbuttons and knob selectors. g 1-13/64" (30mm) | | |
| Full Voltage Clips | Per | Primary Voltage (50/60Hz) Requi required for full voltage pilot ligl | APD-F | | |
| Replacement Keys | do | Pair of keys (#0) | TW-SK | | |

Accessories TWND Series continued

| Item | Appearance | Description/Usage | Part Number | |
|--|------------|---|---|---|
| | | | 1NC | 1NO |
| Contact Blocks (with side entry) | | These contacts are applicable for wires terminated by ring, fork, terminals, not recommended for bare wire connections . | HW-U01 HW-U01-MAU HW-U01R HW-U01R-MAU (with side entry) | HW-U10 HW-U10-MAU HW-U10R HW-U10R-MAU (with side entry) |
| Contact Blocks (without side entry) | | These contacts are applicable for wires terminated by ring, fork, or ferule terminals, and also bare wire connections . | HW-U01-F HW-U01-MAU-F HW-U01R-F HW-U01R-MAU-F (no side entry) | HW-U10-F HW-U10-MAU-F HW-U10R-F HW-U10R-MAU-F (no side entry) |

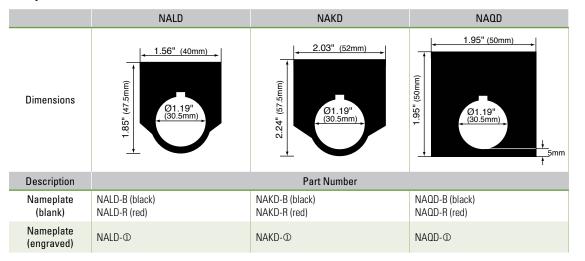
Fingersafe Covers for TWND Series

| ltem | Description | Used with | Part Number |
|------|---|---------------------------|-------------|
| | Fingersafe terminal cover, for full voltage pilot lights, adds 3mm to overall depth | Full voltage pilot lights | APD-PVL |
| | Fingersafe terminal cover, adds 1.5mm to overall depth | Transformer pilot lights | N-VL3 |



Nameplates — TWND Series

Faceplates





- 1. Nameplates are made of 0.031" aluminum. Lettering is white letters engraved on black background.
- 2. In place of ①, insert either the standard legend code from table below or custom engraving delimited by " ".

Standard Legend Codes

| Pushbuttons | | | Pushbuttons/Selector Switches | | | | Selector Switches | | |
|--|---|---|---|---|---|--|--|---|---|
| Legend | Code | Legend | Code | Legend | Code | Legend | Code | Legend | Code |
| AUTO CLOSE DOWN EMERG.STOP* FAST FORWARD HAND HIGH IN INCH JOG LOW LOWER OFF | 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 | OPEN OUT RAISE RESET REVERSE RUN SLOW START STOP* STOP TEST UP I (Int'l On) O (Int'l Off) EMO | 116 117 118 119 120 121 122 123 124 125 126 127 150 151 152 | AUTO-MAN CLOSE-OPEN DOWN-UP FAST-SLOW FOR-REV HAND-AUTO HIGH-LOW JOG-RUN LEFT-RIGHT LOWER-RAISE MAN-AUTO OFF-ON ON-OFF OPEN-CLOSE RAISE-LOWER | 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 | REV-FOR RUN-JOG RUN-SAFE SAFE-RUN SLOW-FAST START-STOP STOP-START UP-DOWN | 216 217 218 219 220 221 222 223 | AUTO-MAN-OFF AUTO-OFF-MAN CLOSE-OFF-OPEN DOWN-OFF-SLOW FAST-OFF-SLOW FOR-OFF-REV LEFT-OFF-RIGHT LOWER-OFF-RAISE OFF-MAN-AUTO OFF-SLOW-FAST OFF-1-2 OPEN-OFF-CLOSE SLOW-OFF-FAST SUMMER-OFF-WINTER UP-OFF-DOWN 1-OFF-2 HAND-OFF-AUTO | 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 |



- *Available in Red as standard legend code 104 and 124. To order engraved nameplate and codes, add legend code to nameplate part number. Character height based on the number of characters, space and size of nameplate. Standard character size is 3/16".
- 2. Nameplates with standard legends are the same list price as blank nameplates. Special engravings, additional cost.

To specify engraving instructions, use the Nameplate order form on next page.

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Custom engraved Nameplates Order Form — TWND Series

| Copy this order form and use it to spe To ensure engraving accuracy, fax it to Your Company Name: | cify Letter Height, Custom Engravings, Loca your IDEC representative. or Distributor. | | or Contact: | |
|---|---|--|---|---|
| | | | if known): | |
| Telephone: | | IDEC Rep/Distribu | tor Phone: | |
| Fax & Email: | | IDEC Rep/Distributor Fa | x & Email: | |
| NALD Nameplate | Step 1. Choose Letter Size - 7/64" or 1/8". | Sample Letter Sizes | 1/0: | haracters max —— 7/64" size letters) |
| Engraving Location | Check the box for the letter size you want. Then write your lettering in box below checkboxes. Note: 1/8" size letters cannot exceed 13 characters. | 7/64" Letters: A B C D 1/8" Letters: A B C D | 1/8" | characters max 1/8" size letters) |
| | Step 2. Specify Quantity. | | | · _ |
| | Enter the number of nameplates desired in the box on the right. | 1 2 3 4 | 5 6 7 8 9 10 11 12 | i I |
| NAKD Nameplate | Step 1. Choose Letter Size - 7/64" or 1/8". | | | |
| Engraving Location | Check the box for the letter size you want. Then write your lettering in box below checkboxes. Note: 1/8" size letters cannot exceed 9 characters. | | | |
| | Step 2. Specify Quantity. | 1 2 3 4 5 | 6 7 8 9 10 11 12 13 | 14 15 16 17 |
| | Enter the number of nameplates desired in the box on the right. | 0 . 0 | Sample Letter Sizes | 14 13 10 17 |
| | in the box on the right. | | 1/8" Letters: A B C D | |
| NAQD Nameplate | Step 1. Choose Letter Size - 7/64" or 1/8" | 7/64" Letter Size | 20 characters max ——————————————————————————————————— | |
| Engraving Location | Check the box for the letter size you want. Then write your lettering in below checkboxes. Note: 1/8" size letters cannot exceed the characters. | box 1/8" | 16 characters max (for 1/8" size letters) | |
| | | | | |
| Step 2. | 1 2 | | 9 10 11 12 13 14 15 16 | 17 18 19 20 |
| Specify Quantity. | 7 | | nple Letter Sizes " Letters: ABCD | |
| Enter the number of nameplates desired in the box on the right. | | | Letters: A B C D | |

Switch Engraving Order Form -TWND Series

| T | n insure e | naravina | accuracy | fay it to | VOUR IDEC | renresent | ative o | r Distributor | |
|---|------------|----------|----------|-----------|-----------|-----------|---------|---------------|--|

| Your Company: | Telephone: | |
|---------------|-----------------------------|--|
| Name: | Fax: | |
| Address: | Email: | |
| PO: | Part Number to be Engraved: | |

Please check one of the boxes below to indicate your choice of engraving options:

Square Switch

| | # of Lines | Letter Height | Max. Characters Per Line | | |
|--|---------------|------------------|-----------------------------|--|--|
| | 1 | 5/32 | 7 | | |
| | | 1/8 | 8 | | |
| | 2 | 5/32 | 7 | | |
| | | 1/8 | 8 | | |
| | 3 | 1/8 | 8 | | |
| | 4 | Custom* | | | |

^{*}Engraving is possible, but character size will be smaller than standard sizes.

Round Switch

| | # of Lines | Letter Height | Max. Characters Per Line |
|--|---------------|------------------|-----------------------------|
| | 1 | 5/32 | 7 |
| | | 1/8 | 8 |
| | 2 | 5/32 | 7 |
| | | 1/8 | 8 |
| | 3 | 1/8 | 8 |
| | 4 | | Custom* |

^{*}Engraving is possible, but character size will be smaller than standard sizes.



| # of Lines | Letter Height | Max. Characters Per Line |
|---------------|------------------|-----------------------------|
| 1 | 3/4 | 4 |
| ' | 5/16 | 5 |
| | 5/16 | 5 |
| 2 | 1/4 | 6 |
| | 5/32 | 8 |
| 2 | 5/32 | 8 |
| 3 | 1/8 | 9 |
| 4 | 1/8 | 9 |

ø29mm, ø40mm Mushroom Head



| | # of Lines | Letter Height | Max. Characters Per Line |
|-----------|---------------|------------------|-----------------------------|
| Engraving | 1 | 5/32 | 5 |
| Area 1 | ! | 1/8 | 5 |
| Engraving | 1 | 5/32 | 7 |
| Area 2 | | 1/8 | 7 |
| | | | |



- 1. Above mentioned specifications hold true for standard size pushbuttons (round and square).
- 2. †Engraving Area 2 can be engraved for 40mm mushroom head non-Illuminated pushbutton only.
- 3. Engraving is done on the button itself for non-Illuminated push buttons and on marking plate for illuminated push buttons and pilot
- 4. Please enter text exactly how you want it engraved, take care to emphasize capital or small letters.

| ciilei lext to be eiiui | ter text to be end | graved: |
|-------------------------|--------------------|---------|
|-------------------------|--------------------|---------|

Line 1: Line 2: Line 3:

Sample Letter Sizes

1/8 Letters:

5/32 Letters:

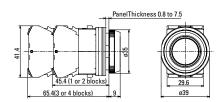
| \triangle | All engravi |
|-------------|-------------|
| 1 | wide. |

ng is 5/8mm

| For IDEC Internal U | Ise Only: | | |
|---------------------|-----------|--|--|
| Work Order #: | | | |
| • | | | |

Line 4:

Pushbutton

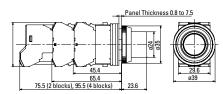


Mushroom Pushbutton w/Full Shroud



Illuminated Pushbuttons

w/Transformer



Lever

45.4 (1 or 2 blocks)

| Illuminated Pushbuttons | Dimension A | Dimension B |
|--|-----------------------------------|------------------------------------|
| Flush w/Full Shroud | 0.975" (25mm) 0.995" (25.5mm) | ø 0.936" (24mm) ø 0.936" (24mm) |
| Extended w/Full Shroud | 0.741" (19mm) 0.761" (19.5mm) | ø 0.936" (24mm) ø 0.936" (24mm) |
| ø 1.56" (40mm) Mushroom Pushlock Turn Reset, Push-Pull | *0.975" (25mm) **0.975" (25mm) | ø 1.56" (40mm) ø 1.56" (40mm) |

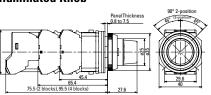


- *Dimension when operator is in reset position.
 **Dimension when operator is in pull position.

Selector Switches

Knob 45.4 (1 or 2 blocks) i.4 (3 or 4 blocks)

Illuminated Knob



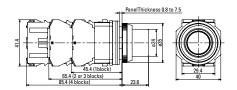
Dimensions (mm)

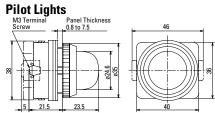
| Pushbuttons | Dimension A | Dimension B |
|--|--|---|
| Flush Extended Extended w/Full Shroud | 0.351" (9mm) 0.566" (14.5mm) 0.663" (17mm) | ø 0.975" (25mm) ø 0.975"(25mm) ø 1.11" (28.5mm) |
| Mushroom Mushroom w/Full Shroud Jumbo Mushroom ø 1.56" (40mm) | 0.858" (22mm) 0.936" (24mm) 1.13" (29mm) | ø 1.56" (40mm) ø 1.87" (48mm) ø 2.54" (65mm) |
| Mushroom, Pushlock Turn Reset and Push-Pull ø 1.56" (40mm) | *0.975" (25mm) **0.975" (25mm) | ø 1.56" (40mm) ø 1.56" (40mm) |



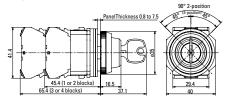
- *Dimension when operator is in reset position.
- *Dimension when operator is in pull position.

Full Voltage



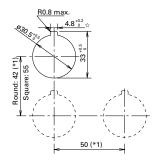


Key





Selector Switches Panel Cut-Out





1. *Jumbo Mushroom < 2.61" (66mm)

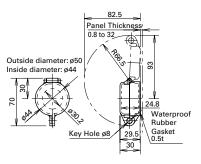
Switches & Pilot Devices

- Minimum mounting centers are applicable to switches with one stack of contact blocks. When mounting two stacks of contact blocks, minimum centers should allow for access to wiring.
- 3. The ø 0.195" (ø 5mm) recess is necessary when either the nameplate or anti-rotation ring is used.

IlluminatedSelector Switches

OL-KL1

Lock-Out Adaptor

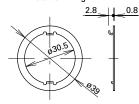


OC-31 **Pushbutton Clear Boot**

ø32.6 18 (OC-31) 22 (OC-32)

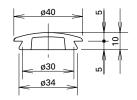
OGL-31

Anti-Rotation Ring



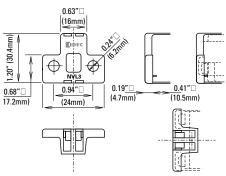
OB-31

Mounting Hole Rubber Plug

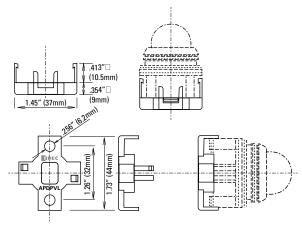


Finger-Safe Cover

N-VL3



APD-PVL

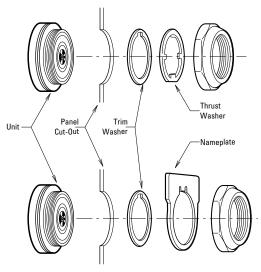




Operating Instructions

Adjustment for Panel Thickness

Each unit is shipped with several waterproof gaskets which are 0.06" (1.5mm) and 0.12" (3mm) thick. Combine the gaskets for a dimension approximately equal to panel thickness and install between the bezel and the body of the unit.

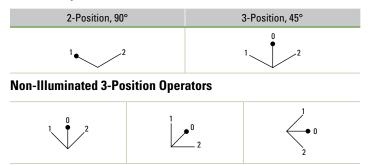


A trim washer must be used with a thrust washer or a nameplate to prevent the control unit from rotating in the mounting hole. When using anti-rotation rings (trim washer with thrust washer or nameplate), install as shown below.

Selector Switches

The operator shaft of each unit has a recess to identify in which direction to install the handle. Align the handle with the recess. Press color insert (TW-HC1) into the Standard Operating Positions.

Standard Operation Positions



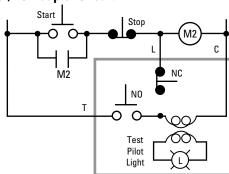
Insallation of LED Illuminated Units

Transformer units are recommended for use in areas subjected to inductive noise.

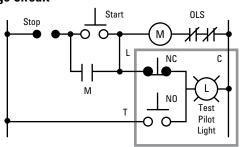
Application Example For Push-To-Test Pilot Light

A typical application of illuminated pushbuttons is a push-to-test pilot light which can be used to check the lamp/LED circuit.

Transformer/AC-Adapter Circuit



Full Voltage Circuit





POWR-GARD® Blocks & Holders LPSC / LPSM POWR-SAFE FUSE HOLDERS

600 V





Littelfuse POWR-SAFE dead front holders provide optimum protection to personnel for Class CC and midget-style fuses.

Features/Benefits

- Indicating and non-indicating options available
- 1-, 2-, 3- and 4-pole configurations
- Easy installation and fuse removal with no additional pullers or tools required
- 35 mm DIN-rail mountable
- Ventilated design for cooler operation

Ordering Information

| INDI | CATING | NON-IN | DICATING | | |
|-------------------|--------------------|-------------------|--------------------|-----------|-------|
| CATALOG NUMBER | ORDERING NUMBER | CATALOG NUMBER | ORDERING NUMBER | FUSE TYPE | POLES |
| LPSC001ID | LPSC0001ZXID | LPSC001 | LPSC0001Z | Class CC | 1 |
| LPSC002ID | LPSC0002ZXID | LPSC002 | LPSC0002Z | Class CC | 2 |
| LPSC003ID | LPSC0003ZXID | LPSC003 | LPSC0003Z | Class CC | 3 |
| LPSC004ID | LPSC0004ZXID | LPSC004 | LPSC0004Z | Class CC | 4 |
| LPSM001ID | LPSM0001ZXID | LPSM001 | LPSM0001Z | Midget | 1 |
| LPSM002ID | LPSM0002ZXID | LPSM002 | LPSM0002Z | Midget | 2 |
| LPSM003ID | LPSM0003ZXID | LPSM003 | LPSM0003Z | Midget | 3 |
| LPSM004ID | LPSM0004ZXID | LPSM004 | LPSM0004Z | Midget | 4 |

Mulit-Pole Assembly Kit

Ordering No. CYHP0001Z-KIT

(Kit contains 20 connector pincers & 10 handle pins)



Specifications

Voltage Rating Ampere Rating Interrupting Rating

Terminal Type
Suggested Torque
Wire Range
Housing
Fuse Clip
Zinc Plated Steel
Terminal Screws
Operating Temperature
Flammability Rating
Approvals

600 V ac/dc 30 A 200 kA (Class CC) 100 kA (Midget) Pressure plate 17.7 in-lbs #8-#14 CU Thermoplastic Silver plated copper Zinc plated steel Nickel plated steel -50 °C to +125 °C UL 94 V-0

UL Listed (LPSC File: E14721) UL Recognized (LPSM File: E14721) CSA Certified (LPSC/LPSM File: LR7316) RoHS Compliant, Lead (Pb) Free

Environmental

Web Resources

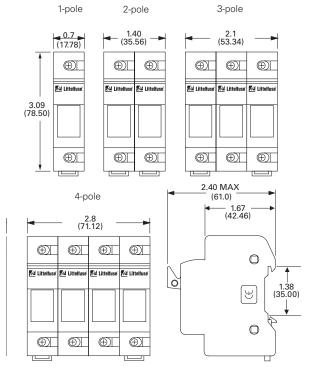
Download CAD drawings and other technical information:

Littelfuse.com/lpsc Littelfuse.com/lpsm

Recommended Fuses

Class CC Midget-style (10 x 38 mm)

Dimensions Inches (mm)



Disclaimer Notice — Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littleffuse products are not designed for, and may not be used in, all applications. Read complete Disclaimer Notice at www.littleffuse.com/product-disclaimer.

ATDR Time-delay/Class CC

The best protection for today's small motors

Amp-Trap 2000® ATDR small-dimension fuses can provide IEC Type 2 No Damage protection to your facility's increasingly sensitive branch circuit components and small motors - minimizing the risk of fault-related damage. ATDR Class CC fuses deliver the best time-delay characteristics in their class with excellent cycling ability for small motor loads.

Features/Benefits:

- · Time-delay for motor starting inrush currents without nuisance opening
- · Highly current-limiting for low peak let-thru current
- Improved cycling ability for frequent motor starts/stops without nuisance fuse opening
- Rejection-style design prevents replacement errors (when used with recommended fuse blocks)
- · High-visibility orange label ensures instant brand recognition, simplifies replacement
- Metal-embossed date and catalog number for traceability and lasting identification
- · Fiberglass body provides dimensional stability in harsh industrial settings
- · High-grade silica filler ensures fast arc quenching and optimum current-limitation

Highlights:

- Time-delay
- Best choice for small motor protection
- · Highly current-limiting
- AC & DC rated

Applications:

- Small motors
- Contactors
- · Lighting, heating & general loads
- Branch circuit protection

Note: See motor fuse applications tables on page P7



Ratings:

Volts: 600VAC

: 300VDC Amps : 1/4 to 30A : 200kA I.R. AC

: 100kA I.R. DC

Approvals:

- UL listed to standard 248-4 File E2137
- CSA certified to standard C22.2 No. 248.4
- DC listed to UL standard 248







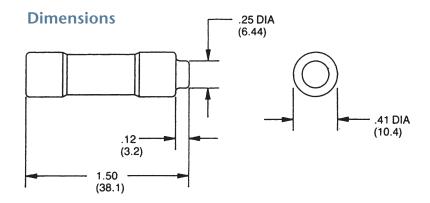
ATDR Time-delay/Class CC

Catalog Numbers (amps)

| ATDR1/4 | ATDR1-1/2 | ATDR3 | ATDR6 | ATDR12 |
|------------|------------|------------|-----------|------------|
| ATDR1/2 | ATDR1-6/10 | ATDR3-2/10 | ATDR6-1/4 | ATDR15 |
| ATDR8/10 | ATDR1-8/10 | ATDR3-1/2 | ATDR7 | ATDR17-1/2 |
| ATDR1 | ATDR2 | ATDR4 | ATDR7-1/2 | ATDR20 |
| ATDR1-1/8 | ATDR2-1/4 | ATDR4-1/2 | ATDR8 | ATDR25 |
| ATDR1-1/4 | ATDR2-1/2 | ATDR5 | ATDR9 | ATDR30 |
| ATDR1-4/10 | ATDR2-8/10 | ATDR5-6/10 | ATDR10 | |

Recommended Fuse Blocks for Class CC Fuses

| | Catalog Numbers | | | | |
|-----------------------|---|---|--|----------------------------|--|
| Number of Poles | UltraSafe™ Indicating Fuse Holder | Screw Connector w/ Double Quick Connects | Pressure Plate Connector w/ Double Quick Connects | Copper Box Connector | |
| ADDER | | 30310R | 30320R | 30350R | |
| 1 | USCC1I | 30311R | 30321R | 30351R | |
| 2 | USCC2I | 30312R | 30322R | 30352R | |
| 3 | USCC3I | 30313R | 30323R | 30353R | |
| 3 | USFMCCI | | | | |





Straight Blade Devices











IP20

| Insulgrip [®] | | | |
|--|-------------------------|----------------|------------|
| Description | Cord Diameter | Catalog Number | ' |
| Black and white nylon. | .230"720" (5.8-18.3) | HBL5266C | HBL5366C |
| Blue and white nylon. | .230"720" (5.8-18.3) | HBL5266CBL | - |
| Black nylon extra large cord clamp. | .360"720" (9.1-18.3) | HBL5266EBK | HBL5366EBK |
| Corrosion resistant yellow nylon. | .230"720" (5.8-18.3) | HBL52CM66C | HBL53CM66C |
| 8-position angle plug, black and white nylon. | .325"655" (8.3-16.6) | HBL5266CA | HBL5366CA |
| 8-position angle plug, transparent enclosure. | .325"655" (8.3-16.6) | HBL5266CAT | - |
| Anchor lock, black and white nylon. | .230"720" (5.8-18.3) | HBL5280C* | - |
| Anchor lock, corrosion resistant yellow nylon. | .230"720" (5.8-18.3) | HBL52CM80C* | - |
| Finger grip, black neoprene, combination screws. CSA only. | .31"43" (7.9-10.9) | HBL5921 | - |
| Fusible, black vinyl housing, slotted screws. CSA only. | .296"625" (7.5-15.9) | HBL5299 | - |



HBL5266C



HBL5266CA



HBL1447

Elastogrip®

Plugs

| Description | Cord Diameter | Catalog Number | Catalog Number | | |
|--|-------------------------|----------------|----------------|--|--|
| Yellow elastomer, dust tight. IP20 SUITABILITY. | .300"655" (7.6-16.6) | HBL1447 | HBL1433 | | |
| Yellow elastomer, watertight. IP20 and IP55 SUITABILITY. | .300"655" (7.6-16.6) | HBL14W47** | HBL14W33** | | |
| ellow elastomer, watertight375"625" 265, 66, 67 SUITABILITY. (9.5-15.9) | | HBL14W47A | HBL14W33A | | |

IP20

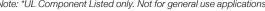


HBL14W47

HBL5965VY

Valise®

| valise | 0 15: 1 | 0.1.1.1.1 | |
|--|-------------------------|----------------|------------|
| Description | Cord Diameter | Catalog Number | |
| Yellow nylon. | .220"660" (5.6-16.8) | HBL5965VY | HBL5364VY |
| Black nylon. | .220"660" (5.6-16.8) | HBL5965VBLK | HBL5364VBK |
| Gray nylon. | .220"660" (5.6-16.8) | HBL5965VGY | _ |
| Orange nylon, sold in bulk pack of 50. | .220"660" (5.6-16.8) | HBL515PVO | - |
| Insulation displacement terminals, black nylon. | .230"360" (5.8-9.1) | HBL5966VBLK | - |
| Insulation displacement terminals, yellow nylon. | .230"360" (5.8-9.1) | HBL5966VY | - |

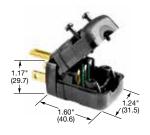


Note: *UL Component Listed only. Not for general use applications.

**Watertight plugs IP55 suitability when installed and used properly with mating Elastogrip watertight connector bodies.

Horsepower ratings listed are AC only.

See page A-48 for accessories.



HBL5966VBLK

Dimensions in Inches (mm)



Carlon°

Circuit Safe JIC Enclosures T&B Catalog Number:

CJ12106 UPC Number: 03448110265

Status: Active

Description:

Circuit Safe Polycarbonate JIC Enclosure Assembly with hinged opaque cover, 12 in. \times 10 in. \times 6 in.

| cover, 12 in. x 10 in. x 6 in. | |
|--------------------------------|---|
| Features | |
| | Hinge caps make covers captive |
| | Non-metallic molded-in hinges on hinged models |
| | No rough corners, sharp edges or burrs. |
| | Non-conductive, eliminates danger of electrical |
| | shock |
| | Lid design provides greater usable internal volume |
| | Ample interior space for ease of working |
| | Fully gasketed |
| | Ultraviolet stabilized for outdoor use. |
| | Non-metallic mounting feet with all mounting hard- |
| | ware included. |
| 2 | Brass screw inserts |
| Standards | |
| | Meets NEMA Types 1, 3, 3S, 3X, 3SX, 4, 4X, 12, |
| | 13. |
| | UL Listed per UL 50, enclosures for electrical equip- |
| | ment |
| | JIC compliance |
| Application | |
| | Instrument case |
| | Junction and terminal boxes |
| | Control and switching enclosures |
| | Splice and pull boxes |
| | Starter, pushbutton and transformer housings |
| | Meter and transformer cabinets |
| General | |
| Motorial | Dalvaarkanata |
| Material Packaging | Polycarbonate |
| rackagilig | |
| Package in Units | 1 |
| T&B Sold in UOM | Each |
| T&B Weight Per UOM | 7.32 lbs. Each |
| Notes | |
| | Order back panels separately |
| | Enclosures shipped with mounting feet, hinge caps |
| | and screws. |
| Certifications | |
| | |
| RoHS Compliance | Yes |
| | |



Certifications





File Nbr: E 108856

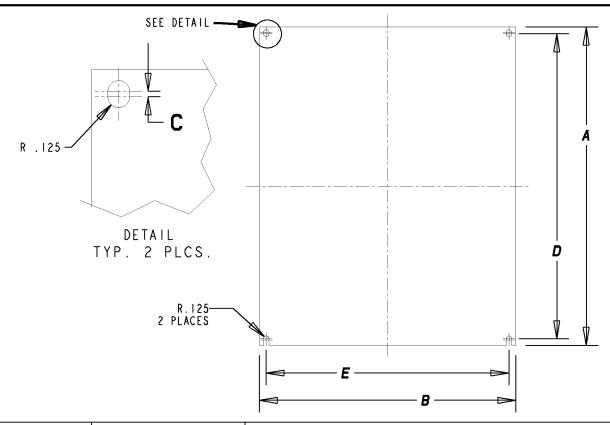
For further technical assistance, please contact us...

T&B Technical Support MS 3B-50 8155 T&B Blvd. Memphis, TN 38125 Hours: 7AM - 6PM CDT Monday-Friday Phone: (888) 862-3289 Fax: (901) 252-1321

Email:techsupport@tnb.com

Thomas & Betts - USA 8155 T&B Blvd. Memphis, TN 38125 www.tnb.com

Carlon[•]



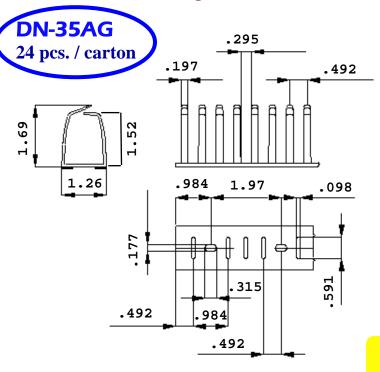
| STEEL PLATE CRS 10 18/1008 NON- METALLIC TYPE 2, ANSI 61 GREY | | | | | | | | |
|--|---------------|----------------|-------------|-------------|-------------|------------|-------------|--------------|
| PART NUMBER | THICKNESS | PART Number | THICKNESS | A | В | C | D | E |
| JP64 | .075 (14 GA.) | JP64P | .25 [6] PVC | 4.88 [124] | 2.88 [73] | | 4.25 [108] | 2.25 [57] |
| JP66 | .075 (14 GA.) | JP66P | .25 [6] PVC | 4.88 [124] | 4.88 [124] | | 4.25 [108] | 4.25 [108] |
| JP86 | .075 (14 GA.) | JP86P | .25 [6] PVC | 6.75 [171] | 4.88 [124] | .063 [1.6] | 6.12 [155] | 4.25 [108] |
| JP88 | .075 (14 GA.) | JP88P | .25 [6] PVC | 6.75 [171] | 6.88 [175] | .063 [1.6] | 6.12 [155] | 6.25 [159] |
| JP108 | .075 (14 GA.) | JP108P | .25 [6] PVC | 8.75 [222] | 6.88 [175] | .063 [1.6] | 8.12 [206] | 6.25 [159] |
| JP1010 | .075 (14 GA.) | JP1010P | .25 [6] PVC | 8.75 [222] | 8.88 [226] | .063 [1.6] | 8.12 [206] | 8.25 [210] |
| JP1210 | .075 (14 GA.) | JP1210P | .25 [6] PVC | 10.75 [273] | 8.88 [226] | .063 [1.6] | 10.12 [257] | 8.25 [210] |
| JP1212 | .075 (14 GA.) | JP1212P | .25 [6] PVC | 10.75 [273] | 10.88 [276] | .063 [1.6] | 10.12 [257] | 10.25 [260] |
| JP1412 | .075 (14 GA.) | JP1412P | .25 [6] PVC | 12.75 [324] | 10.88 [276] | .063 [1.6] | 12.12 [308] | 10.25 [260] |
| JP1614 | .075 (14 GA.) | JP1614P | .25 [6] PVC | 14.75 [375] | 12.88 [327] | .063 [1.6] | 14.12 [359] | 12.25 [3111] |

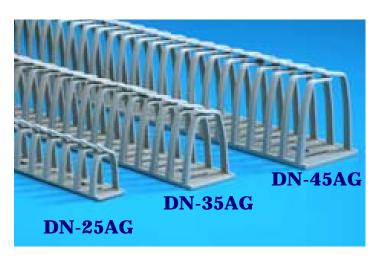
GENERAL NOTES Thomas@Betts ALL DIMENSIONS ARE FOR REFERENCE ONLY. DIMENSIONS IN BRACKETS [] ARE IN METRIC UNITS. **BACK PANELS** DESCRIPTION: REVISIONS JIC & JP SERIES SEE ERN (****) FOR APPROVAL SIGNATURES & RELEASE DATE. PROJECT NO: **** DRAWING NO: ORIGINAL PROJECT NO / (ERN NO) SHEET NO: REV. NO: WSD-AC04208 **/** { } 1 OF 1

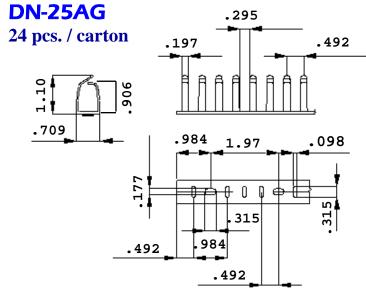
IBOCO INTRODUCES THE NEWLY REDESIGNED GREY DINOSAUR DUCT!

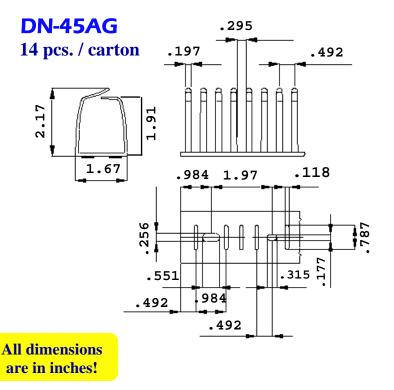
Within the next couple of months IBOCO will be REPLACING the DN-20AG, DN-30AG and DN-40AG with a NEWLY DESIGNED GREY Dinosaur Duct. For the time being, the WHITE DINOSAUR DUCT WILL REMAIN UNCHANGED.

Once inventory is depleted the DN-10AG, DN-20AG, DN-30AG and DN-40AG will no longer be available.











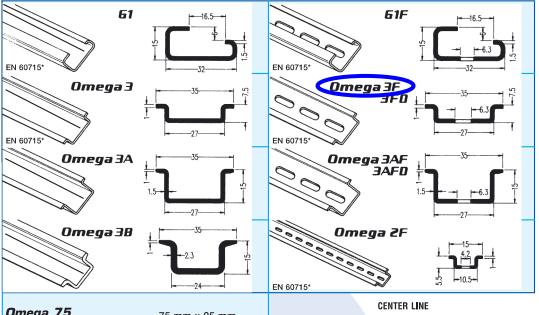
26 Northfield Avenue, Edison, NJ 08837 Tel: 732-417-0066 Fax: 732 417-1166

email: iboco@iboco.com website: www.iboco.com



RoHS compliant

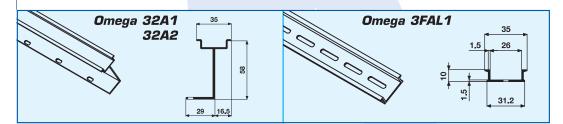
The most comprehensive range of **Din metal mounting rails**



Omega 75 EN 60715*

75 mm x 25 mm

The unperforated mounting rails (G1/OMEGA 3/OMEGA 3A/ OMEGA 3B) have a center line in order to expedite the drilling of the mounting holes.

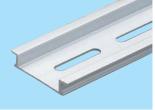


| Catalog | Lengths |
|------------|----------|
| Number | Per Pack |
| G1 | 12 |
| G1F | 12 |
| OMEGA 2F | 20 |
| OMEGA 2F1 | 40* |
| OMEGA 3 | 20 |
| OMEGA 3F | 20 |
| OMEGA 3F1 | 40* |
| OMEGA 3FD | 20 |
| OMEGA 3A | 10 |
| OMEGA 3AF | 10 |
| OMEGA 3AF1 | 20* |
| OMEGA 3AFD | 10 |
| OMEGA 3B | 10 |
| OMEGA 3B1 | 10* |
| OMEGA 75 | 2 |

| Number | Per Pack |
|---|----------------|
| ALUMINUM | |
| OMEGA 32A1 OMEGA 32A2 OMEGA 3FAL1 | 6* 6 40* |
| GROMMET | |
| IG-11 | 10 |
| COPPER | |
| OMEGA 3ACU | 1 |
| STAINLESS STEEL | |
| OMEGA 3SS OMEGA 3SS1 | 2 6* |
| | |

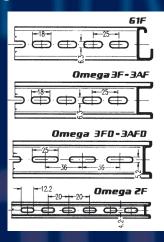
^{*}One meter long



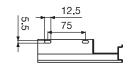


Treated with galvanic zinc plating and passivation (gal Zn 8c according to Din 50960) Minimum thickness 6 microns Standard length: 2 meters (6'63/4")

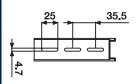
Bottom perforation



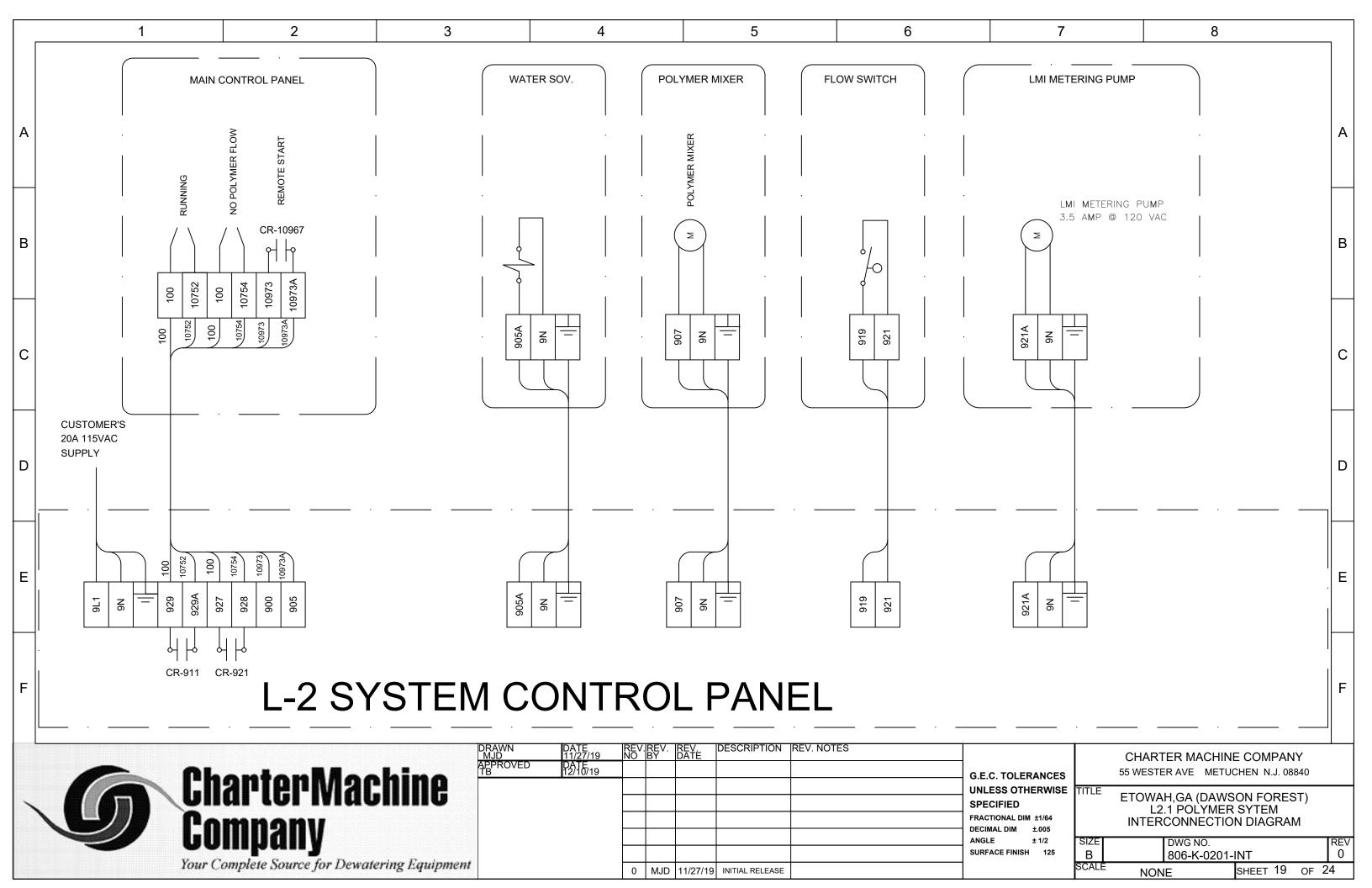
Omega 32A1 32A2



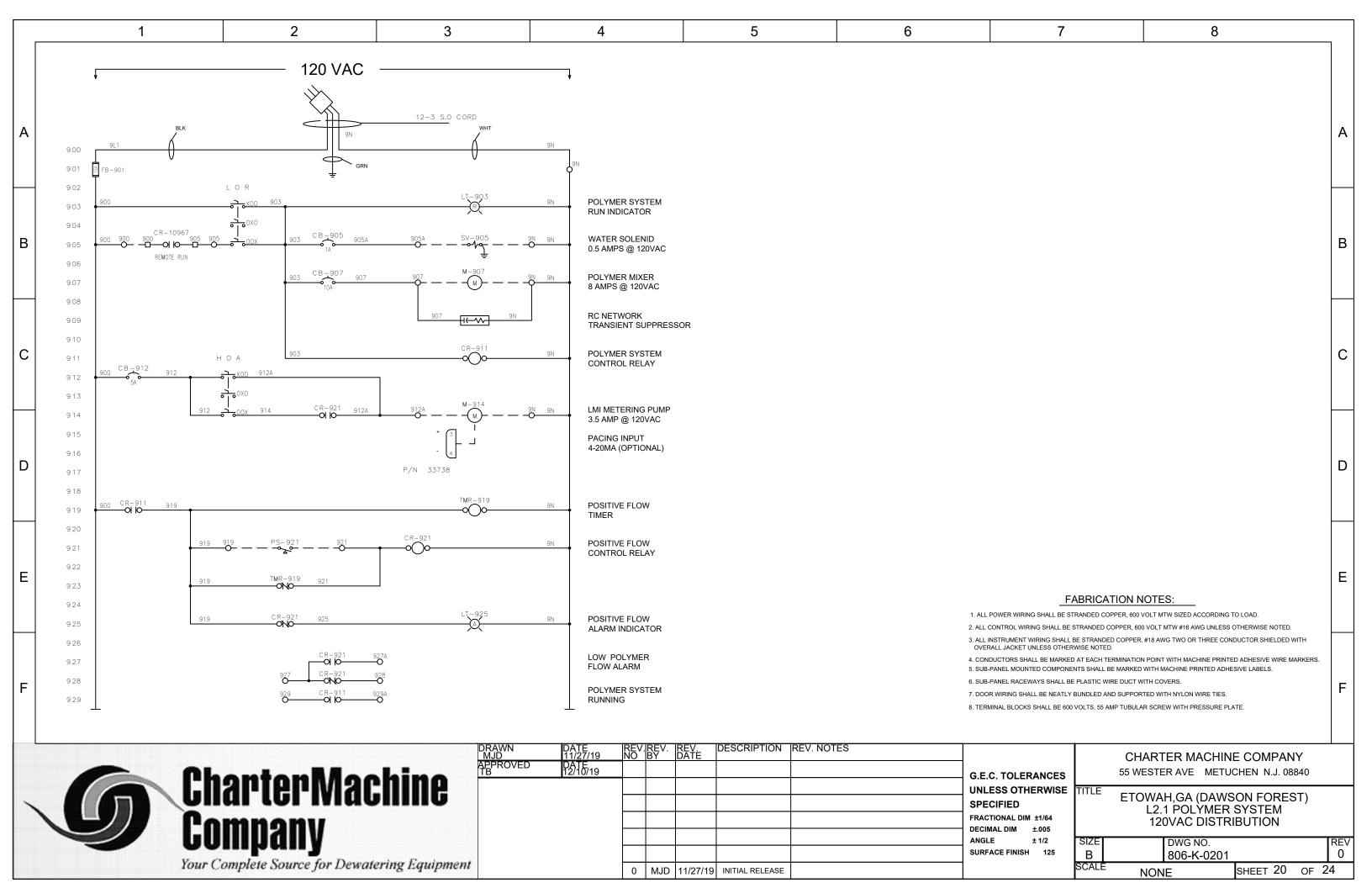
Omega 3FAL1



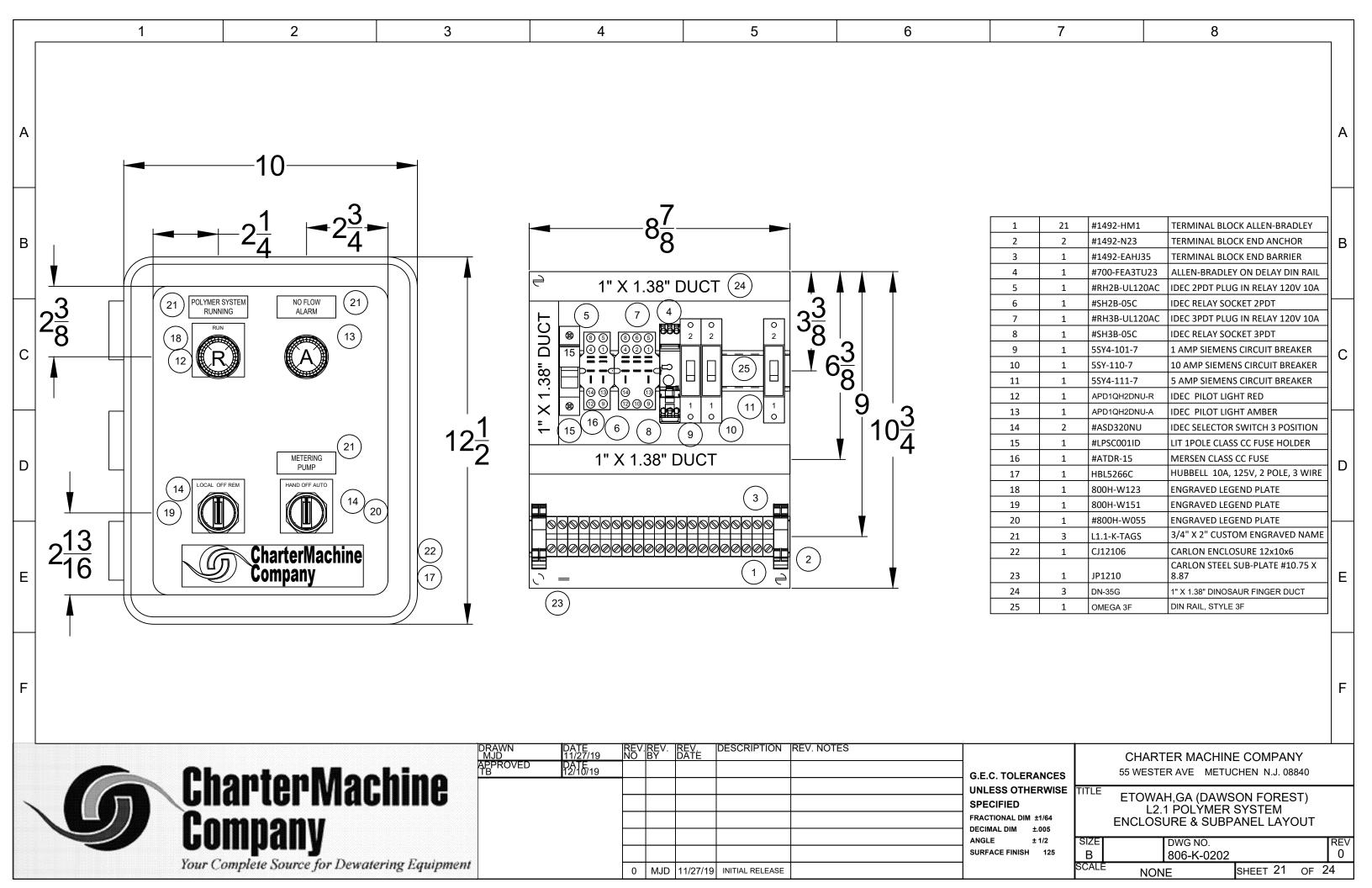
In compliance with EN 60715 standard



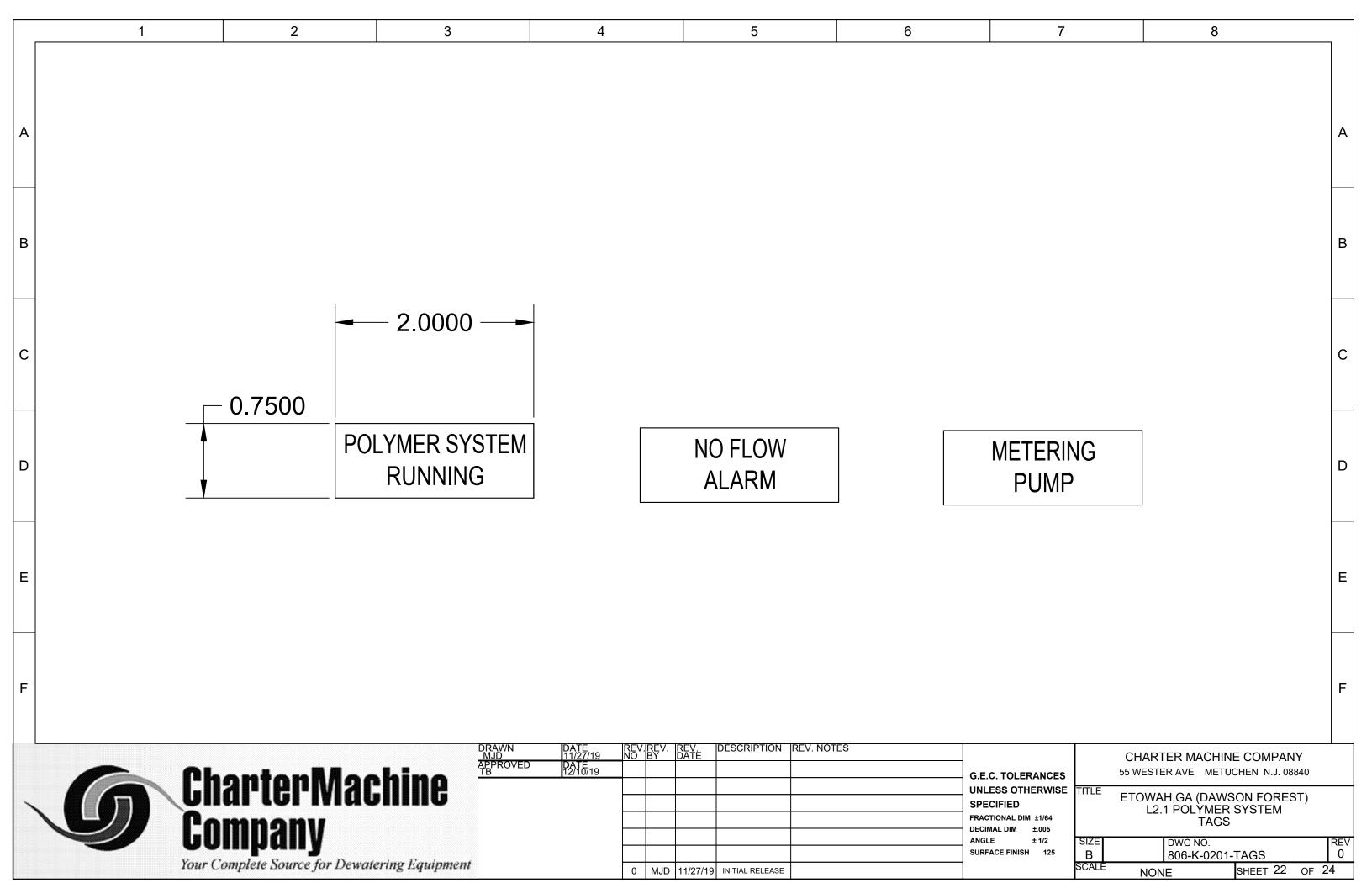




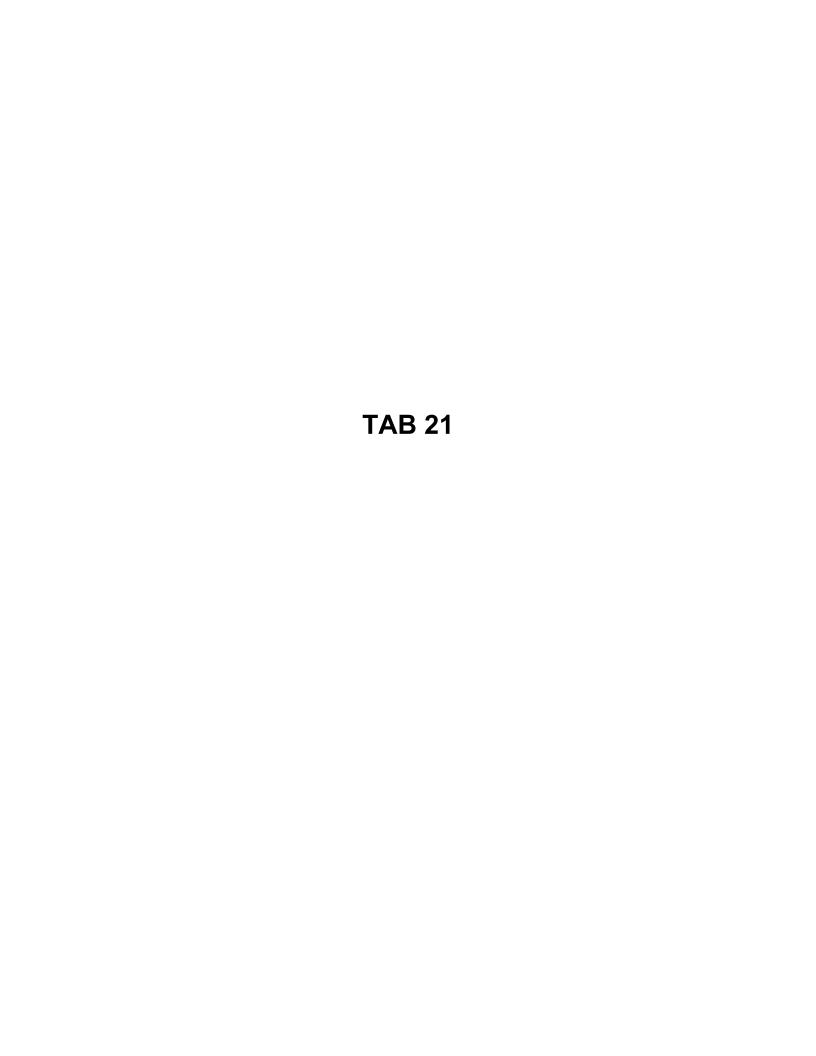














CHARTER MACHINE COMPANY SUMMARIZED BILL OF MATERIAL

PARENT ITEM# DESCRIPTION REQ QTY

1 806.L2.1 ETOWAH, GA (DAWSON FOREST)

LOCAL PANEL

DIN RAIL, STYLE 3F

1.5" X 3" NARROW FINGER DUCT

OMEGA 3F

T1E-1530G

WT#

COMPONENT COMPONENT QTY ITEM NUMBER DESCRIPTION/COMMENT REQUIRED UM #1492-HM1 TERMINAL BLOCK ALLEN-BRADLEY 54 EΑ 4 #1492-N23 TERMINAL BLOCK END ANCHOR EΑ ALLEN-BRADLEY #1492-EAHJ35 TERMINAL BLOCK END BARRIER 1 EΑ 2711P-T10C21D8S PANELVIEW PLUS 7 STANDARDTERMINAL 1 EΑ TOUCH SCREEN, 10.4 INCHES S8VK-G12024 OMRON 24VDC POWER 5A SUPPLY 1 EΑ EΑ LPSC001ID LITTLE FUSE 1 POLE 1 ATDR3 MERSEN 3 AMP CC FUSE TYPE 1 EΑ SCE-20EL2008SSLP 20X20X8 ENCLOSURE EΑ SCE-20P20 20X20 BACK PANEL EΑ IDEC PUSHBUTTON BLACK FLUSH HEAD ABD110NU-B 2 EΑ **1NO** AVD302UR IDEC MUSH HEAD RED TWIST TO RELEASE EΑ 2NC 800H-W100E*004 ENGRAVED LEGEND "SILENCE" 30 MM EΑ 1 WHITE LETTERS BLACK BACKGROUND YELLOW BLANG "EMERG STOP" 30 MM 800T-X646 1 EΑ 800H-W121 ENGRAVED LEGEND "RESET" 30 MM 1 EΑ WHITE LETTERS BLACK BACKGROUND

1

5

EΑ

EΑ





[+ Worldwide]



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Terminal Blocks, NEMA/EEMAC

- Terminal Blocks, NEMA/EEMAC Overview
- NEMA/EEMAC Terminal Blocks
- Finger-Safe Terminal Blocks
- Panel Mount Blocks
- NEMA Terminal Block Accessories

<u>Catalogs</u> > <u>Industrial Controls Catalog</u> > <u>Terminal Blocks and Wiring Systems</u> > <u>Terminal Blocks, NEMA/EEMAC</u> > Finger-Safe Terminal Blocks

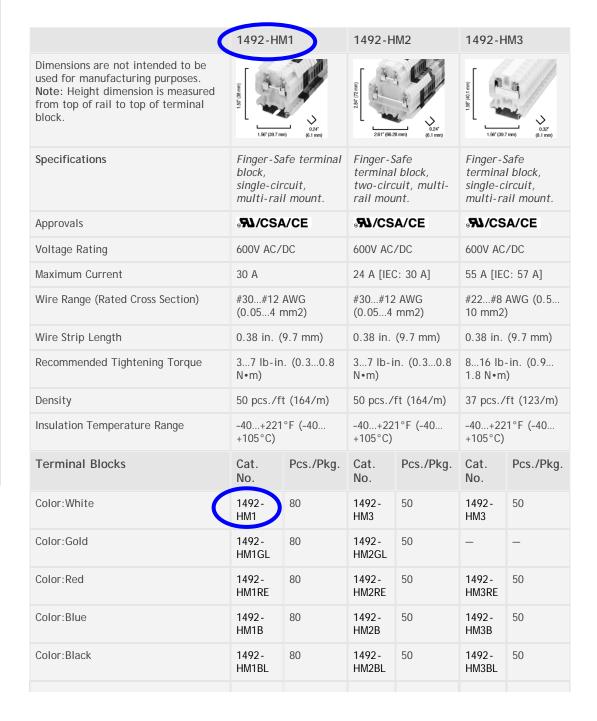
FINGER-SAFE TERMINAL BLOCKS

Introduction

High Density Blocks Fuse and Surge Suppressor Blocks Resistor, Voltage Indicating, and Component Blocks Short-Circuit Current Ratings



High Density Blocks



| Color:Green | 1492 - HM1G | 80 | 1492 - HM2G | 50 | 1492 - HM3G | 50 |
|---|-----------------|-----------|--------------------|-----------|-----------------|-----------|
| Color:Yellow | 1492 - HM1Y | 80 | 1492 - HM2Y | 50 | 1492 - HM3Y | 50 |
| Color:Brown | 1492 - HM1BR | 80 | 1492 - HM2BR | 50 | 1492 - HM3BR | 50 |
| Color:Violet | 1492- HM1VT | 80 | 1492 - HM2VT | 50 | 1492 - HM3VT | 50 |
| Color:Grey | 1492- HM1GY | 80 | 1492 - HM2GY | 50 | 1492 - HM3GY | 50 |
| Color:Orange | 1492 - HM1OR | 80 | 1492 - HM2OR | 50 | 1492 - HM3OR | 50 |
| Accessories (<u>Accessories</u>) | Cat. No. | Pcs./Pkg. | Cat. No. | Pcs./Pkg. | Cat. No. | Pcs./Pkg. |
| Mounting Rails: A-B Rail | 1492 - N1 | 20 | 1492 - N1 | 20 | 1492 - N1 | 20 |
| 3 ft Rigid A-B Rail | 1492 - N22 | 20 | 1492 - N22 | 20 | 1492 - N22 | 20 |
| 3 ft High-Rise A-B Rail | 1492 - N44 | 2 | - | - | 1492 - N44 | - |
| Standoff Brackets (use every 12 in.) | 1492 - N25 | 2 | 1492 - N25 | 2 | 1492 - N25 | 2 |
| DIN Rail | 199- DR1 | 10 | 199- DR1 | 10 | 199- DR1 | 10 |
| 1 m Symmetrical DIN (Aluminum) | 1492 - DR5 | 10 | 1492 - DR5 | 10 | 1492 - DR5 | 10 |
| 1 m Hi-Rise Sym. DIN (Aluminum) | 1492 - DR6 | 2 | 1492 - DR6 | 2 | 1492 - DR6 | 2 |
| 1 m Angled Hi-Rise Sym. DIN (Steel) | 1492 - DR7 | 2 | 1492 - DR7 | 2 | 1492 - DR7 | 2 |
| End Barrier | 1492 - NM36 | 50 | 1492 - NM40 | 50 | 1492 - NM36 | 50 |
| End Anchors: A-B Rail | 1492- N23 | 10 | 1492 - N23 | 10 | 1492 - N23 | 10 |
| A-B Rail — Normal Duty | 1492 - N47 | 50 | - | _ | 1492 - N47 | 50 |
| A-B Rail — Retaining Clip — Light Duty | 1492 - N2 | 50 | _ | _ | _ | _ |
| DIN Rail — Normal Duty | 1492 - EA35 | 50 | 1492 - EA35 | 50 | 1492 - EA35 | 50 |
| DIN Rail — Heavy Duty | 1492 - EAH35 | 10 | 1492 - EAH35 | 10 | 1492 - EAH35 | 10 |
| Color:=26,1165366 | 1492 - N42 | 50 | 1492 - N42 | 50 | _ | 50 |
| Color:=23,1165366 | 1492- SJ8-10 | 10 | 1492 - SJ6 - 10 | 10 | 1492- SJ8-10 | 10 |
| 50-pole Uninsulated | 1492 - N39 | 10 | 1492 - N39 | 10 | - | - |
| Insulating Sleeve | 1492 - SJS | 10 | 1492 - SJS | 10 | - | - |
| Marking System | 1492- | 5 | 1492- | 5 | 1492- | 5 |

| Standard Feed-Through Bi | JUNS | | | | | | | | | |
|---|---------------------|-----------------------|---------------------------------------|----------------------------|-------------------------------|-------------------|---|-----------------|-------------------|-------------------------------------|
| | | 1492-J3 | | | 149 | 2-J4 | | 1 | 492-J6 | |
| Dimensions are not intended to be used for manufacturing purposes. Note: Height dimension is measured from top of rail to top of terminal block. | (5.1 mm) | | | (6.1 mm) 2.36" (60 mm) | | | (au (au (au (au (au (au (au (au (au (au | | | |
| Specifications | Feed-thro | ugh terminal | block | Fee | ed-through | terminal | block | Feed-throu | gh terminal | block |
| Certifications | 71 cs | A IEC | ATEX | <i>77</i> | CSA | IEC | ATEX | SAL CSA | IEC | ATEX |
| Voltage Rating | 600V AC/DO | 600V AC/DC 800V AC/DC | | 600V | 00V AC/DC 800V AC/DC AC/DC | | 690V AC/DC | 600V AC/DC | 800\/ | |
| Maximum Current | 25 A 20 | A 24 A | 21 A | 35 A | 25 A | 32 A | 28 A | 50 A | 41 A | 36 A |
| Wire Range (Rated Cross Section) | #2212 #26 AWG AW | | 2.5 mm ² (#2014 AWG) | #2210 AWG | #2610 AWG | 4 mm ² | 4 mm ² (#2012 AWG) | #228 AWG | 6 mm ² | 6 mm ² (#2010 AWG) |
| Wire Strip Length | 0.3 | 9 in. (10 mm) | , | | 0.39 in. | (10 mm) | , | 0.47 | in. (12 mm) | , |
| Recommended Tightening Torque | 4.57.1 ll | o•in (0.50.8 | B N∙m) | | 9.0 lb•in | (1.0 N•m) |) | 14.2 lk | •in (1.6 N•n | n) |
| Density | | s/ft (196 pcs/i | | | 49 pcs/ft (| (163 pcs/r | n) | | ft (123 pcs/i | |
| Housing Temperature Range | -58+24 | 3 °F (-50+1 | 20 °C) | -58 | +248 °F | <u> </u> | 20 °C) | -58+248 | °F (-50+1 | 20 °C) |
| Short-Circuit Current Rating | | | | | See pa | ge 12-42 | | | | |
| Tarrainal Blacks | 0-4 | N | Die Ohe | | Cat. No. | | Die Ohe | C-4 A | ۱ | Die Ohe |
| Terminal Blocks Color: Grey | Cat. 1492 | | Pkg Qty. | | 1492-J4 | | Pkg Qty. | Cat. N 1492- | | Pkg Qty. |
| Red | 1492-J | | 100 | | 1492-J4-R | F | 100 | 1492-J6 | | 100 |
| Blue | | | 100 | | 1492-J4-E | | 100 | 1492-J | | 100 |
| Black | | | 100 | | 1492-J4-B | | 100 | 1492-J6 | | 100 |
| Green | 1492- | J3-G | 100 | | 1492-J4-0 | | 100 | 1492-J | | 100 |
| Yellow | 1492- | | 100 | | 1492-J4-Y | | 100 | 1492-J | 6-Y | 100 |
| Orange | 1492-J | 3-OR | 100 | - | 1492-J4-O | R | 100 | | | 100 |
| Brown | 1492-J | 3-BR | 100 | | 1492-J4-B | R | 100 | 1492-J6 | 1492-J6-BR | |
| White | 1492- | J3-W | 100 | | 1492-J4-V | V | 100 | 1492-J | 6-W | 100 |
| Violet | 1492- | J3-V | 100 | | 1492-J4-V | / | 100 | _ | | _ |
| Mounting Rails: 1 m Symmetrical DIN (Steel) | 199-I | DR1 | 10 | | 199-DR1 | | 10 | 199-D | R1 | 10 |
| 1 m Symmetrical DIN (Aluminum) | 1492- | DR5 | 10 | | 1492-DR5 | | 10 | 1492-D | R5 | 10 |
| 1 m Hi-Rise Sym. DIN (Aluminum) | 1492- | DR6 | 2 | 1492-DR6 | | 2 | 1492-DR6 | | 2 | |
| 1 m Angled Hi-Rise Sym. DIN (Steel) | 1492- | DR7 | 2 | | 1492-DR7 | | 2 | 1492-DR7 | | 2 |
| End Barriers Grey | 1492-1 | | 50 | 1492-EBJ3 | | 50 | 1492-E | 3J3 | 50 | |
| Blue | | | 50 | 1492-EBJ3-B | | 50 | 1492-EB | | 50 | |
| Yellow | 1492-EBJ3-Y | | 50 | 1492-EBJ3-Y | | 50 | 1492-EB | J3-Y | 50 | |
| End Anchors and Retainers: DIN Rail — Normal Duty | 1492-EAJ35 | | 100 | 1492-EAJ35 | | 100 | 1492-EAJ35 | | 100 | |
| DIN Rail — Heavy Duty | 1492-E | AHJ35 | 50 | 1492-EAHJ35 | | 50 | 1492-EAHJ35 | | 50 | |
| Screwless End Retainer | 1492-E | RL35 | 20 | 1492-ERL35 | | 20 | 1492-ERL35 | | 20 | |
| Jumpers:* Screw Center Jumper — 10-pole | 1492-C | | 20 | 1492-CJJ6-10 | | | 20 | 1492-CJJ8-10 | | 20 |
| Screw Center Jumper — 4-pole | 1492-C | | 50 | 1492-CJJ6-4 | | 50 | 1492-CJJ8-4 | | 50 | |
| Screw Center Jumper — 3-pole | 1492-C | | 50 | 1492-CJJ6-3 1492-CJJ6-2 | | 50 | 1492-CJJ8-3 1492-CJJ8-2 | | 50 | |
| Screw Center Jumper — 2-pole Plug-in Center Jumper — 50-Pole | 1492-C 1492-CJ | | 50 10 | | JLJ6-41 (4 | | 50 10 | 1492-GJ | JU-2 | 50 |
| Plug-in Center Jumper — 10-Pole | 1492-CJ | | 20 | | 92-CJLJ6 | . , | 20 | _ | | |
| Plug-in Center Jumper — 9-Pole | 1492-C | | 20 | | _ | | _ | _ | | _ |
| Plug-in Center Jumper — 8-Pole | 1492-C | | 20 | | _ | | _ | _ | | _ |
| Plug-in Center Jumper — 7-Pole | 1492-C | JLJ5-7 | 20 | | _ | | _ | _ | | |
| Plug-in Center Jumper — 6-Pole | 1492-C | | 20 | | _ | | | _ | | |
| Plug-in Center Jumper — 5-Pole | 1492-C | | 20 | | | | | _ | | _ |
| Plug-in Center Jumper — 4-Pole | 1492-C | | 60 | | 192-CJLJ6 | | 60 | _ | | |
| Plug-in Center Jumper — 3-Pole | 1492-C | | 60 | | 192-CJLJ6 | | 60 | _ | | |
| Plug-in Center Jumper — 2-Pole Insulated Side Jumper — 24-Pole | 1492-C | | 60 50 | 14 | 192-CJLJ6 — |)-2 | 60 | _ | | - |
| Insulated Side Jumper — 24-Pole Insulated Side Jumper — 10-Pole | | | 50 | | | | | _ | | $\vdash \equiv$ |
| Screw Type Jumper Notching Tool | • | | 1 | | 1492-T1 | | 1 | 1492-T1 | | 1 |
| Other Accessories: Partition Plate | 1492-E | | 20 | | 1492-EBJ1 | 6 | 20 | 1492-FBJ16 | | 20 |
| Test Plug Socket | 1492-T | PS23 | 20 | 1 | 492-TPS2 | 3L | 50 | 1492-TP | S23L | 50 |
| Test Plug | 1492-1 | | 20 | | 1492-TP2 | | 20 | 1492-T | | 20 |
| Test Plug (Stackable) | 1492- | | 25 | | 1492-TPJ | | 25 | _ | | _ |
| Electrical Warning Plate | 1492-E | | 25 | | 492-EWP | | 25 | 1492-EV | /PJ8 | 50 |
| Marking Systems: | 1492-M5X12 | , | 5 | | M6X12 (12 | | 5 | 1492-MR8X12 | , , | 5 |
| Snap-in Marker Cards | 1492-M5X5 | (200/card) | 5 | 1492- | M6X5 (200 | 0/card) | 5 | 1492-M8X5 (| 160/card) | 5 |

 $[\]star$ Use of center jumpers may affect spacings, requiring derating of terminal blocks. See page 12-83 for details.





PanelView Plus 7 Standard Terminals

Catalog Numbers 2711P-T4W21D8S, 2711P-T4W22D8S, 2711P-T4W21D8S-B, 2711P-T4W22D8S-B, 2711P-T6C21D8S, 2711P-T6C22D8S, 2711P-T6C21D8S-B, 2711P-T6C22D8S-B, 2711P-T7C21D8S, 2711P-T7C22D8S, 2711P-T7C21D8S-B, 2711P-T7C22D8S-B, 2711P-T9W21D8S, 2711P-T9W22D8S, 2711P-T9W21D8S-B, 2711P-T9W22D8S-B, 2711P-T10C21D8S, 2711P-T10C22D8S, 2711P-T10C21D8S-B, 2711P-T10C22D8S-B, 2711P-T12W21D8S, 2711P-T12W22D8S, 2711P-T12W21D8S-B, 2711P-T12W22D8S-B, 2711P-T15C21D8S, 2711P-T15C22D8S, 2711P-T15C21D8S-B, 2711P-T15C22D8S-B

| Торіс | Page |
|------------------------------|------|
| Summary of Changes | 1 |
| Environmental Specifications | 2 |
| Certifications | 3 |
| Technical Specifications | 4 |
| Product Dimensions | 7 |
| HMI Software | 8 |
| Additional Resources | 8 |

Summary of Changes

| Торіс | Pages |
|--|-------|
| In the Technical Specifications table, added "Recommended" to the Replacement option in the Power Supply line. | 46 |

The PanelView[™] Plus 7 Standard terminals are operator interface devices. They monitor and control devices that are attached to ControlLogix® 5570 and CompactLogix™ 5370 controllers on an EtherNet/IP network. Animated graphic and text displays provide operators a view into the operating state of a machine or process. Operators interact with the control system by using touch screen input.

The PanelView Plus 7 Standard terminals include these features:

- Terminal functionality permits connection to 1 controller, up to 25 screens, and up to 200 alarms.
- FactoryTalk® View Machine Edition software provides a familiar environment for creating HMI applications.
- Windows CE operating system with desktop access for configuration and third-party applications.
- Ethernet communication that supports linear and star network topology.
- PDF viewer to access PDF files that are stored on the terminal.







- More screen options including 4-in., 6-in., 7-in., 9-in., 10-in., 12-in., and 15-in. terminals.
- Widescreen on three sizes, 4-in., 9-in., and 12-in. terminals.
- Greater screen resolution.
- Terminals are available with an Allen-Bradley brand marking, or with no marking for customers who want to put their own brand label on the terminal.
- Certifications including Class I, Div. 2; Class II, Div. 2; Class III; and ATEX and INMETRO Zones 2 and 22.

Environmental Specifications

Table 1 - Environmental Specifications - 2711P-T4W21D8S, 2711P-T4W22D8S, 2711P-T4W21D8S-B, 2711P-T4W22D8S-B, 2711P-T6C21D8S, 2711P-T6C22D8S-B, 2711P-T6C22D8S-B, 2711P-T7C22D8S-B, 2711P-T7C2D8S-B, 2711P-T7C2D8S-B, 2711P-T9W21D8S, 2711P-T9W22D8S-B, 2711P-T9W22D8S-B, 2711P-T10C21D8S, 2711P-T10C22D8S, 2711P-T10C22D8S, 2711P-T10C2D8S, 2711P-T12W21D8S-B, 2711P-T12W22D8S-B, 2711P-T12W22D8S-B, 2711P-T15C21D8S, 2711P-T15C22D8S, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C22D8S-B, 2711P-T15C2D8S-B,
| Attribute | Value |
|---|--|
| Temperature, operating | 055 °C (32131 °F) |
| Temperature, nonoperating | -25+70 °C (-13+158 °F) |
| Relative humidity | 595% without condensation |
| Heat dissipation | 4 in., 15 W = 51 BTU |
| | 6 in., 15 W = 51 BTU |
| | 7 in., 15 W = 51 BTU |
| | 9 in., 20 W = 68 BTU |
| | 10 in., 20 W= 68 BTU |
| | 12 in., 30 W= 102 BTU |
| | 15 in., 30 W= 102 BTU |
| Altitude, operating | 2000 M |
| Vibration | |
| 4.3-in., 5.7-in., 6.5-in., 9.0-in., 10.4-in., 12.1-in., and | 0.012 pk-pk, 1057 Hz |
| 15-in. | 2g peak at 57500 Hz |
| Shock, operating | 15 g at 11 ms |
| Shock, nonoperating | 30 g at 11 ms |
| Enclosure ratings | NEMA and UL Type 12, 13, 4X (indoor use only), also rated IP54 or IP66 as Classified by UL |

⁽¹⁾ Catalog numbers with a -B extension denote terminals that do not include the Allen-Bradley brand marking. Customers can put their own brand labels on these terminals.

Certifications

Table 2 Certifications - 2711P-T4W21D8S, 2711P-T4W22D8S, 2711P-T4W21D8S-B, 2711P-T4W22D8S-B, 2711P-T6C22D8S, 2711P-T6C22D8S, 2711P-T6C21D8S-B, 2711P-T7C22D8S-B, 2711P-T7C22D8S-B, 2711P-T7C2D8S-B, 2711P-T7C2D8S-B, 2711P-T9W21D8S, 2711P-T9W21D8S-B, 2711P-T9W22D8S-B, 2711P-T10C21D8S-B, 2711P-T10C21D8S-B, 2711P-T10C21D8S-B, 2711P-T10C2D8S-B, 2711P-T12W21D8S, 2711P-T12W21D8S, 2711P-T12W21D8S-B, 2711P-T15C2D8S, 2711P-T15C2D8S, 2711P-T15C2D8S, 2711P-T15C2D8S-B, 271

| Certification ⁽²⁾ | Value |
|------------------------------|---|
| cULus | cULus Listed Industrial Control Equipment for use in Hazardous Locations (E10314) per standards ANSI / ISA 12.12.01 and CSA C22.2 No. 213. rated: • Class I, Division 2, Groups A, B, C and D • Class II, Division 2, Groups F and G • Class III Enclosure type ratings per UL50 and CSA C22.2 No. 94.2-07. Enclosure ingress protection classified by UL per IEC 60529 |
| ATEX | European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-0:2009; EN 60079-11:2012; EN 60079-15:2010; and EN 60079-31:2009 • II 3 GD • Ex ic nA IIC T4 Gc • Ex tc IIIC T135 °C (275 °F) Dc IP66 • Tamb = 0 °C to +55 °C (32 °F to +131 °F) • DEMKO 14 ATEX 1302X |
| INMETRO | ABNT NBR IEC 60079-0:2008+Errata 1:2011; ABNT NBR IEC 60079-11:2009; ABNT NBR IEC 60079-15:2012; ABNT NBR IEC 60079-31:2011 Ex ic nA IIC T4 Gc Ex tc IIIC T135 °C (275 °F) Dc IP66 Tamb = 0 °C to +55 °C (32 °F to +131 °F) UL-BR 14.0716X |
| CE (EMC) | European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers |
| CE (LVD) | European Union 2006/95/EC Low Voltage Directive, compliant with: • EN 61131-2; Programmable Controllers |
| RCM | Australian Radio Communications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions |
| EAC | Certificate of compliance |
| RoHS | China RoHS, Turkey RoHS, European RoHS |
| KCC | Certificate of compliance |

⁽¹⁾ Catalog numbers with a -B extension denote terminals that do not include the Allen-Bradley brand marking. Customers can put their own brand labels on these terminals

⁽²⁾ When marked. See the Product Certification link on http://www.ab.com for declarations of conformity, certificates, and other certification details.

Technical Specifications

Table 3 - PanelView Plus 7 Standard 4-in and 6-in Terminals

| Attribute | 4-in. Touch 2711P-T4W21D8S, 2711P-T4W21D8S-B, 2711P-T4W22D8S, 2711P-T4W22D8S-B | 6-in. Touch 2711P-T6C21D8S, 2711P-T6C21D8S-B, 2711P-T6C22D8S, 2711P-T6C22D8S-B | | | |
|---|---|--|--|--|--|
| Operator input | Touch | Touch | | | |
| Display type | Color TFT LCD | Color TFT LCD | | | |
| Display size, diagonal | 4.3 in. widescreen | 5.7 in. | | | |
| Viewing area | 95 x 54 mm | 115 x 86 mm | | | |
| Display resolution | 480 x 272 WQVGA, 18-bit color graphics | 640 x 480 VGA, 18-bit color graphics | | | |
| Aspect ratio | 16:9 4:3 | | | | |
| Brightness, typical | 300 nits | | | | |
| Backlight life | 50,000 h life, min. at 40° C to half-brightness. Backli | ght is not replaceable | | | |
| Touch screen | Analog resistive Actuation rating: 1 million presses Operating force: 100 grams | | | | |
| Battery (real-time clock backup) | Accuracy: +/-2 minutes per month. Battery life: 4 years min at 25 °C (77 °F) Replacement: CR2032 lithium coin cell (Allen-Bradley part number 2711P-RY2032) | | | | |
| Memory System User | 512 MB RAM and 512 MB storage 80 MB nonvolatile storage for applications | | | | |
| Secure Digital (SD) card slot | One SD card slot for storing application files Replacement: Allen-Bradley part number 1784-SD1 (1 GB) and 1784-SD2 (2 GB) | | | | |
| USB ports Host Device | One USB 2.0 high-speed host port (type A) support removal flash drives for storage One high-speed 1.0 device port (type B) supports connection to host computer | | | | |
| Ethernet port Cat. Nos. with 21 Cat. Nos. with 22 | One 10/100Base-T, Auto MDI/MDI-X Ethernet port w Two 10/100Base-T, Auto MDI/MDI-X Ethernet ports s | | | | |
| Operating system | Windows CE includes FTP, VNC client server, ActiveX o | ontrols, PDF reader, third-party device support | | | |
| Software | FactoryTalk View Studio for Machine Edition, version 8.0 or later, FactoryTalk ViewPoint, version 2.6 or later | | | | |
| Electrical | | | | | |
| Input voltage, DC | 24V DC nom (1830V DC), nonisolated DC powers | ıpply | | | |
| Power consumption, DC | 35 W max (1.46A at 24V DC) | | | | |
| Power supply | DIN-rail power supply, AC-to-DC, 85265V AC, 4763 Hz Recommended Replacement: Allen-Bradley part number 2711P-RSACDIN | | | | |
| Mechanical | | | | | |
| Weight, approx | 0.44 kg (0.97 lb) | 0.70 kg (1.53 lb) | | | |
| Dimensions, HxWxD, approx. | 110 x 135 x 56.5 mm (4.33 x 5.31 x 2.22 in.) | 152 x 176 x 56.5 mm (5.98 x 6.93 x 2.22 in.) | | | |
| Cutout dimensions, HxW, approx. | 92 x 117 mm (3.62 in. x 4.61 in.) | 123 x 156 mm (4.84 x 6.14 in.) | | | |

Table 4 - PanelView Plus 7 Standard 7-in., 9-in., and 10-in. Terminals

| Attribute | 7-in. Touch 2711P-T7C21D8S, 2711P-T7C21D8S-B, 2711P-T7C22D8S, 2711P-T7C22D8S-B | 9-in. Touch 2711P-T9W21D8S, 2711P-T9W21D8S-B, 2711P-T9W22D8S, 2711P-T9W22D8S-B | 10-in. Touch 2711P-T10C21D85, 27D1P-T10C21D85-B, 2711P-T10C22D85, 2711P-T10C22D85-B | | | | |
|---|--|--|---|--|--|--|--|
| Operator input | Touch | Touch | Touch | | | | |
| Display type | Color TFT LCD | Color TFT LCD | Color TFT LCD | | | | |
| Display size, diagonal | 6.5 in. | 9 in. widescreen | 10.4 in. | | | | |
| Viewing area | 132 x 99 mm | 32 x 99 mm 196 x 118 mm | | | | | |
| Display resolution | 640 x 480 VGA, 18-bit color graphics | 800 x 480 WVGA, 18-bit color graphics | 800 x 600 SVGA, 18-bit color graphics | | | | |
| Aspect ratio | 4:3 | 5:3 | 4:3 | | | | |
| Brightness, typical | 300 nits | | | | | | |
| Backlight life | 50,000 hr life, min at 40° C (104 °F) to half-brightne | ss. Backlight is not replaceable. | | | | | |
| Touch screen | Analog resistive Actuation rating: 1 million presses Operating force: 100 grams | | | | | | |
| Battery (real-time clock backup) | Accuracy: ±2 minutes per month. Battery life: 4 years min at 25 °C (77 °F) Replacement: CR2032 lithium coin cell (Allen-Bradley part number 2711P-RY2032) | | | | | | |
| Memory System User | 512 MB RAM and 512 MB storage 80 MB nonvolatile storage for applications | | | | | | |
| Secure Digital (SD) card slot | One SD card slot for storing application files Replacement: Allen-Bradley part number 1784-SD1 | (1 GB) and 1784-SD2 (2 GB) | | | | | |
| USB ports Host Device | One USB 2.0 high-speed host port (type A) support r One high-speed 1.0 device port (type B) supports co | | | | | | |
| Ethernet port Cat. Nos. with 21 Cat. Nos. with 22 | One 10/100Base-T, Auto MDI/MDI-X Ethernet port w Two 10/100Base-T, Auto MDI/MDI-X Ethernet ports s | | | | | | |
| Operating system | Windows CE includes FTP, VNC client server, ActiveX | controls, PDF reader, third-party device support | | | | | |
| Software | FactoryTalk View Studio for Machine Edition, version | 8.0 or later, FactoryTalk ViewPoint, version 2.6 or late | r | | | | |
| Electrical | | | | | | | |
| nput voltage, DC | 24V DC nom (1830V DC), nonisolated DC powers | upply | | | | | |
| Power consumption, DC | 50 W max (2.1A at 24V DC) | | | | | | |
| Power supply | DIN-rail power supply, AC-to-DC, 85265V AC, 47. Recommended Replacement: Allen-Bradley part nu | | | | | | |
| Mechanical | | | | | | | |
| Weight, approx | 0.85 kg (1.86 lb) | 1.29 kg (2.84 lb) | 1.82 kg (4.0 lb) | | | | |
| Dimensions, HxWxD, approx | 170 x 212 x 56.5 mm (6.69 x 8.35 x 2.22 in.) | 190 x 280 x 56.5 mm (7.48 x 11.02 x 2.22 in.) | 252 x 297 x 56.5 mm (9.92 x 11.69 x 2.22 in.) | | | | |
| Cutout dimensions, HxW, approx. | 142 x 184 mm (5.59 x 7.24 in.) | 162 x 252 mm (6.38 x 9.92 in.) | 224 x 269 mm (8.82 x 10.59 in.) | | | | |

Table 5 - PanelView Plus 7 Standard 12-in. and 15-in. Terminals

| Attribute | 12-in. Touch 2711P-T12W21D8S, 2711P-T12W21D8S-B, 2711P-T12W22D8S, 2711P-T12W22D8S-B | 15-in. Touch 2711P-T15C21D8S, 2711P-T15C21D8S-B, 2711P-T15C22D8S, 2711P-T15C22D8S-B | | | |
|---|---|---|--|--|--|
| Operator Input | Touch | Touch | | | |
| Display type | Color TFT LCD | Color TFT LCD | | | |
| Display size, diagonal | 12.1 in. widescreen | 15-in. | | | |
| Viewing area | 261 x 163 mm | 304 x 228 mm | | | |
| Display resolution | 1280 x 800 WXGA, 18-bit color graphics | 1024 x 768 XGA, 18-bit color graphics | | | |
| Aspect ratio | 5:3 | 4:3 | | | |
| Brightness, typical | 300 nits | | | | |
| Backlight life | 50,000 h life, min. at 40° C to half-brightness. Backli | ght is not replaceable | | | |
| Touch screen | Analog resistive Actuation rating: 1 million presses Operating force: 100 grams | | | | |
| Battery (real-time clock backup) | Accuracy: +/-2 minutes per month Battery life: 4 years min at 25 °C (77 °F) Replacement: CR2032 lithium coin cell | | | | |
| Memory System User | 512 MB RAM and 512 MB storage 80 MB nonvolatile storage for applications | | | | |
| Secure Digital (SD) card slot | One SD card slot for storing application files Replacement: Allen-Bradley part number 1784-SD1 (1 GB) and 1784-SD2 (2 GB) | | | | |
| USB ports Host Device | One USB 2.0 high-speed host port (type A) support removal flash drives for storage One high-speed 1.0 device port (type B) supports connection to host computer | | | | |
| Ethernet port Cat. Nos. with 21 Cat. Nos. with 22 | One 10/100Base-T, Auto MDI/MDI-X Ethernet port with IEEE1588 support Two 10/100Base-T, Auto MDI/MDI-X Ethernet ports supporting star, linear, or DLR network topology | | | | |
| Operating system | Windows CE includes FTP, VNC client server, ActiveX o | ontrols, PDF reader, third-party device support | | | |
| Software | FactoryTalk View Studio for Machine Edition, version | 8.0 or later, FactoryTalk ViewPoint, version 2.6 or late | | | |
| Electrical | | | | | |
| Input voltage, DC | 24V DC nom (1830V DC), nonisolated DC power supply | | | | |
| Power consumption, DC | 50 W max (2.1A at 24V DC) | | | | |
| Power supply | DIN-rail power supply, AC-to-DC, 85265V AC, 4763 Hz Recommended Replacement: Allen-Bradley part number 2711P-RSACDIN | | | | |
| Mechanical | | | | | |
| Weight, approx. | 1.95 kg (4.29 lb) | 3.07 kg (6.75 lb) | | | |
| Dimensions, HxWxD, approx. | 240 x 340 x 56.5 mm (9.65 x 13.39 x 2.22 in.) | 318 x 381 x 56.5mm (12.52 x 15.00 x 2.22 in.) | | | |
| Cutout dimensions, HxW, approx. | 218 x 312 mm (8.58 x 12.28 in.) | 290 x 353 mm (11.42 x 13.90 in.) | | | |



Switch Mode Power Supply

VK-G (15/30/60/120/240/480-W Models)

Reliable and Easy Operation-Worldwide Power Supply Resistant in tough environments Easy and fast installation

The most compact class on the market

- Universal input for worldwide applications: 100 to 240 VAC (85 to 264 VAC)
- DC input can be available: 90 to 350 VDC
- Possible for 2 phases input usage.
- Wide operation temperature range: -40 to 70 °C
- Power Boost function at 120%
- · Safety standards:

UL508/60950-1, CSA C22.2 No. 107.1/60950-1 EN50178, EN60950-1.

Lloyd's standards, EN60204-1 PELV Safety of Power Transformers: EN61558-2-16

- ANSI/ISA 12.12.01 (excluding 480-W models)
- CSA C22.2 No.213 (excluding 480-W models)
- 15-W,30-W, and 60-W models conform to **UL Class 2 output Standards**

 EMS: EN 61204-3 EMI: EN61204-3 Class B

Five years Warranty















Refer to Safety Precautions for All Power Supplies and Safety Precautions on page 17.

S8VK-G

Model Number Structure

Model Number Legend

Note: Not all combinations are possible. Refer to List of Models in Ordering Information, below.

S8VK- 1 2 3

1. Input voltage types

G: Single phase

2. Power Ratings

015: 15 W 030: 30 W 060: 60 W

120: 120 W

240: 240 W 480: 480 W 3. Output voltage

05: 5 V

12: 12 V

24: 24 V

48: 48 V

Ordering Information

Note: For details on normal stock models, contact your nearest OMRON representative.

| Power ratings | Input voltage | Output Voltage | Output current | Boost Current | Model number |
|---------------|----------------|----------------|----------------|---------------|--------------|
| | | 5 V | 3 A | 3.6 A | S8VK-G01505 |
| 15 W | | 12 V | 1.2 A | 1.44 A | S8VK-G01512 |
| | | 24 V | 0.65 A | 0.78 A | S8VK-G01524 |
| | | 5 V | 5 A | 6 A | S8VK-G03005 |
| 30 W | | 12 V | 2.5 A | 3 A | S8VK-G03012 |
| | Single phase | 24 V | 1.3 A | 1.56 A | S8VK-G03024 |
| 20.14/ | 100 to 240 VAC | 12 V | 4.5 A | 5.4 A | S8VK-G06012 |
| 0 W | 90 to 350 VDC | 24 V | 2.5 A | 3 A | S8VK-G06024 |
| 20 W | | 24 V | 5 A | 6 A | S8VK-G12024 |
| 240 W | | 24 V | 10 A | 12 A | S8VK-G24024 |
| 240 W | | 48 V | 5 A | 6 A | S8VK-G24048 |
| 100.144 | | 24 V | 20 A | 24 A | S8VK-G48024 |
| 480 W | | 48 V | 10 A | 12 A | S8VK-G48048 |

Specifications

Ratings, Characteristics, and Functions

| | Power ratings | | 15 W | | | | 30 W | | | |
|---------------------|---|---------------------|---|-------------------------------|------------------|----------------------|----------------------|----------|--|--|
| Item | | Output voltage | 5 V | 12 V | 24 V | 5 V | 12 V | 24 V | | |
| Efficiency | (Typical) | 230 VAC input | 77% | * | 80% | 79% | 82% | 86% | | |
| | Voltage *1 | | 100 to 240 VAC, | , 90 to 350 VDC (| allowable range | : 85 to 264 VAC) : | * 6 | | | |
| | Frequency *1 | | 50/60 Hz (47 to | 450 Hz) | | | | | | |
| | 0 | 115 VAC input | 0.32 A | 0.3 A | 0.31 A | 0.5 A | 0.57 A | 0.58 A | | |
| | Current (Typical) | 230 VAC input | 0.2 A | 0.21 A | 0.2 A | 0.32 A | 0.37 A | 0.36 A | | |
| nput | Power factor (Typical) | 230 VAC input | 0.42 | | | 0.43 | 0.42 | 0.43 | | |
| | Harmonic current | emissions | Conforms to EN | 61000-3-2 | | | | | | |
| | Leakage current | 115 VAC input | 0.14 mA | | | 0.13 mA | | | | |
| | (Typical) | 230 VAC input | 0.25 mA | | | 0.24 mA | | | | |
| | Inrush current | 115 VAC input | 16 A | | | | | | | |
| | (Typical) *2 | 230 VAC input | 32 A | | | | | | | |
| | Voltage adjustme | nt range *3 | -10% to 15% (w | rith V.ADJ) (guara | nteed) | | | | | |
| | Ripple *4 | at 20 MHz (Typical) | 60 mV | 50 mV | 30 mV | 30 mV | 30 mV | 30 mV | | |
| | Input variation inf | luence | 0.5% max. (at 85 | 5 to 264 VAC inpu | ıt, 100% load) | | | | | |
| 0 | Load variation Inf (Rated Input volta | | 3.0% max. (5 V) | , 2.0% max. (12 \ | /), 1.5% max. (2 | 24 V), at 0% to 100 |)% load | | | |
| Output | Temperature varia | ation influence | 0.05%/°C max. | | | | | | | |
| | Start up time | 115 VAC input | 530 ms | 520 ms | 580 ms | 550 ms | 550 ms | 600 ms | | |
| | (Typical) *2 | 230 VAC input | 330 ms | 400 ms | 400 ms | 430 ms | 490 ms | 480 ms | | |
| | Hold time | 115 VAC input | 28 ms | 29 ms | 32 ms | 33 ms | 36 ms | 23 ms | | |
| | (Typical) *2 | 230 VAC input | 134 ms | 138 ms | 134 ms | 177 ms | 170 ms | 154 ms | | |
| | Overload protecti | on *2 | 121% to 160% of rated load current (130% typ value) | | | | | | | |
| | Overvoltage prote | ection *2 | Yes * 5 | | | | | | | |
| Additional unctions | Power Boost | | 120% of rated current (Refer to Engineering Data) | | | | | | | |
| u | Parallel operation | | Yes (Refer to Engineering Data) | | | | | | | |
| | Series operation | | Possible for up to two Power Supplies (with external diode) | | | | | | | |
| | Ambient operating | g temperature | -40 to 70°C (Refer to Engineering Data) | | | | | | | |
| | Storage temperate | ure | -40 to 85°C | | | | | | | |
| | Ambient operating | g humidity | 0% to 95% (Stor | rage humidity: 0% | to 95%) | | | | | |
| | Dielectric strengtl (detection current | | 3.0 kVAC for 1 min. (between all inputs and outputs) 2.0 kVAC for 1 min. (between all inputs and PE terminal) 1.0 kVAC for 1 min. (between all outputs and PE terminal) | | | | | | | |
| | Insulation resista | nce | 100 MΩ min. (between all outputs and all inputs/ PE terminals) at 500 VDC | | | | | | | |
| | Vibratias | | 10 to 55 Hz, 0.375-mm single amplitude for 2 h each in X, Y, and Z directions | | | | | | | |
| | Vibration resistan | ce | 10 to 150 Hz, 0.3 | 35-mm single am | olitude (5 G ma | x.) for 80 min. eac | h in X, Y, and Z dir | rections | | |
| | Shock resistance | | 150 m/s ² , 3 time | s each in ±X, ±Y, | and ±Z direction | ins | | | | |
| | Output indication | | Yes (color: greei | n), lighting from 8 | 0% to 90% or m | nore of rated voltag | је | | | |
| | ЕМІ | Conducted Emission | Conforms to EN | 61204-3 EN5501 | 1 Class B and b | ased on FCC Clas | ss A | | | |
| N41 | E1VII | Radiated Emission | Conforms to EN | 61204-3 EN5501 | 1 Class B | | | | | |
| Others | EMS | | | 61204-3 high sev | | | | | | |
| | Approved Standards | | UL Listed: UL508 (Listing, Class2 Output: Per UL1310) UL UR: UL60950-1 (Recognition) cUL: CSA C22.2 No.107.1 (Class2 Output: Per CSA C22.2 No.223) cUR: CSA C22.2 No.60950-1 EN/VDE: EN50178, EN60950-1 Lloyd's standards *7 ANSI/ISA 12.12.01 CSA C22.2 No.213 | | | | | | | |
| | Fulfilled Standard | | Safety of Power EN50274 for Ter | Transformers (EN rminal parts | | (EN60204-1, EN50 | 0178), | | | |
| | Degree of protect | ion | IP20 by EN / IEC | | | | | | | |
| | SEMI | | | 7-0706 (200 to 24 | 0 VAC) | | | | | |
| | Weight | | 150 g | | | 195 g | | | | |

- ***1.** Do not use an inverter output for the Power Supply. Inverters with an output frequency of 50/60 Hz are available, but the rise in the internal temperature of the Power Supply may result in ignition or burning.
- *2. For a cold start at 25°C. Refer to Engineering Data on page 11 for details.
- *3. If the output voltage adjuster (V. ADJ) is turned, the voltage will increase by more than +15% of the voltage adjustment range. When adjusting the output voltage, confirm the actual output voltage from the Power Supply and be sure that the load is not damaged.
- *4. A characteristic when the ambient operating temperature is between -25 to 70°C.
- ***5.** To reset the protection, turn OFF the input power for three minutes or longer and then turn it back ON.

- *6. Safety Standards for a DC Input
 - The following safety standards apply to a DC input: UL 60950-1, cUR (CSA C22.2 No. 60950-1), EN 50178, EN 60950-1, and

For a DC input, safety is ensured by an external fuse. Select an external fuse the meets the following conditions. S8VK-G015□□: 350 VDC min, 3 A

S8VK-G030□□: 350 VDC min, 4 A

*7. Clamp filter "ZCAT2035-0930" manufactured by TDK Corporation. or equivalent should be installed in the cable connected to the input - output terminals of S8VK-G series. Noise filter "FN2080-10-06" manufactured by SCHAFFNER Corporation. or equivalent should be connected to the Input terminals of S8VK-G series.

| | | Power ratings | 60 | W | 120 W | | | |
|--------------|---|---------------------|---|---|----------|--|--|--|
| Item | | Output voltage | 12 V | 24 V | 24 V | | | |
| Efficiency (| (Typical) | 230 VAC input | 85% | 88% | 89% | | | |
| _ | Voltage *1 | - | 100 to 240 VAC, 90 to 350 VDC (a | allowable range: 85 to 264 VAC) *6 | | | | |
| | Frequency *1 | | 50/60 Hz (47 to 450 Hz) | 50/60 Hz (47 to 63 Hz) | | | | |
| | | 115 VAC input | 1.0 A | 1.1 A | 1.3 A | | | |
| | Current (Typical) | 230 VAC input | 0.6 A | .6 A 0.7 A | | | | |
| Input | Power factor (Typical) | 230 VAC input | 0.46 | 0.45 | 0.94 | | | |
| | Harmonic current | emissions | Conforms to EN61000-3-2 | | | | | |
| | Leakage current | 115 VAC input | 0.16 mA | | 0.24 mA | | | |
| | (Typical) | 230 VAC input | 0.30 mA | | 0.38 mA | | | |
| | Inrush current | 115 VAC input | 16 A | | <u> </u> | | | |
| | (Typical) *2 | 230 VAC input | 32 A | | | | | |
| | Voltage adjustmen | nt range *3 | -10% to 15% (with V.ADJ) (guarar | nteed) | | | | |
| | Ripple *4 | at 20 MHz (Typical) | 150 mV | 50 mV | 150 mV | | | |
| | Input variation inf | | 0.5% max. (at 85 to 264 VAC inpu | t, 100% load) | | | | |
| | Load variation Inf (Rated Input volta | | 2.0% max. (12 V), 1.5% max. (24 V | V), at 0% to 100% load | | | | |
| Output | Temperature varia | | 0.05%/°C max. | | | | | |
| | Start up time | 115 VAC input | 570 ms | 650 ms | 790 ms | | | |
| | (Typical) *2 | 230 VAC input | 430 ms | 500 ms | 750 ms | | | |
| | Hold time | 115 VAC input | 26 ms | 25 ms | 42 ms | | | |
| | (Typical) *2 | 230 VAC input | 139 ms | 129 ms | 42 ms | | | |
| | Overload protection | on *2 | 121% to 160% of rated load current, (130% typ value) 121% to 160% of rated load (125% typ value) | | | | | |
| Additional | Overvoltage prote | ection *2 | Yes *5 | | | | | |
| functions | Power Boost | | 120% of rated current (Refer to Engineering Data) | | | | | |
| | Parallel operation | | Yes (Refer to Engineering Data) | | | | | |
| | Series operation | | Possible for up to two Power Supplies (with external diode) | | | | | |
| | Ambient operating | g temperature | -40 to 70°C (Refer to Engineering Data) | | | | | |
| | Storage temperati | ure | -40 to 85°C | | | | | |
| | Ambient operating | g humidity | 0% to 95% (Storage humidity: 0% to 95%) | | | | | |
| | Dielectric strength (detection current | | 3.0 kVAC for 1 min. (between all inputs and outputs) 2.0 kVAC for 1 min. (between all inputs and PE terminal) 1.0 kVAC for 1 min. (between all outputs and PE terminal) | | | | | |
| | Insulation resistar | nce | 100 M Ω min. (between all outputs and all inputs/ PE terminals) at 500 VDC | | | | | |
| | VIII | | ` ' | litude for 2 h each in X, Y, and Z di | | | | |
| | Vibration resistan | ce | 10 to 150 Hz, 0.35-mm single amplitude (5 G max.) for 80 min. each in X, Y, and Z directions | | | | | |
| | Shock resistance | | 150 m/s ² , 3 times each in ±X, ±Y, | and ±Z directions | | | | |
| | Output indication | | Yes (color: green), lighting from 80% to 90% or more of rated voltage | | | | | |
| | EMI | Conducted Emission | Conforms to EN61204-3 EN55011 | Class B and based on FCC Class | A | | | |
| | EMI | Radiated Emission | Conforms to EN61204-3 EN55011 | Class B | | | | |
| Others | EMS | | Conforms to EN61204-3 high seve | erity levels | | | | |
| | Approved Standards | | UL Listed: UL508 (Listing, For 60 W only Class2 Output: Per UL1310) UL UR: UL60950-1 (Recognition) cUL: CSA C22.2 No.107.1 (For 60 W only Class2 Output: Per CSA C22.2 No.223) cUR: CSA C22.2 No.60950-1 EN/VDE: EN50178, EN60950-1 Lloyd's standards *7 ANSI/ISA 12.12.01 CSA C22.2 No.213 | | | | | |
| | Fulfilled Standard | İs | SELV (EN60950-1/EN50178/UL60 Safety of Power Transformers (EN EN50274 for Terminal parts | 950-1), PELV(EN60204-1, EN5017 61558-2-16) | 78), | | | |
| | Degree of protecti | ion | IP20 by EN / IEC60529 | | | | | |
| | SEMI | | Conforms to F47-0706 (200 to 240 | VAC) | | | | |
| | Weight | | 260 g | | 620 g | | | |

- *1. Do not use an inverter output for the Power Supply. Inverters with an output frequency of 50/60 Hz are available, but the rise in the internal temperature of the Power Supply may result in ignition or burning.
- *2. For a cold start at 25°C. Refer to Engineering Data on page 11 for details.
- *3. If the output voltage adjuster (V. ADJ) is turned, the voltage will increase by more than +15% of the voltage adjustment range. When adjusting the output voltage, confirm the actual output voltage from the Power Supply and be sure that the load is not damaged.
- ***4.** A characteristic when the ambient operating temperature is between –25 to 70°C.
- ***5.** To reset the protection, turn OFF the input power for three minutes or longer and then turn it back ON.

- *6. Safety Standards for a DC Input
 - The following safety standards apply to a DC input: UL 60950-1, cUR (CSA C22.2 No. 60950-1), EN 50178, EN 60950-1, and Lloyd's.
- For a DC input, safety is ensured by an external fuse. Select an external fuse the meets the following conditions. S8VK-G060□□: 350 VDC min, 6 A S8VK-G12024: 350 VDC min, 5 A *7. Clamp filter "ZCAT2035-0930" manufactured by TDK
- *7. Clamp filter "ZCAT2035-0930" manufactured by TDK Corporation. or equivalent should be installed in the cable connected to the input - output terminals of S8VK-G series. Noise filter "FN2080-10-06" manufactured by SCHAFFNER Corporation. or equivalent should be connected to the Input terminals of S8VK-G series.

| | | Power ratings | 24 | 0 W | 480 | W | |
|--------------|---|---------------------|--|--|------------------------------|---------------------------|--|
| Item | | Output voltage | 24 V | 48 V | 24 V | 48 V | |
| Efficiency (| (Typical) | 230 VAC input | 92% | 10 (| 93% | 10 1 | |
| | Voltage *1 | | | 0 VDC (allowable range: 8 | | | |
| | Frequency *1 | | 50/60 Hz (47 to 63 Hz) | o voo (anomabio iango, o | | | |
| | | 115 VAC input | 2.4 A | | 4.7 A | | |
| | Current (Typical) | 230 VAC input | 1.3 A | | 2.3 A | | |
| | Power factor | • | | | | | |
| Input | (Typical) 230 VAC input | | 0.9 | | 0.97 | | |
| | Harmonic current | emissions | Conforms to EN61000-3-2 | 2 | | | |
| | Leakage current | 115 VAC input | 0.23 mA | | 0.3 mA | | |
| (Typical) | | 230 VAC input | 0.33 mA 0.49 mA | | | | |
| | Inrush current | 115 VAC input | 16 A | | | | |
| | (Typical) *2 | 230 VAC input | 32 A | | | | |
| | Voltage adjustmen | | -10% to 15% (with V.AD. | , , , | T | | |
| | Ripple *4 | at 20 MHz (Typical) | 180 mV | 350 mV | 230 mV | 470 mV | |
| | Input variation inf | | 0.5% max. (at 85 to 264 \ | /AC input, 100% load) | | | |
| Output | Load variation Infl (Rated Input volta | | 1.5% max. (24 V, 48 V), a | at 0% to 100% load | | | |
| Output | Temperature varia | | 0.05%/°C max. | 1 | + | | |
| | Start up time | 115 VAC input | 250 ms | 290 ms | 380 ms | | |
| | (Typical) *2 | 230 VAC input | 250 ms | 290 ms | 260 ms | | |
| | Hold time | 115 VAC input | 44 ms | 43 ms | 40 ms | | |
| | (Typical) *2 | 230 VAC input | 44 ms | | 50 ms | | |
| | Overload protection | | 121% to 160% of rated load current (130% typ value) Yes *5 | | | | |
| Additional | Overvoltage prote | ction *2 | 1.22.12 | | | | |
| functions | Power Boost | | 120% of rated current (Refer to Engineering Data) | | | | |
| | Parallel operation | | Yes (Refer to Engineering | · · · · · · · · · · · · · · · · · · · | 1 4:- 4-) | | |
| | Series operation | . tammavatuus | Possible for up to two Power Supplies (with external diode) -40 to 70°C (Refer to Engineering Data) | | | | |
| | Ambient operating | | -40 to 85°C | gineering Data) | | | |
| | Storage temperating Ambient operating | | 0% to 95% (Storage humidity: 0% to 95%) | | | | |
| | Dielectric strength (detection current | 1 | 3.0 kVAC for 1 min. (between all inputs and PE terminal) 1.0 kVAC for 1 min. (between all outputs and PE terminal) 1.0 kVAC for 1 min. (between all outputs and PE terminal) | | | | |
| | Insulation resistar | nce | 100 MΩ min. (between al | l outputs and all inputs/ PE | terminals) at 500 VDC | | |
| | | | 10 to 55 Hz, 0.375-mm si | ngle amplitude for 2 h eac | h in X, Y, and Z directions | | |
| | Vibration resistan | ce | 10 to 150 Hz, 0.35-mm sin and Z directions | ngle amplitude (5 G max fo | or 240 W, 3 G max for 480 W) | for 80 min. each in X, Y, | |
| | Shock resistance | | 150 m/s ² , 3 times each in | $\pm X$, $\pm Y$, and $\pm Z$ directions | | | |
| | Output indication | | Yes (color: green), lighting from 80% to 90% or more of rated voltage | | | | |
| | ЕМІ | Conducted Emission | | EN55011 Class B and bas | ed on FCC Class A | | |
| Others | | Radiated Emission | Conforms to EN61204-3 I | | | | |
| | EMS | | Conforms to EN61204-3 high severity levels | | | | |
| | Approved Standards | | UL Listed: UL508 (Listing) UL UR: UL60950-1 (Recognition) cUL: CSA C22.2 No.107.1 cUR: CSA C22.2 No.60950-1 EN/VDE: EN50178, EN60950-1 Lloyd's standards *7 ANSI/ISA 12.12.01 (excluding 480-W models) CSA C22.2 No.213 (excluding 480-W models) | | | | |
| | Fulfilled Standard | s | SELV (EN60950-1/EN50178/UL60950-1), PELV(EN60204-1, EN50178), Safety of Power Transformers (EN61558-2-16) EN50274 for Terminal parts | | | | |
| | Degree of protecti | on | IP20 by EN / IEC60529 | | | | |
| | SEMI | | Conforms to F47-0706 (200 to 240 VAC) | | | | |
| | Weight | | 900 g 1,500 g | | | | |

- *1. Do not use an inverter output for the Power Supply. Inverters with an output frequency of 50/60 Hz are available, but the rise in the internal temperature of the Power Supply may result in ignition or burning.
- *2. For a cold start at 25°C. Refer to Engineering Data on page 11 for details.
- *3. If the output voltage adjuster (V. ADJ) is turned, the voltage will increase by more than +15% of the voltage adjustment range. When adjusting the output voltage, confirm the actual output voltage from the Power Supply and be sure that the load is not damaged.
- ***4.** A characteristic when the ambient operating temperature is between –25 to 70°C.
- ***5.** To reset the protection, turn OFF the input power for three minutes or longer and then turn it back ON.

- *6. Safety Standards for a DC Input
 - The following safety standards apply to a DC input: UL 60950-1, cUR (CSA C22.2 No. 60950-1), EN 50178, EN 60950-1, and Lloyd's.

For a DC input, safety is ensured by an external fuse. Select an external fuse the meets the following conditions. S8VK-G240 : 350 VDC min, 8 A S8VK-G480 : 350 VDC min, 12 A

***7.** Shipping Standards

Clamp filter "ZCAT2035-0930" manufactured by TDK Corporation. or equivalent should be installed in the cable connected to the input - output terminals of S8VK-G series. Noise filter "FN2080-10-06" manufactured by SCHAFFNER Corporation. or equivalent should be connected to the Input terminals of S8VK-G series.

POWR-GARD® Blocks & Holders LPSC / LPSM POWR-SAFE FUSE HOLDERS

600 V





Littelfuse POWR-SAFE dead front holders provide optimum protection to personnel for Class CC and midget-style fuses.

Features/Benefits

- Indicating and non-indicating options available
- 1-, 2-, 3- and 4-pole configurations
- Easy installation and fuse removal with no additional pullers or tools required
- 35 mm DIN-rail mountable
- Ventilated design for cooler operation

Ordering Information

| INDI | CATING | NON-IN | DICATING | | | |
|-------------------|--------------------|-------------------|--------------------|-----------|-------|--|
| CATALOG NUMBER | ORDERING NUMBER | CATALOG NUMBER | ORDERING NUMBER | FUSE TYPE | POLES | |
| LPSC001ID | LPSC0001ZXID | LPSC001 | LPSC0001Z | Class CC | 1 | |
| LPSC002ID | LPSC0002ZXID | LPSC002 | LPSC0002Z | Class CC | 2 | |
| LPSC003ID | LPSC0003ZXID | LPSC003 | LPSC0003Z | Class CC | 3 | |
| LPSC004ID | LPSC0004ZXID | LPSC004 | LPSC0004Z | Class CC | 4 | |
| LPSM001ID | LPSM0001ZXID | LPSM001 | LPSM0001Z | Midget | 1 | |
| LPSM002ID | LPSM0002ZXID | LPSM002 | LPSM0002Z | Midget | 2 | |
| LPSM003ID | LPSM0003ZXID | LPSM003 | LPSM0003Z | Midget | 3 | |
| LPSM004ID | LPSM0004ZXID | LPSM004 | LPSM0004Z | Midget | 4 | |

Mulit-Pole Assembly Kit

Ordering No. CYHP0001Z-KIT

(Kit contains 20 connector pincers & 10 handle pins)



Specifications

Voltage Rating Ampere Rating Interrupting Rating

Terminal Type
Suggested Torque
Wire Range
Housing
Fuse Clip
Zinc Plated Steel
Terminal Screws
Operating Temperature
Flammability Rating
Approvals

600 V ac/dc 30 A 200 kA (Class CC) 100 kA (Midget) Pressure plate 17.7 in-lbs #8-#14 CU Thermoplastic Silver plated copper Zinc plated steel Nickel plated steel -50 °C to +125 °C UL 94 V-0

UL Listed (LPSC File: E14721) UL Recognized (LPSM File: E14721) CSA Certified (LPSC/LPSM File: LR7316) RoHS Compliant, Lead (Pb) Free

Environmental

Download CAD drawings and other technical information:

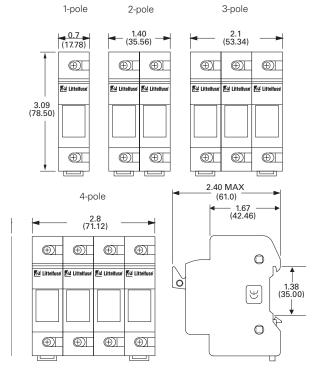
Littelfuse.com/lpsc Littelfuse.com/lpsm

Web Resources

Recommended Fuses

Class CC Midget-style (10 x 38 mm)

Dimensions Inches (mm)



Disclaimer Notice — Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littleffuse products are not designed for, and may not be used in, all applications. Read complete Disclaimer Notice at www.littleffuse.com/product-disclaimer.

ATDR Time-delay/Class CC

The best protection for today's small motors

Amp-Trap 2000® ATDR small-dimension fuses can provide IEC Type 2 No Damage protection to your facility's increasingly sensitive branch circuit components and small motors - minimizing the risk of fault-related damage. ATDR Class CC fuses deliver the best time-delay characteristics in their class with excellent cycling ability for small motor loads.

Features/Benefits:

- · Time-delay for motor starting inrush currents without nuisance opening
- · Highly current-limiting for low peak let-thru current
- Improved cycling ability for frequent motor starts/stops without nuisance fuse opening
- Rejection-style design prevents replacement errors (when used with recommended fuse blocks)
- · High-visibility orange label ensures instant brand recognition, simplifies replacement
- Metal-embossed date and catalog number for traceability and lasting identification
- · Fiberglass body provides dimensional stability in harsh industrial settings
- · High-grade silica filler ensures fast arc quenching and optimum current-limitation

Highlights:

- Time-delay
- Best choice for small motor protection
- · Highly current-limiting
- AC & DC rated

Applications:

- Small motors
- Contactors
- · Lighting, heating & general loads
- Branch circuit protection

Note: See motor fuse applications tables on page P7



Ratings:

Volts: 600VAC

: 300VDC Amps : 1/4 to 30A

> : 200kA I.R. AC : 100kA I.R. DC

Approvals:

- UL listed to standard 248-4 File E2137
- CSA certified to standard C22.2 No. 248.4
- DC listed to UL standard 248







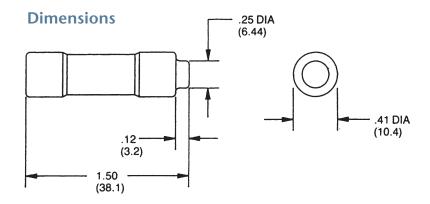
ATDR Time-delay/Class CC

Catalog Numbers (amps)

| ATDR1/4 | ATDR1-1/2 | ATDR3 | ATDR6 | ATDR12 |
|------------|------------|------------|-----------|------------|
| ATDR1/2 | ATDR1-6/10 | ATDR3-2/10 | ATDR6-1/4 | ATDR15 |
| ATDR8/10 | ATDR1-8/10 | ATDR3-1/2 | ATDR7 | ATDR17-1/2 |
| ATDR1 | ATDR2 | ATDR4 | ATDR7-1/2 | ATDR20 |
| ATDR1-1/8 | ATDR2-1/4 | ATDR4-1/2 | ATDR8 | ATDR25 |
| ATDR1-1/4 | ATDR2-1/2 | ATDR5 | ATDR9 | ATDR30 |
| ATDR1-4/10 | ATDR2-8/10 | ATDR5-6/10 | ATDR10 | |

Recommended Fuse Blocks for Class CC Fuses

| | Catalog Numbers | | | | |
|-----------------------|---|---|--|----------------------------|--|
| Number of Poles | UltraSafe™ Indicating Fuse Holder | Screw Connector w/ Double Quick Connects | Pressure Plate Connector w/ Double Quick Connects | Copper Box Connector | |
| ADDER | | 30310R | 30320R | 30350R | |
| 1 | USCC1I | 30311R | 30321R | 30351R | |
| 2 | USCC2I | 30312R | 30322R | 30352R | |
| 3 | USCC3I | 30313R | 30323R | 30353R | |
| 3 | USFMCCI | | | | |







Your Enclosure Source ®

Saginaw Control and Engineering 95 Midland Road Saginaw, MI 48638-5770 (800) 234-6871 - Fax: (989) 799-4524 SCE@SaginawControl.com

SCE-20EL2008SSLP

Product Specifications:



Part Number: SCE-20EL2008SSLP Description: S.S. EL Enclosure Height: 20.00" Width: 20.00" Depth: 8.00" Price Code: S5 List Price: \$853.79 Catalog Page: 274 Est. Ship Weight: 37.00 lbs

Construction

- 0.075 In. stainless steel Type 304. Seams continuously welded and ground smooth. Flange trough collar around all sides of door opening.

- Pour in place oil & water resistant gasket Collar studs provided for mounting optional panels.
- Stainless steel concealed hinges
- Removable and interchangeable doors.
- Black quarter turn latches.
- Latche's are opened or closed with a screwdriver (optional tamper-

- Latches are opened or closed with a screwdriver (optional tamper-resistant inserts are available).
 Mounting holes in back of enclosure.
 Mounting hardware, sealing washer and hole plug included.
 Removable print pocket furnished if height and width of enclosure is greater than 12 inches.
 Ground studs on door and body.

Application

Designed to house electrical and electronic controls, instruments and components in areas which may be regularly hosed down or are in very wet conditions. Provides protection from dust, dirt, oil, and water. For outdoor applicationS a drip shield is recommended.

Optional mounting feet available. Door hardware available.

#4 brushed finish on all exterior surfaces. Optional sub-panels are powder coated white.

- Industry Standards (IS6)

 NEMA Type 3R, 4, 4X, 12 and Type 13
- UL Listed Type 3R, 4, 4X and 12
- CSA Type 4, 4X and 12
- IEC 60529 Φ
- IP 66

Notes

Special Instructions apply for IS3, IS4 and IS6 to maintain the environmental rating of Type 3R for these parts. Instructions are located on the enclosure door. Drip shield is required on IS3, drip shield is recommended on IS4 and IS6. Drain holes are required on all.

Optional Accessories SCE-20P20 Subpanel, Flat SCE-20P20GALV Subpanel, Flat Galvannealed SCE-20P20GALV Subpanel, Flat Galvannealed SCE-BVK Breather Vent SCE-DF20EL20LP Panel, Dead Front (Wall Mount) SCE-DS20SS Shield, S.S. Drip SCE-ELFM20HSS S.S. EL Flush Mount Frame SCE-ELFM20WSS S.S. EL Flush Mount Frame SCE-ELMFK4 Foot Kit, EL Mounting (4pc.) SCE-ELSP3 KIT, Swing-Out Panel (20 High & Up)

Similar Part Numbers

ilar Part Numbers
SCE-12EL1206SSLPS.S. EL Enclosure
SCE-12EL2406SSLPS.S. EL Enclosure
SCE-16EL1206SSLPS.S. EL Enclosure
SCE-16EL1206SSLPS.S. EL Enclosure
SCE-16EL1208SSLPS.S. EL Enclosure
SCE-16EL1608SSLPS.S. EL Enclosure
SCE-16EL2008SSLPS.S. EL Enclosure
SCE-20EL1606SSLPS.S. EL Enclosure
SCE-20EL1608SSLPS.S. EL Enclosure
SCE-20EL1608SSLPS.S. EL Enclosure
SCE-20EL1608SSLPS.S. EL Enclosure

- Installation Information

 Mounting Foot Kit for Enviroline Enclosures

 EL Flush Mount Frame
- **Drip Shield Kit Assembly**
- Sealing Washer Specifications Dead Front Wall Mount Installation Instructions
- Swing Panel Assembly for Enviroline Enclosures
 Dead Front Wall Mount < 20 In Height Installation Instructions
 Swing Panel ELSP for Encl. Height > 16
 Swing Panel ELSP for Encl. Height <= 16

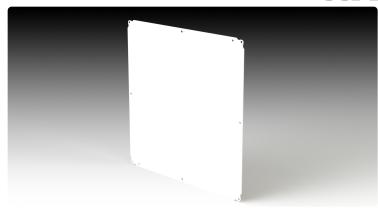
- Service Parts Wall Mount Enclosures



Your Enclosure Source®

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SCE-20P20



Finish Powder Coated White.

Industry Standards - (IS17) NEMA Not Applicable

- UL Not Applicable
- CSA N/A

Product Specifications:

Part Number: SCE-20P20 Part Number: SCE-20P20 Description: Subpanel, Flat Height: 17.00" Width: 17.00" Depth: 0.10" Price Code: P3 List Price: \$35.44 Catalog Page: 418 Est. Ship Weight: 10.00 lbs Edge Flanges: Flat Configuration: B

Similar Part Numbers
SCE-10P10Subpanel, Flat
SCE-10P6Subpanel, Flat
SCE-10P8Subpanel, Flat
SCE-12DLP12Subpanel, Flat
SCE-12P10Subpanel, Flat SCE-12P12Subpanel, Flat SCE-12P12CSubpanel, Flat SCE-12P16CSubpanel, Flat SCE-12P20CSubpanel, Flat SCE-12P24Subpanel, Bent

Installation Information

❖ Sub-Plate Layout & Grounding for 3/8-16

New TWND Series – Full Size NEMA Pushbuttons



New! TWND Series: Heavy duty switches built to last Key features:

- Variety of button sizes up to 2 9/16" (65mm)
- Rugged construction includes chrome plated zinc locking ring die cast zinc mounting thread
- LED illumination
- Transformer or full voltage
- Slow make, double break wiping contacts
- Modular construction for maximum flexibility
- Available assembled or as sub-components
- UL Type 4X, 13 and IP65 watertight/oiltight panel

The rugged series of TWND switches offers both variety and durability in an attractive design.

With button sizes up to 2 9/16" (65mm), chrome plated zinc locking rings, die cast zinc mounting threads, steel anti-rotation rings, and self cleaning contacts, the TWNDs are here to stay.

The TWND series also offers LED illumination in full voltage and transformer models.

Regardless of your switching needs, the NEW TWND series provides the kind of long lasting, industrial strength quality you've come to expect from IDEC.











Specifications

746

| Conforming to Standards | EN60947-5-1, UL508, CSA C22-2 No.14 |
|--|---|
| Approvals | CSA: pushbuttons and selector switches: A600 pilot lights and illuminated pushbuttons, direct supply pilot lights and illuminated pushbuttons with integral transformer (100/110, 115, 120, 200/220, 230, 240, 380, 400/440, 480V) UL: pushbuttons and selector switches: A600 pilot lights and illuminated pushbuttons, direct supply pilot lights and illuminated pushbuttons with integral transformer (100/110, 115, 120, 200/220, 230, 240, 380, 400/440, 480V) TÜV: pushbuttons and selector switches: A600 pilot lights and illuminated pushbuttons, direct supply pilot lights and illuminated pushbuttons with integral transformer (100/110, 115, 120, 200/220, 230, 240, 380, 400/440, 480V) |
| Operating Temperature | Operation: -25 to $+50$ °C (illuminated versions) $-25 \sim +70$ C non-illuminated Storage: -40 to $+80$ °C (without freezing) C-> °C |
| Vibration Resistance | 5 to 55Hz, 98m/sec ² (10g) conforming to IEC60068-2-6 |
| Shock Resistance | 980m/sec ² (100g) conforming to IEC60068-2-27 |
| Electric Shock Protection | Class 2 conforming to IEC60664-1 |
| Degree of Protection | IP65 (from front of the panel) (conforming to IEC60529) UL Type 1, 2, 3, 3R, 3S, 4, 4X, 5, 12, 13 (conforming to NEMA ICS6-110) |
| Mechanical Life | Momentary pushbuttons: 5,000,000 (1800 operations per hour) All other switches: 500,000 |
| Pollution Degree (conforming to IEC60947-1) | 3 |

Mechanical-Electrical Specifications

| Rated Operational Characteristics | AC-15: A600 | | | | | | | |
|---|---|--|--|-----------------|---------------------------------------|----------------|--|--|
| Rated Insulation Voltage | 600V | | | | | | | |
| Rated Impulse Withstanding Voltage øDielectric Strength | Between live and dead meta 2.5kV AC, 1 minute | etween live and dead metal parts 5kV AC, 1 minute | | | | | | |
| Rated Thermal Current | 10 Amp | | | | | | | |
| Minimum Switching Capacity | 5 mA at 3V AC/DC (applicab | le range may var | y with operating conditions and load | types) | | | | |
| Contact Operation | Slow break NC or NO | ow break NC or NO | | | | | | |
| Operating Force | | ush and extended pushbuttons—with 1NO or 1NC contact: 6.2±2N (momentary), 9.0±1.5N dditional contacts—1NO or 1NC: +3.0N | | | | | | |
| | Unit | | Wire | Number of Wires | Recommended Tightening Torque (Nm) | Terminal Screw | | |
| | | | Crimping Terminal | 2 | 1.0 to 1.3 | M3.5 | | |
| | | Solid Wire | ø0.5 to 1.6 mm (AWG14 to 22) | 2 | 1.0 to 1.3 | | | |
| D 1 1 7 1 7 | HW-U Contact Block | Soliu Wile | ø1.7 to 2.0 mm (AWG12) | 1 | 1.2 to 1.3 | | | |
| Recommended Terminal Torque | | Stranded Wire | 0.3 to 2.0 mm ² (AWG14 to 22) | 2 | 1.0 to 1.3 | | | |
| | | Stranded wire | 2.1 to 3.5 mm ² (AWG12) | 1 | 1.2 to 1.3 | | | |
| | | Crimping Terminal | | | | | | |
| | Illuminated Unit (*1) | Solid Wire | ø0.5 to 1.6 mm (AWG14 to 22) | 2 | 1.0 to 1.3 | M3.5 | | |
| | | Stranded Wire | 0.3 to 2.0 mm (AWG14 to 22) | | | | | |
| | | | Crimping Terminal | | 0.6 to 1.0 (M3.0) | | | |
| Applicable Wire Size | Pilot Light | Solid Wire | ø0.5 to 1.6 mm (AWG14 to 22) | 2 | | | | |
| | | Stranded Wire | ø0.3 to 2.0 mm (AWG14 to 22) | | 1.0 to 1.3 (M3.5) | | | |
| | * refers to the lamp terminals of the illuminated push buttons and selector switches. | | | | | | | |
| Contact Resistance | Initial contact resistance of | 50mΩ or less | | | | | | |
| Contact Gap | 4mm (NO and NC) 2mm (NO-EM and NC-LB) | | | | | | | |
| LED Ratings | LEDs: 6V: 8mA, 12V: 11mA, | 24V: 11mA, 120V | : 8.8mA, 240V: 8.6mA | | | | | |
| Contact Material | Silver | | | | | | | |
| | | | | | | | | |

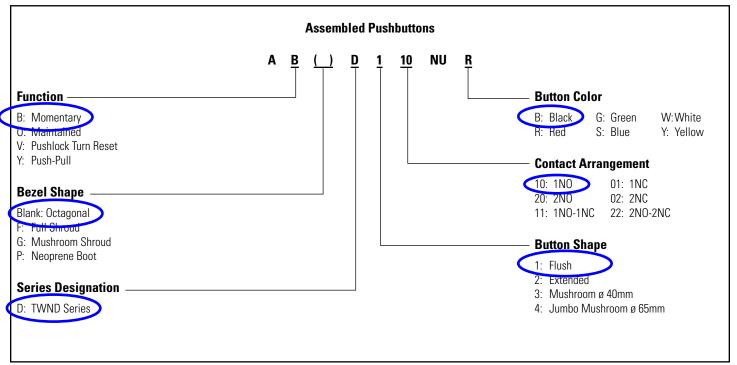
Contact Ratings

| Contact Ratings by Utilization Category IEC 60947-5-1 | | AC-15 (A600) | | | | | | | |
|---|-------------------------------|---|------|-----|-----|------|------|------|----|
| | | DC-13 (P600) | | | | | | | |
| Contact Ratings by Utilization Category | | | | | | | | | |
| Operational Voltage | | | 24V | 48V | 50V | 110V | 220V | 440V | |
| AC 50/60 Hz | | oads | 10A | _ | 10A | 10A | 6A | 2A | |
| Operation Current AC 50/60 Hz AC-15 Control of electron | | AC-15 Control of electromagnetic loads (> 72V/ | 4) | 10A | - | 7A | 5A | 3A | 1A |
| Operation Guirent | DC | DC-12 Control of resistive loads & solid state lo | oads | 10A | 5A | _ | 2.2A | 1.1A | _ |
| | DC-13 Control of electromagne | DC-13 Control of electromagnets | | 5A | 2A | _ | 1.1A | 0.6A | _ |



Non-Illuminated Pushbuttons (Assembled)







- 1. Use only when interpreting part numbers. Do not use for developing part numbers.
- 2. Custom contact configurations available, contact IDEC for details.

Non-Illuminated Pushbuttons (Assembled)

Non-Illuminated Pushbuttons

| Non-Illuminated Pushbuttons Style Contacts Momentary Maintained | | | | | | |
|--|--|-------------------------------------|---|--|--|--|
| Flush | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD110NU® ABD101NU® ABD111NU® ABD120NU® ABD102NU® | AOD110NU® AOD101NU® AOD111NU® AOD120NU® AOD102NU® | | |
| Extended | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD210NU® ABD201NU® ABD211NU® ABD220NU® ABD202NU® | AOD210NU® AOD201NU® AOD211NU® AOD220NU® AOD202NU® | | |
| Extended with Neoprene Boot [†] | | 1NO 1NC 1NO-1NC 2NO 2NC | ABPD210NU® ABPD201NU® ABPD211NU® ABPD220NU® ABPD202NU® | AOPD210NU® AOPD201NU® AOPD211NU® AOPD220NU® AOPD202NU® | | |
| Recessed | | 1NO 1NC 1NO-1NC 2NO 2NC | ABFD110NU® ABFD101NU® ABFD111NU® ABFD120NU® ABFD102NU® | AOFD110NU® AOFD101NU® AOFD1111NU® AOFD120NU® AOFD102NU® | | |
| Extended with Full Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABFD210NU® ABFD201NU® ABFD211NU® ABFD220NU® ABFD220NU® | AOFD210NU® AOFD201NU® AOFD211NU® AOFD220NU® AOFD202NU® | | |
| ø 40mm Mushroom Head | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD310NU® ABD301NU® ABD311NU® ABD320NU® ABD302NU® | AOD310NU® AOD301NU® AOD311NU® AOD320NU® AOD302NU® | | |
| ø 40mm Mushroom Head with Full Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABGD310NU® ABGD301NU® ABGD311NU® ABGD320NU® ABGD302NU® | AOGD310NU® AOGD301NU® AOGD311NU® AOGD320NU® AOGD302NU® | | |
| ø 65mm Jumbo Mushroom Head | | 1NO 1NC 1NO-1NC 2NO 2NC | ABD410NU® ABD401NU® ABD411NU® ABD420NU® ABD420NU® | AOD410NU® AOD401NU® AOD411NU® AOD420NU® AOD402NU® | | |
| ø 65mm Jumbo Mushroom Head with Shallow Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABGD410NU® ABGD401NU® ABGD411NU® ABGD420NU® ABGD402NU® | AOGD410NU® AOGD401NU® AOGD411NU® AOGD420NU® AOGD402NU® | | |
| ø 65mm Jumbo Mushroom Head With Deep Shroud | | 1NO 1NC 1NO-1NC 2NO 2NC | ABFD410NU® ABFD401NU® ABFD411NU® ABFD420NU® ABFD402NU® | AOFD410NU® AOFD401NU® AOFD411NU® AOFD420NU® AOFD402NU® | | |

① Button Color Codes

| Color | Code |
|--------|------|
| Black | В |
| Green | G |
| Red | R |
| Blue | S |
| Yellow | Υ |
| White | W |

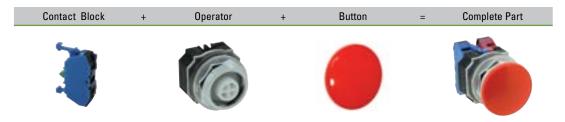


- 1. 65mm Jumbo mushroom not available in white.
- 2. Neoprene boot is not available in blue or white.

1. In place of ①, specify the Button Color Code.

For sub-assembly part numbers, see next page.
 Neoprene boot available only in Black (B), Green (G), Red (R) and Yellow (Y).

Non-Illuminated Pushbuttons (Sub-Assembled)



Operators

| Uperators | | | | | |
|---|-------|------------|-------------|--|--|
| | Chulo | Part N | umber | | |
| | Style | Momentary | Maintained | | |
| Flush/Extended | | ABD1200T8 | AOD1200T8 | | |
| Extended with Full Shroud | | ALFD2300T8 | AOLFD2300T8 | | |
| ø 40mm Mushroom/ø 65mm Jumbo Mushroom | 6 | ABD3400T8 | A0D3400T8 | | |
| ø 40mm Mushroom with Full Shroud | | ABGD-300T | AOGD-300T | | |
| ø 65mm Jumbo Mushroom with Shallow Shroud | 0 | ABGD-400T | AOGD-400T | | |
| ø 65mm Jumbo Mushroom with Deep Shroud | | ABFD-400T | AOFD-400T | | |

Buttons and Lenses

| | Style | Part Number |
|--------------------------|-------|-------------|
| Flush | | ABD1BN-⊕ |
| Extended | | ABD2BN-⊕ |
| ø 40mm Mushroom | | ABD3BN-⊕ |
| ø 65mm Jumbo Mushroom | | ABD4BN-⊕ |



In place of ①, specify the Button Color Code. (See table previous page)

Contact Blocks

| | Part Number | | | |
|-------------------|-------------|---------------------------------------|---------------------------------------|--|
| | Style | 1N0 | 1NC | |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) | |
| Dummy Block | | HW | -DB | |



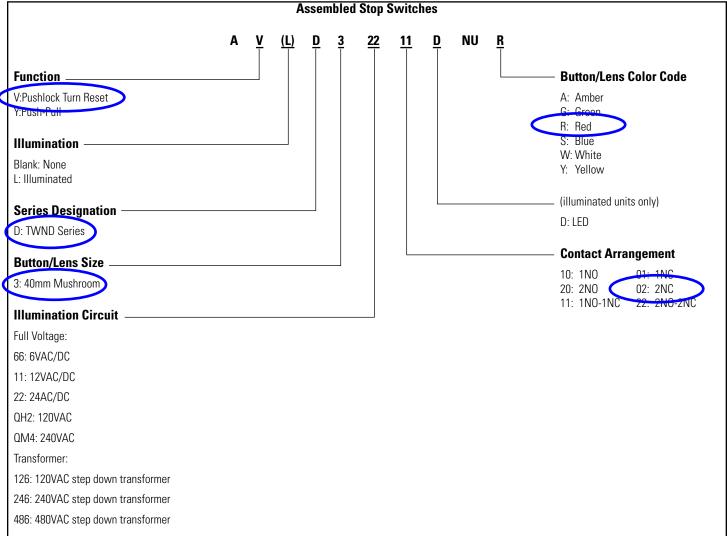
Dummy blocks (no contacts) are used with an odd number of contact blocks.

Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or closed, when switch is moved between two positions).

_ _

Stop Switches (Assembled)





. Use only when interpreting part numbers. Do not use for developing part numbers.

Custom contact configurations available, contact IDEC for details.

Stop Switches (Assembled)

Stop Switches

| 2: 1 | Contacts | Part Number | |
|--|-----------------|-------------------------------------|---|
| Style | Style | | |
| ø 40mm Pushlock Turn Reset | Non-Illuminated | 1N0 1NC 1N0-1NC 2N0 2NC | AVD310NUR* AVD301NUR* AVD311NUR* AVD320NUR* AVD302NUR* |
| ø 40mm Illuminated Pushlock Turn Reset | Full Voltage | 1NO-1NC 2NO 2NC | AVLD3@11DNUR* AVLD3@20DNUR* AVLD3@02DNUR* |
| | Transformer | 1NO-1NC 2NO 2NC | AVLD3 ⊕ 11DNUR* AVLD3 ⊕ 20DNUR* AVLD3 ⊕ 02DNUR* |
| ø 40mm Push-Pull | Non-Illuminated | 1N0 1NC 1NO-1NC 2NO 2NC | AYD310NU⊕ AYD301NU⊕ AYD311NU⊕ AYD320NU⊕ AYD302NU⊕ |
| ø 40mm Illuminated Push-Pull | Full Voltage | 1NO-1NC 2NO 2NC | AYLD3③11DNU② ** AYLD3③20DNU② ** AYLD3③02DNU② ** |
| | Transformer | 1NO-1NC 2NO 2NC | AYLD3 |



- 1. In place of ①, specify the button color code
- 2. In place of ②, specify the lens color code.
- 3. In place of ③, specify the Full Voltage (lamp voltage) Code.
- 4. * Only available in red.
 5. In place of ①, specify the transformer voltage code.
 6. **Not available in blue.
- 7. For sub-assembly part numbers, see next page.
- 8. For nameplates and accessories, see page 769 and page 767.
- 9. For dimensions, see page 772.

① Button Color Codes

| Color | Code |
|--------|------|
| Black | В |
| Green | G |
| Red | R |
| Blue | S |
| Yellow | Υ |

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | Α |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Y |

3 Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |

4 Transformer Voltage Codes

| Voltage | Code |
|---------|------|
| 120VAC | 126 |
| 240VAC | 246 |
| 480VAC | 486 |



Transformers step down to 6V.

Stop Switches (Sub-Assembled)

| Transformer* | + | Operator | + | Lamp | + | Button/Lens | = | Complete Part |
|--------------|---|----------|---|------|---|-------------|---|---------------|
| P | | 6 | | | | | | |

^{*} Not required for full voltage units.

Operators

| St | Part Number | |
|---|-------------|----------|
| ø40mm Illuminated and Non-illuminated Pushlock Turn Reset | 6 | AVD000T8 |
| ø 40mm Illuminated and Non-illuminated Push-Pull | 6 | AYD000T8 |

Buttons and Lenses

| St | Style | | | | |
|--|--------|-----------|--|--|--|
| Button for Pushlock Turn Reset Stop Switches (ø40mm, red only) | | AVN3B-R | | | |
| Lens for Illuminated Pushlock Turn Reset Stop Switches (ø40mm, red only) | | AVLN3LU-R | | | |
| Button for Push-Pull Stop Switches (ø40mm) | | AYD3BN-⊕ | | | |
| Lens for Illuminated Push-Pull Stop Switches (ø40mm) | 2 pos* | AYLD3L-② | | | |



- 1. In place of ①, specify the Button Color Code. (See table below)
- In place of ②, specify the LED Color Code.
 *Not available in blue.

Lamp Circuit Components

| Style | Application | Part Number |
|------------------|---|-------------|
| Long Lamp Holder | Used with Full-size Transformer and two contact blocks Used with Full Voltage Adaptor and two contact blocks | TW-LH2 |
| Lead Holder | Used with TW-LH2 holder when using four contact blocks | HW-LH3 |

Lamps

| Style | Voltage | Part Number | |
|-------|-----------|-------------|--|
| IED | 6V AC/DC | LSTD-63 | |
| LED | 12V AC/DC | LSTD-13 | |
| | 24V AC/DC | LSTD-23 | |
| | 120V AC | LSTD-H2® | |
| | 240V AC | LSTD-M43 | |



1. In place of ②, specify the LED color code. 2. The LED contains a current-limiting resistor and a protection diode.

① Button Color Codes

| Color | Code |
|--------|------|
| Black | В |
| Green | G |
| Red | R |
| Blue | S |
| Yellow | Υ |

② Lens Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| | |

③ LED Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| | |

Contact Blocks

| Style | | Part Number | |
|-------------------|--|---------------------------------------|---------------------------------------|
| | | 1N0 | 1NC |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) |
| Dummy Block | | HW-DB | |



- Dummy blocks (no contacts) are used with an odd number of contact blocks.
 Combining HW-U10R-F and HW-U01R-F result in overlapping contacts.

Transformers

| Style | Primary Voltage (50/60Hz) | Part Number |
|-------|------------------------------|-------------|
| - | 120V AC | TW-F126B |
| | 240V AC | TW-F246B |
| - | 480V AC | HW-L486 |



6V secondary voltage (uses 6V LED).

Full Voltage Modules

| | Style | | Description | Part Number |
|--|-------|---------------------------------------|-------------|-------------|
| Dummy Block with Full Voltage Adaptor | | For use with odd number of contacts. | Finger-Safe | HW-DA1FBN |
| Full Voltage Adaptor | | For use with even number of contacts. | Finger-Safe | TW-DA1FB |

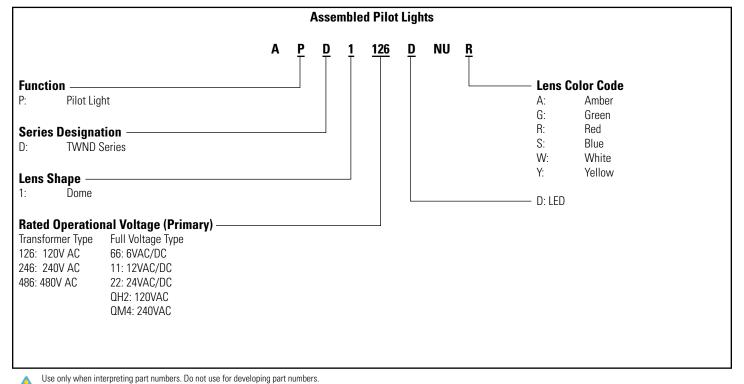


All Transformers step down to 6V (use 6V lamp).



Pilot Lights (Assembled)







| Style | Operating | Part Number |
|-------------------|-------------------------------|---|
| Style | Voltage | LED |
| Transformer Dome | | |
| 6 | 120V AC 240V AC 480V AC | APD1126DNU@ APD1246DNU@ APD1486DNU@ |
| Full Voltage Dome | _ | APD13DNU2 |



- 1. In place of $\ensuremath{\mathfrak{Q}}$, specify the Lens/LED Color Code.
- 2. In place of ③, specify the Full Voltage Code (LED voltage).
- 3. Yellow pilot light comes with white LED.

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

③ Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |
| | |

Pilot Lights (Sub-Assembled)



plus

APD09ST8

| Operators | | |
|-----------|-------|-------------|
| | Style | Part Number |
| | | |

One Each from Left Column

Full Voltage Clips

| Primary Voltage (50/60Hz) | Part Number |
|---------------------------|-------------|
| Per | APD-F |

One Selection from Right Column

Required for all full voltage models. Two pieces each. 2 clips required for full voltage pilot lights

Transformers (only for Pilot Lights)

| Style | Primary Voltage (50/60Hz) | Part Number | |
|-------|------------------------------|-------------|----------|
| | | 120V AC | TWD-0126 |
| LED | | 240V AC | TWD-0246 |
| | | 480V AC | TWD-0486 |



6V secondary voltage (use 6V lamp).

Lenses

Transformer or

FULL Voltage

| | Style | Part Number |
|-----------|-------|-------------|
| Dome Lens | | APN106LN-@ |



1. In place of ②, specify the Lens Color Code.

Lamps

| Style | Voltage | Part Number |
|-------|-----------|---|
| LED | 6V AC/DC | LSTD-6® |
| | 12V AC/DC | LSTD-1® |
| | 24V AC/DC | LSTD-23 |
| | 120V AC | LSTD-H2③ |
| | 240V AC | LSTD-M43 |
| | Style | 6V AC/DC 12V AC/DC 24V AC/DC 120V AC |



- 1. In place of ②, specify the LED color code.
- 2. The LED contains a current-limiting resistor and a protection diode.

2 Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

3 LED Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |

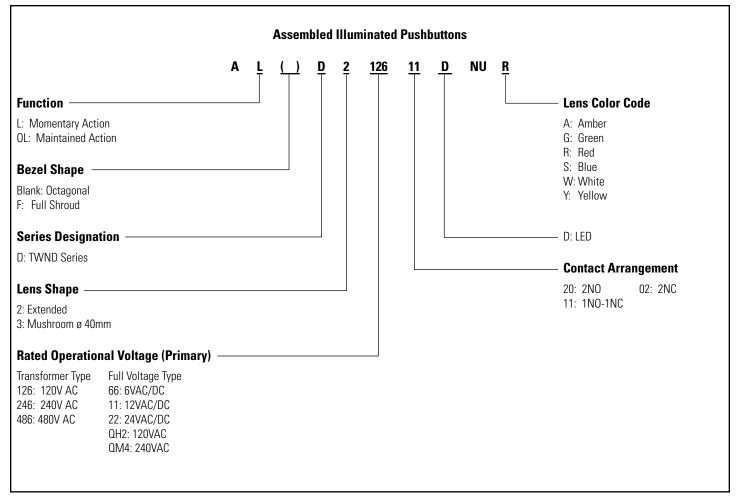


Yellow LED not available, use white LED with Yellow lens.



Illuminated Pushbuttons (Assembled)







- 1. Use only when interpreting part numbers. Do not use for developing part numbers.
- 2. All transformers step down to 6V.

Illuminated Pushbuttons (Assembled)

Illuminated Pushbuttons

| Stude | | Contacts | Part Number | |
|--------------------------------|--------------|-----------------------|--|---|
| Style | | Contacts | Momentary | Maintained |
| Extended Lens | Full Voltage | 1NO-1NC 2NO 2NC | ALD2@11DNU@ ALD2@20DNU@ ALD2@02DNU@ | AOLD2@11DNU@ AOLD2@20DNU@ AOLD2@02DNU@ |
| | Transformer | 1NO-1NC 2NO 2NC | ALD2 ⊕ 11DNU② ALD2 ⊕ 20DNU② ALD2 ⊕ 02DNU② | AOLD2 @ 11DNU@ AOLD2 @ 20DNU@ AOLD2 @ 02DNU@ |
| Extended Lens with Full Shroud | Full Voltage | 1NO-1NC 2NO 2NC | ALFD2@11DNU@ ALFD2@20DNU@ ALFD2@02DNU@ | AOLFD2③11DNU② AOLFD2③20DNU② AOLFD2③02DNU② |
| | Transformer | 1NO-1NC 2NO 2NC | ALFD2 @ 11DNU@ ALFD2 @ 20DNU@ ALFD2 @ 02DNU@ | AOLFD2 @ 11DNU@ AOLFD2 @ 20DNU@ AOLFD2 @ 02DNU@ |
| ø 40mm Mushroom Lens | Full Voltage | 1NO-1NC 2NO 2NC | ALD3@11DNU@ ALD3@20DNU@ ALD3@02DNU@ | AOLD3@11DNU@ AOLD3@20DNU@ AOLD3@02DNU@ |
| | Transformer | 1NO-1NC 2NO 2NC | ALD3 ⊕ 11DNU@ ALD3 ⊕ 20DNU@ ALD3 ⊕ 02DNU@ | AOLD3 @ 11DNU@ AOLD3 @ 20DNU@ AOLD3 @ 02DNU@ |

② Lens Color Codes

| Color | Code | |
|--------|------|--|
| Amber | Α | |
| Green | G | |
| Red | R | |
| Blue | S | |
| White | W | |
| Yellow | Υ | |

3 Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |
| | |

4 Transformer Voltage Codes

| Voltage | Code |
|---------|------|
| 120VAC | 126 |
| 240VAC | 246 |
| 480VAC | 486 |



6V secondary voltage (uses 6V LED).

- 1. In place of ②, specify the Lens Color Code.
 - In place of ③, specify the Full Voltage Code (LED voltage).
 In place of ④, specify the Transformer Voltage Code.
 Light is independent of switch position.

 - 5. Yellow pushbutton comes with white LED only.

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Illuminated Pushbuttons (Sub-Assembled)



^{*}Not required for full voltage types.

Operators

| Style | | Part Number | |
|------------------------------|---|-------------|-------------|
| | | Momentary | Maintained |
| Extended | 6 | ALD2300T8 | A0LD2300T8 |
| Extended with Full Shroud | | ALFD2300T8 | AOLFD2300T8 |
| 40mm Mushroom | 6 | ALD2300T8 | A0LD2300T8 |

Lamps

| Style | Voltage | Part Number |
|-------|-----------|-------------|
| LED | 6V AC/DC | LSTD-6® |
| LED | 12V AC/DC | LSTD-13 |
| | 24V AC/DC | LSTD-23 |
| | 120V AC | LSTD-H2® |
| | 240V AC | LSTD-M43 |



 In place of ②, specify the LED color code.
 The LED contains a current-limiting resistor and a protection diode.

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

3 LED Color Codes

| Color | Code |
|-------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |



Yellow lens only. Yellow LED not available, use white LED.

Lenses

| | Style | Part Number |
|-----------------|-------|-------------|
| Extended | | ALN06LU-@ |
| ø 40mm Mushroom | | ALN3LU-@ |



In place of $\ensuremath{\mathfrak{D}}$, specify the Lens Color Code.

Lamp Circuit Components

| Style | Application | Part Number |
|------------------|--|-------------|
| Long Lamp Holder | Used with Full-size Transformer and two contact blocks Used with Full Voltage Adaptor and two contact blocks | TW-LH2 |
| Lead Holder | Used with TW-LH2 holder when using four contact blocks | HW-LH3 |

Contact Blocks

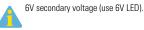
| | Part Number | | | |
|-------------------|-------------|---------------------------------------|---------------------------------------|--|
| | 1N0 | 1NC | | |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) | |
| Dummy Block | | HW-DB | | |



- 1. Dummy blocks (no contacts) are used with an odd number of contact blocks.
- Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or closed, when switch is moved between two positions).

Transformers

| | Style | Primary Voltage (50/60Hz) | Part Number | |
|--------------|-------|------------------------------|-------------|--|
| | TE | 120V AC | TW-F126B | |
| Transformers | | 240V AC | TW-F246B | |
| | | 480V AC | HW-L486 | |



Full Voltage Modules

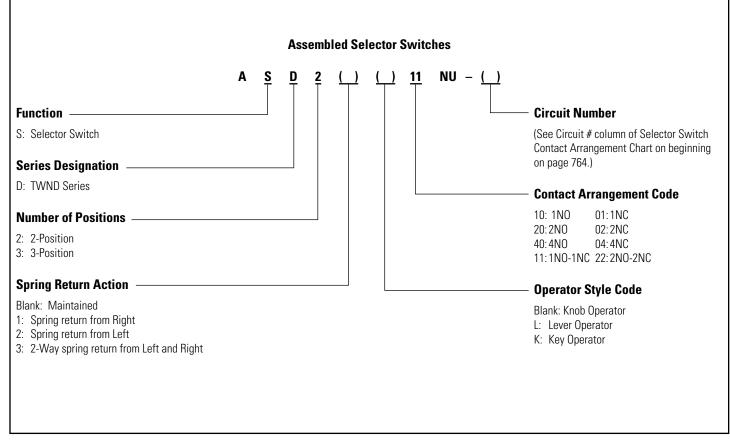
| | Style | | Description | Part Number |
|--|-------|---------------------------------------|-------------|-------------|
| Dummy Block with Full Voltage Adaptor | | For use with odd number of contacts. | Finger-Safe | HW-DA1FBN |
| Full Voltage Adaptor | | For use with even number of contacts. | Finger-Safe | TW-DA1FB |



All Transformers step down to 6V (use 6V lamp).

Non-Illuminated Selector Switches (Assembled)







- 1. Use only when interpreting part numbers. Do not use for developing part numbers.
- 2. Custom key removal codes available. Please contact IDEC for details.

Non-Illuminated Selector Switches (Assembled)

Non-Illuminated 2-Position Selector Switches

| Style | | | | | Part Number | | | |
|------------|------------------|----------------------|------------------|----------------------|--|---|---|--|
| act | Mounting | Operator Position | | | Maintained | Spring Return from Right | Spring Return from Left | |
| Contact | | L | R | | L R | L R | L. R | |
| 1N0 | 1 2 | 0 0 | X 0 | Knob Lever Key | ASD210NU ASD2L10NU ASD2K10NU | ASD2110NU ASD21L10NU ASD21K10NU | ASD2210NU ASD22L10NU ASD22K10NU | |
| 1NC | 1 2 | X 0 | 0 0 | Knob Lever Key | ASD201NU ASD2L01NU ASD2KUTNU | ASD2101NU ASD21L01NU ASD21K01NU | ASD2201NU ASD22L01NU ASD22K01NU | |
| 1NO 1NC | 1 2 | 0 X | X 0 | Knob Lever Key | ASD211NU ASD2L11NU ASD2K11NU | ASD2111NU ASD21L11NU ASD21K11NU | ASD2211NU ASD22L11NU ASD22K11NU | |
| 2N0 | 1 2 | 0 0 | X X | Knob Lever Key | ASD220NU ASD2L20NU ASD2K20NU | ASD2120NU ASD21L20NU ASD21K20NU | ASD2220NU ASD22L20NU ASD22K20NU | |
| 2NC | 1 2 | X X | 0 0 | Knob Lever Key | ASD202NU ASD2L02NU ASD2K02NU | ASD2102NU ASD21L02NU ASD21K02NU | ASD2202NU ASD22L02NU ASD22K02NU | |
| 2N0 2NC | 1 2 3 4 | 0 X 0 X | X 0 X 0 | Knob Lever Key | ASD222NU ASD2L22NU ASD2K22NU | ASD2122NU ASD21L22NU ASD21K22NU | ASD2222NU ASD22L22NU ASD22K22NU | |
| 2NO 2NC | 1 2 3 4 | 0 0 X X | X X 0 0 | Knob Lever Key | ASD222NU-111 ASD2L22NU-111 ASD2K22NU-111 | ASD2122NU-111 ASD21L22NU-111 ASD21K22NU-111 | ASD2222NU-111 ASD22L22NU-111 ASD22K22NU-111 | |



- The truth table indicates the operating position of contact block when the operator is switched to that position.
 - X = On (closed contacts) O = Off (open contacts)
 X—X = Overlapping Contacts: Remain on (closed contacts) when switch is moved between these two positions.
- All knob and lever selector switches come in black.
 Other colors are available by ordering the knob or lever senarately.
- 3. Custom contact arrangements available, see page 764.

Non-Illuminated 3-Position Selector Switches

| Style | | | | | | Part Number | | | | |
|------------|------------------|------------------|-------------------|--------------------|----------------------|--|---|---|---|--|
| + | t Du | | Operator Position | | | Maintained | Spring Return from Right | Spring Return from Left | Spring Return Two-Way | |
| Contact | Mounting | L | C ≜ | R | | C R | L C R | L ^C R | L ^C →R | |
| 2N0 | 1 2 | X 0 | 0 0 | 0 X | Knob Lever Key | ASD320NU ASD3L20NU ASD3K20NU | ASD3120NU ASD31L20NU ASD31K20NU | ASD3220NU ASD32L20NU ASD32K20NU | ASD3320NU ASD33L20NU ASD33K20NU | |
| 2NC | 1 2 | 0 X | X— X | —X 0 | Knob Lever Key | ASD302NU ASD3L02NU ASD3K02NU | ASD3102NU ASD31L02NU ASD31K02NU | ASD3202NU ASD32L02NU ASD32K02NU | ASD3302NU ASD33L02NU ASD33K02NU | |
| 2N0 2NC | 1 2 3 4 | X 0 0 X | 0 0 X— X | 0 X —X 0 | Knob Lever Key | ASD322NU ASD3L22NU ASD3K22NU | ASD3122NU ASD31L22NU ASD31K22NU | ASD3222NU ASD32L22NU ASD32K22NU | ASD3322NU ASD33L22NU ASD33K22NU | |
| 2N0 2NC | 1 2 3 4 | X X 0 0 | 0 —X X 0 | X 0 0 X | Knob Lever Key | ASD322NU-309 ASD3L22NU-309 ASD3K22NU-309 | ASD3122NU-309 ASD31L22NU-309 ASD31K22NU-309 | ASD3222NU-309 ASD32L22NU-309 ASD32K22NU-309 | ASD3322NU-309 ASD33L22NU-309 ASD33K22NU-309 | |
| 2NO 2NC | 1 2 3 4 | 0 0 0 0 | X 0 X 0 | 0 X 0 X | Knob Lever Key | ASD322NU-310 ASD3L22NU-310 ASD3K22NU-310 | ASD3122NU-310 ASD31L22NU-310 ASD31K22NU-310 | ASD3222NU-310 ASD32L22NU-310 ASD32K22NU-310 | ASD3322NU-310 ASD33L22NU-310 ASD33K22NU-310 | |
| 4N0 | 1 2 3 4 | X 0 X 0 | 0 0 0 | 0 X 0 X | Knob Lever Key | ASD340NU ASD3L40NU ASD3K40NU | ASD3140NU ASD31L40NU ASD31K40NU | ASD3240NU ASD32L40NU ASD32K40NU | ASD3340NU ASD33L40NU ASD33K40NU | |
| 4NC | 1 2 3 4 | 0 X 0 X | X——X X——X | —X 0 —X 0 | Knob Lever Key | ASD304NU ASD3L04NU ASD3K04NU | ASD3104NU ASD31L04NU ASD31K04NU | ASD3204NU ASD32L04NU ASD32K04NU | ASD3304NU ASD33L04NU ASD33K04NU | |

Non-Illuminated Selector Switches (Sub-Assembled)

| Contact Blocks | + | Operator | + | Knob or Lever* | + | Color Insert* | = | Complete Part [†] |
|----------------|---|----------|---|----------------|---|---------------|---|----------------------------|
| | | 6 | | | | | | |

ø30mm - TWND Series

*Not needed with key type switches.

†Knob type shown.

Operators

| Style | Position | Description | Part Number |
|------------|----------|--|----------------------------|
| | | Maintained | ASD0201T8 |
| | 2 | Spring return from right | ASD0213T8 |
| Knob/Lever | | Spring return from left | ASD0224T8 |
| KHOD/LEVE | | Maintained, Cam 1 Maintained, Cam 2 | ASD0302T8 ASD0306T8 |
| | 3 | Spring return from right, Cam 1 Spring return from right, Cam 2 | ASD0314T8 ASD0310T8 |
| | 3 | Spring return from left, Cam 1 Spring return from left, Cam 2 | ASD0323T8 ASD0328T8 |
| | | Spring return from left/right, Cam 1 Spring return from left/right, Cam 2 | ASD0335T8 ASD0339T8 |
| | | Maintained | ASD0201KT8 |
| | 2 | Spring return from right | ASD0213KT8 |
| Key | | Spring return from left | ASD0224KT8 |
| | | Maintained, Cam 1 Maintained, Cam 2 | ASD0302KT8 ASD0306KT8 |
| | 3 | Spring return from right, Cam 1 Spring return from right, Cam 2 | ASD0302KT8B ASD0310KT8B |
| | 3 | Spring return from left, Cam 1 Spring return from left, Cam 2 | ASD0323KT8 ASD0310KT8B |
| | | Spring return from left/right, Cam 1 Spring return from left/right, Cam 2 | ASD0335KT8 ASD3K339KT8 |



- 1. Order knobs, levers, color inserts separately (see below).
- 2. For key switches, keys are removable in all maintained positions. Other options available, contact IDEC for details.
- 3. See page 766 "Operator Truth Tables" for details of difference between cams.

① Color Codes

| Knob/Lever Color | Code |
|------------------|------|
| Black | В |
| Blue | S |
| Green | G |
| Red | R |
| Yellow | Υ |
| White | W |
| | |



- Knob/Lever not available in white.
- Color inserts not available in Black.
- 3. Lever not available in yellow.

Handles and Inserts

Switches & Pilot Devices

| | Style | Part Number |
|--------------|-------|-------------|
| Knob | | ASDHHY-① |
| Lever | | ASDHHL-⊕* |
| Color Insert | | TW-HC1-① |



1. In place of ①, specify the Color Code. *Not available in yellow.

Contact Blocks

| | Part Number | | |
|-------------------|-------------|---------------------------------------|---------------------------------------|
| | Style | | |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U01-F HW-U01R-F (late break) |
| Dummy Block | | HW | '-DB |

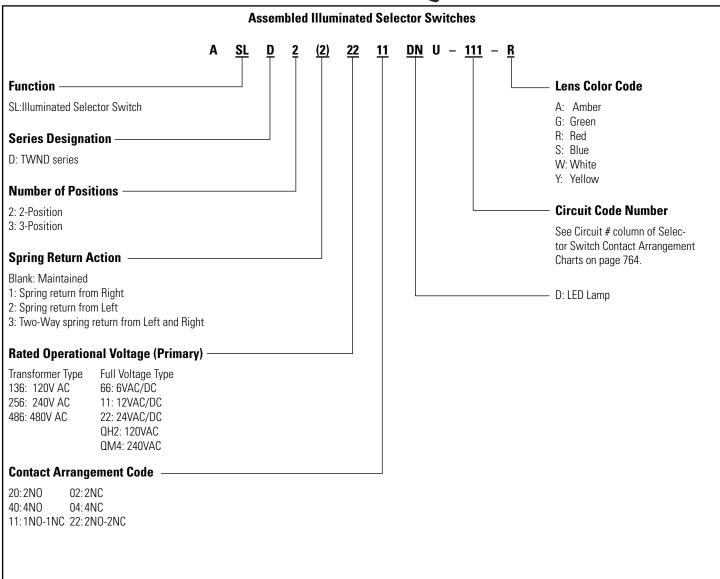


Dummy blocks (no contacts) are used with an odd number of contact blocks.
 Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or

closed, when switch is moved between two positions).

Illuminated Selector Switches (Assembled)







Use only when interpreting part numbers. Do not use for developing part numbers.

Illuminated Selector Switches (Assembled)

Illuminated 2-Position Selector Switches

| | St | yle | | | | Part Number | |
|--|------------------|------------------|------------------|--|--------------------------------------|--|---|
| Contact Position Operator Position L R Ci | | | | Lamp | Maintained Spring Return from Ri | | Spring Return from Left |
| | | Circuit Type | L\R | L\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\ | L ^C R | | |
| 1NO 1NC | 1 2 | 0 X | X 0 | Transformer Full Voltage | ASLD2 @11DNU@ ASLD2@11DNU@ | ASLD21 @11DNU@ ASLD21@11DNU@ | ASLD22 @11DNU@ ASLD22@11DNU@ |
| 2N0 | 1 2 | 0 0 | X X | Transformer Full Voltage | ASLD2 @20DNU@ ASLD2 @20DNU@ | ASLD21 @20DNU@ ASLD21 @20DNU@ | ASLD22 @20DNU@ ASLD22 @20DNU@ |
| 2NC | 1 2 | X | 0 0 | Transformer Full Voltage | ASLD2 @02DNU-@ ASLD2 @02DNU-104-@ | ASLD21 | ASLD22 |
| 2N0 2NC | 1 2 3 4 | 0 X 0 X | X 0 X 0 | Transformer Full Voltage | ASLD2 @22DNU@ ASLD2 @22DNU@ | ASLD21 @22DNU@ ASLD21 @22DNU@ | ASLD22 ⊕22DNU@ ASLD22③22DNU@ |
| 2N0 2NC | 1 2 3 4 | 0 0 X X | X X 0 0 | Transformer Full Voltage | ASLD2 | ASLD21 @22DNU-111-@ ASLD21 @22DNU-111-@ | ASLD22 ⊕22DNU-111-@ ASLD22③22DNU-111-@ |

② Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Υ |

③ Full Voltage Codes

| Voltage | Code |
|-----------|------|
| 6V AC/DC | 66 |
| 12V AC/DC | 11 |
| 24V AC/DC | 22 |
| 120V AC | QH2 |
| 240V AC | QM4 |

Illuminated 3-Position Selector Switches, Maintained and Spring Return

| | | Style | | | | Part Number | | | | |
|------------|------------------------------|------------------|--------------------|--------------------|-----------------------------|--|--|--|--|--|
| + | бı | Oper | ator Po | sition | | Maintained | Spring Return From Right | Spring Return from Left | Spring Return Two-Way | |
| Contact | Contact L C B C Curcuit Type | | | C R | L C R | L C R | L C R | | | |
| 2N0 | 1 2 | X 0 | 0 0 | 0 X | Transformer Full Voltage | ASLD3 ⊕ 20DNU@ ASLD3@20DNU@ | ASLD31 @ 20DNU@ ASLD31@20DNU@ | ASLD32 @ 20DNU@ ASLD32@20DNU@ | ASLD33 ⊕ 20DNU@ ASLD33③20DNU@ | |
| 2NC | 1 2 | 0 X— | X— —X | —X 0 | Transformer Full Voltage | ASLD3 @ 02DNU@ ASLD3@02DNU@ | ASLD31 @ 02DNU@ ASLD31@02DNU@ | ASLD32 @ 02DNU@ ASLD32@02DNU@ | ASLD33 ⊕ 02DNU@ ASLD33③02DNU@ | |
| 2NO 2NC | 1 2 3 4 | X 0 0 X | 0 0 X— —X | 0 X X 0 | Transformer Full Voltage | ASLD3 @ 22DNU@ ASLD3@22DNU@ | ASLD31 @ 22DNU@ ASLD31 @ 22DNU@ | ASLD32 | ASLD33 @ 22DNU@ ASLD33@22DNU@ | |
| 2N0 2NC | 1 2 3 4 | X X 0 0 | 0 —X X 0 | X 0 0 X | Transformer Full Voltage | ASLD3 @ 22DNU-309-@ ASLD3 @ 22DNU-309-@ | ASLD31 @ 22DNU-309-@ ASLD31@22@DNU-309-@ | ASLD32 @ 22DNU-309-@ ASLD32 @ 22DNU-309-@ | ASLD33 @ 22DNU-309-@ ASLD33@22DNU-309-@ | |
| 2NO 2NC | 1 2 3 4 | 0 0 0 0 | X 0 X 0 | 0 X 0 X | Transformer Full Voltage | ASLD3 @ 22DNU-310-@ ASLD3@22DNU-310-@ | ASLD31 @ 22DNU-310-@ ASLD31 @ 22DNU-310-@ | ASLD32 @ 22DNU-310-@ ASLD32 @ 22DNU-310-@ | ASLD33 @ 22DNU-310-@ ASLD33 @ 22DNU-310-@ | |
| 4N0 | 1 2 3 4 | X 0 X 0 | 0 0 0 0 | 0 X 0 X | Transformer Full Voltage | ASLD3 @ 40DNU@ ASLD3 @ 40DNU@ | ASLD31 @ 40DNU@ ASLD31 @ 40DNU@ | ASLD32 | ASLD33 | |
| 4NC | 1 2 3 4 | 0 X 0 X | X— X X— X | —X 0 —X 0 | Transformer Full Voltage | ASLD3 @ 04DNU@ ASLD3@04DNU@ | ASLD31 @ 04DNU@ ASLD31 @ 04DNU@ | ASLD32 @ 04DNU@ ASLD32 @ 04DNU@ | ASLD33 | |



- In place of ③, specify the Lens/LED Color Code, in place of ③, specify the Full Voltage (LED voltage) Code, in place of ④, specify the Transformer Voltage Code.
- The truth table indicates the operating position of contact block when the operator is switched to that position.

X = On (Closed Contacts) O = Off (Open Contacts)

 $X\!\!-\!\!X=$ Overlapping Contacts: Remain on (closed contacts) when switch is moved between these positions

3. Yellow selector switch comes with white LED.

4 Transformer Voltage Codes

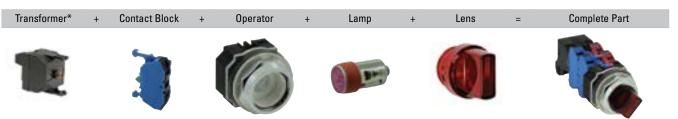
| Voltage | Code |
|---------|------|
| 120VAC | 136 |
| 240VAC | 256 |
| 480VAC | 486 |



Transformers step down to 6V (use 6V LED).



Illuminated Selector Switches (Sub-Assembled)





*Not required for full voltage units.

Operators

| Style | Position | Description | Part Number |
|----------|----------|--|--------------------------|
| | 2 | Maintained | ASLD0201T8 |
| Operator | 3 | Maintained, Cam 1 Maintained, Cam 2 | ASLD0302T8 ASLD0306T8 |
| Орогасог | 2 | Spring return from right | ASLD0213T8 |
| 500 | Z | Spring return from left | ASLD0224T8 |
| | | Spring return from right, Cam 1 Spring return from right, Cam 2 | ASLD0314T8 ASLD0310T8 |
| | 3 | Spring return from left, Cam 1 Spring return from left, Cam 2 | ASLD0323T8 ASLD0328T8 |
| | | Spring return from left/right, Cam 1 Spring return from left/right, Cam 2 | ASLD0335T8 ASLD0339T8 |

Lenses

| | Part Number | | |
|------|-------------|------------|--|
| Knob | | ASLNHU-③ ② | |

Lamps

| Style | Voltage | Part Number |
|--------|-----------|-------------|
| | 6V AC/DC | LSTD-6③ |
| LED | 12V AC/DC | LSTD-13 |
| A BANK | 24V AC/DC | LSTD-2③ |
| | 120V AC | LSTD-H2® |
| | 240V AC | LSTD-M43 |



- 1. In place of ②, specify the LED color code.
- 2. The LED contains a current-limiting resistor and a protection diode.

Contact Blocks

| | Part Number | | | |
|-------------------|-------------|---------------------------------------|---------------------------------------|--|
| | 1N0 | 1NC | | |
| All Control Units | | HW-U10-F HW-U10R-F (early make) | HW-U10-F HW-U10R-F (late break) | |
| Dummy Block | | HW | '-DB | |



Dummy blocks (no contacts) are used with an odd number of contact blocks.
 Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remains).

Combining HW-U10R-F and HW-U01R-F result in overlapping contacts (remain on, or closed, when switch is moved between two positions).

Lamp Circuit Components

| Style | Application | Part Number |
|------------------|---|-------------|
| Long Lamp Holder | Used with Full-size Transformer and two contact blocks Used with Full Voltage Adaptor and two contact blocks | TW-LH2 |
| Lead Holder | Used with TW-LH2 holder when using four contact blocks | HW-LH3 |

Full Voltage Modules

| J | | | | |
|--|-------|---------------------------------------|-------------|-------------|
| | Style | | Description | Part Number |
| Dummy Block with Full Voltage Adaptor | | For use with odd number of contacts. | Finger-Safe | HW-DA1FBN |
| Full Voltage Adaptor | | For use with even number of contacts. | Finger-Safe | TW-DA1FB |



All Transformers step down to 6V (use 6V lamp).

Transformers

| | Style | Primary Voltage (50/60Hz) | Part Number |
|--------------|-------|------------------------------|-------------|
| | | 120V AC | TW-F126B |
| Transformers | | 240V AC | TW-F126B |
| | | 480V AC | HW-L486 |



6V secondary voltage.

2 Lens Color Codes

| Color | Code |
|--------|------|
| Amber | А |
| Green | G |
| Red | R |
| Blue | S |
| White | W |
| Yellow | Y |

3 LED Color Codes

| C | olor | Code | | | |
|----------|-------------------------|------|--|--|--|
| Ar | nber | А | | | |
| Gr | reen | G | | | |
| F | Red | R | | | |
| В | lue | S | | | |
| W | hite | W | | | |
| <u> </u> | Yellow lens only. Yello | | | | |



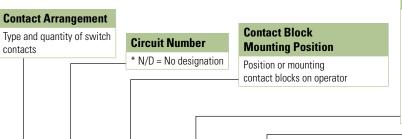
Yellow lens only. Yellov LED not available, use white LED. Relays & Sockets

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Contact Arrangement Charts

How to Read Contact Arrangement Charts

To determine contact block mounting position, first make sure the selector switch is oriented as shown on the right



Contact Arrangement Chart: 2-Position Selector Switches

Operator Position

Truth table indicates the operating position of contact block when operator is switched to that position.

X = On (Closed Contacts)

0 = Off (Open Contacts)

X—X = Overlapping Contacts: Remain on (closed) when switch is moved between these two positions

Contact Block Part Number

Part number to use when ordering sub-assembly contact blocks, as required for use with corresponding mounting position

| Sty | ⁄le | | One | | | | Operator Part Number | | r | |
|---------|---------|----------------------|--------|----------------|------------------------------|-------------------------|--------------------------|--------------------------|--------------------------|--|
| | Circuit | Mounting Position | | rator ition | Contact Block Part Number | Description | Maintained | Spring Return from Right | Spring Return from Left | |
| Contact | Number | i osition | L | R | i art ivallibei | | L R | L R | L [*] R | |
| | | 1 | 0 | Х | HW-U10-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 | |
| 1NO | N/D | 2 | 0 | 0 | HW-DB | Key Illuminated Knob | ASD0201KT8 ASLD0201T8 | ASD0213KT8 ASLD0213T8 | ASD0224KT8 ASLD0224T8 | |
| 1NC | N/D | 1 | Χ | 0 | HW-U01-F | Knob/Lever | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| INC | N/D | 2 | 0 | 0 | HW-DB | Key Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASD0224K18 ASLD0224T8 | |
| | N/D | 1 | 0 | Χ | HW-U10-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| 1NO | N/D | 2 | Χ | 0 | HW-U01-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224K18 | |
| 1NC | 103 | 1 | Χ | 0 | HW-U01-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| | 100 | 2 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| | 600 | 1 | 0 | Χ | HW-U10R-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| 1NO-EM | 000 | 2 | Х | 0 | HW-U01R-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| 1NC-LB | 601 | 1 | Χ | 0 | HW-U01R-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| | | 2 | 0 | Χ | HW-U10R-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| 2N0 | N/D | 1 | 0 | Χ | HW-U10-F | Knob/Lever Kev | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| | .,,5 | 2 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| 2NC | N/D | 1 | Χ | 0 | HW-U01-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| | , | 2 | X | 0 | HW-U01-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| | N/D | 1 2 | 0 X | X 0 | HW-U10-F HW-U01-F | Knob/Lever Key | ASD0201T8 ASD0201KT8 | ASD0213T8 ASD0213KT8 | ASD0224T8 ASD0224KT8 | |
| | N/D | 3 4 | 0 X | X 0 | HW-U10-F HW-U01-F | Illuminated Knob | ASLD0201R18 | ASLD0213T8 | ASLD0224R18 | |
| | | 1 | Χ | 0 | HW-U01-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 | |
| 2N0 | 110 | 2 3 | 0 X | X 0 | HW-U10-F | Key | ASD020118 | ASD021310 | ASD0224KT8 | |
| 2NC | | 4 | 0 | X | HW-U01-F HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| | | 1 | 0 | Χ | HW-U10-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 | |
| | 111 | 2 3 | 0 X | X 0 | HW-U10-F HW-U01-F | Key | ASD0201KT8 | ASD0213KT8 | ASD0224KT8 | |
| | | 4 | X | 0 | HW-U01-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |
| | | 1 | 0 | Χ | HW-U10-F | Knob/Lever | ASD0201T8 | ASD0213T8 | ASD0224T8 | |
| 4N0 | N/D | 2 | 0 | X | HW-U10-F HW-U10-F | Key | ASD0201KT8 | ASD0213KT8 | ASD0224KT8 | |
| | | 4 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0201T8 | ASLD0213T8 | ASLD0224T8 | |

Contact Arrangement Chart: 3-Position Selector Switches

| St | yle | | | | | | | | | art Number | | |
|------------|---------|----------|--------|---------------|----------|----------------------|-------------------------|--------------------------|-----------------------------|--------------------------|-------------------------|--|
| | Circuit | Mounting | Oper | ator Pos | sition | Contact Block | Description | Maintained | Spring Return from Right | Spring Return from Left | Two-Way | |
| Contact | Number | Position | L | C ♠ | R | Part Number | Beschiption | | L C R | L C | | |
| | 000 | 1 | Х | 0 | 0 | HW-U10-F | Knob/Lever | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 | |
| | 202 | 2 | X | —X | 0 | HW-U01-F | Key Illuminated Knob | ASD0302KT8 ASLD0302T8 | ASD0314KT8 ASLD0314T8 | ASD0323KT8 ASLD0323T8 | ASD0335KT8 ASD0335T8 | |
| | 203 | 1 | 0 | X | —X | HW-U01-F | Knob/Lever Kev | ASD0302T8 ASD0302KT8 | ASD0314T8 ASD0314KT8 | ASD0323T8 ASD0323KT8 | ASD0335T8 ASD0335KT8 | |
| NO | 203 | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 | |
| NC | 302 | 1 | Х | 0 | Χ | HW-U10-F | Knob/Lever Key | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 | |
| | 302 | 2 | X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |
| | 303 | 1 | 0 | Χ | 0 | HW-U01-F | Knob/Lever Kev | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 | |
| | 303 | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0323T8 | ASLD0339T8 | |
| | N/D | 1 | Х | 0 | 0 | HW-U10-F | Knob/Lever Key | ASD0302T8 ASD0302KT8 | ASD0314T8 ASD0314KT8 | ASD0323T8 ASD0323KT8 | ASD0335T8 ASD0335KT8 | |
| NO NO | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 | | |
| | 301 | 1 | Х | 0 | Χ | HW-U10-F | Knob/Lever Key | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 | |
| | 00. | 2 | 0 | 0 | Χ | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |
| 304 !NC | 304 | 1 | 0 | Χ | 0 | HW-U01-F | Knob/Lever Key | ASD0306T8 ASD0306KT8 | ASD0310T8 ASD0301KT8 | ASD0328T8 ASD0328KT8 | ASD0339T8 ASD0339KT8 | |
| | | 2 | X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |
| | N/D | 1 | 0 | X | X | HW-U01-F | Knob/Lever Key | ASD0302T8 ASD0302KT8 | ASD0314T8 ASD0314KT8 | ASD0323T8 ASD0323KT8 | ASD0335T8 ASD0335KT8 | |
| | | 2 | X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 | |
| | N/D | 1 2 | X 0 | 0 | 0 X | HW-U10-F HW-U10-F | Knob/Lever | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 | |
| | N/D | 3 | 0 | Χ | —X | HW-U01-F | Key Illuminated Knob | ASD0302KT8 ASLD0302T8 | ASD0314KT8 ASLD0314T8 | ASD0323KT8 ASLD0323T8 | ASD0335KT8 ASD0335T8 | |
| | | 4 | X | X | 0 | HW-U01-F | mummatcu Knob | AGEDOSOZIO | AULDUSTATO | A0LD032010 | A0D000010 | |
| | | 1 2 | 0 | X | —X X | HW-U01-F HW-U10-F | Knob/Lever | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 | |
| | 210 | 3 | 0 | X | X | HW-U01-F | Key | ASD0302KT8 | ASD0314KT8 | ASD0323KT8 | ASD0335KT8 | |
| | | 4 | 0 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0302T8 | ASLD0314T8 | ASLD0323T8 | ASD0335T8 | |
| | | | X | 0 | X | HW-U10-F | | | | | | |
| 10 | | 2 | X— | —X | 0 | HW-U01-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASD0339T8 | |
| VC | 308 | 3 | X | 0 | Х | HW-U10-F | Key | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 | |
| | | 4 | X X | —X | 0 | HW-U01-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |
| | | 1 | X | 0 | Х | HW-U10-F | | | | | | |
| | | 2 | Χ— | —X | 0 | HW-U01-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASD0339T8 | |
| | 309 | 3 | 0 | X | 0 | HW-U01-F | Key | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 | |
| | | 4 | 0 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |
| | | 1 | 0 | X | 0 | HW-U01-F | | | | | | |
| | 0.15 | 2 | 0 | 0 | X | HW-U10-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASD0339T8 | |
| | 310 | 3 | 0 | X | 0 | HW-U01-F | Key | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 | |
| | | 4 | 0 | 0 | X | HW-U10-F | Illuminated Knob | ASLD0306T8 | ASLD310T8 | ASLD0328T8 | ASLD0339T8 | |



Each operator sub-assembly is available as an "02" and an "06" for 3-position selector switches. The internal cam of an "02" is different from that of an "06". This results in designated combinations of open and closed contacts in the various operator positions.

^{2.} N/D = No circuit number designation required in assembled part number.

^{3.} X = On (closed contacts) 0 = Off (open contacts). X—X Overlapping contacts remain on (closed) when switch is moved between these two positions.

Contact Arrangement Chart: 3-Position Selector Switches

| St | yle | 0 . 5 | | | | Operator Part Number | | | | | |
|---------|-------------------|----------|----|---------------|-------------------|----------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| | a Mounting | | | | Operator Position | | Description - | Maintained | Spring Return from Right | Spring Return from Left | Two-Way |
| Contact | Circuit Number | Position | L | C ≜ | R | Part Number | Description | C R | L C | L C | L C R |
| | | 1 | Χ | 0 | 0 | HW-U10-F | | | | | |
| | N/D | 2 | 0 | 0 | Χ | HW-U10-F | Knob/Lever | ASD0302T8 | ASD0314T8 | ASD0323T8 | ASD0335T8 |
| | N/D | 3 | Χ | 0 | 0 | HW-U10-F | Key Illuminated Knob | ASD0302KT8 ASLD0302T8 | ASD0314KT8 ASLD0314T8 | ASD0323KT8 ASLD0323T8 | ASD0335KT8 ASD0335T8 |
| 4N0 | | 4 | 0 | 0 | Χ | HW-U10-F | mammatou Knob | 71022000210 | 7.022001110 | 71025002010 | |
| 4110 | INU | 1 | Χ | 0 | Χ | HW-U10-F | Knob/Lever Key Illuminated Knob | ASD0306T8 ASD0306KT8 ASLD0306T8 | A 0 D 0 0 4 0 T 0 | AODOGGTO | AODOGGTO |
| | 305 | 2 | 0 | 0 | Χ | HW-U10-F | | | ASD0310T8 ASD0301KT8 ASLD0310T8 | ASD0328T8 ASD0328KT8 ASLD0328T8 | ASD0339T8 ASD0339KT8 ASLD0339T8 |
| | 300 | 3 | Χ | 0 | Χ | HW-U10-F | | | | | |
| | | 4 | 0 | 0 | Χ | HW-U10-F | aatou ruros | | | | |
| | | 1 | 0 | Χ— | X | HW-U01-F | | | | | |
| | N/D | 2 | Χ— | —X | 0 | HW-U01-F | Knob/Lever Key | ASD0302T8 | ASD0314T8 ASD0314KT8 | ASD0323T8 | ASD0335T8 ASD0335T8 |
| | IN/ D | 3 | 0 | Х | X | HW-U01-F | Illuminated Knob | ASD0302KT8 ASLD0302T8 | ASLD0314K18 | ASD0323KT8 ASLD0323T8 | ASD0335T8 |
| | | 4 | X | —X | 0 | HW-U01-F | aatou ruros | 7.0250002.0 | 7.025.00 | 7.0250020.0 | 7.02000.0 |
| 4NC | | 1 | 0 | Χ | 0 | HW-U01-F | | | | | |
| | | 2 | X | —X | 0 | HW-U01-F | Knob/Lever | ASD0306T8 | ASD0310T8 | ASD0328T8 | ASLD0339T8 |
| | 314 | 3 | 0 | Χ | 0 | HW-U01-F | Key Illuminated Knob | ASD0306KT8 | ASD0301KT8 | ASD0328KT8 | ASD0339KT8 ASLD0339T8 |
| | | 4 | X— | X | 0 | HW-U01-F | or switches. The internal ca | ASLD0306T8 | ASLD0301T8 | ASLD0328T8 | |



- Each operator sub-assembly is available as an "02" and an "06" for 3-position selector switches. The internal cam of an "02" is different from that of an "06". This results in designated combinations of open and closed contacts in the various operator positions.

 2. N/D = No circuit number designation required in assembled part number.
- 3. X = On (closed contacts) 0 = Off (open contacts). X—X Overlapping contacts remain on (closed) when switch is moved between these two positions.

Operator Truth Tables

Use the following tables to build custom selector switches.

2 Position Selector Switches

| | Contact | Mounting | Operator | Position |
|--------------|-----------------------|----------|----------------|----------------|
| | Contact | Position | Left | Right |
| | HW-U10-F (N0) | L | 0 | Χ |
| | HVV-010-F (INO) | R | 0 | Χ |
| | UNA/ LIO1 E (NIC) | L | Х | 0 |
| A CL DO201TO | HW-U01-F (NC) | R | Χ | 0 |
| ASLD0201T8 | HW-U10R-F (NO-EM) | L | 0 | -X- |
| | HVV-UTUN-F (INU-EIVI) | R | 0 | -X- |
| | LIM/ LIG1D E (NIC LD) | L | -X- | 0 |
| | HW-U01R-F (NC-LB) | R | -X- | 0 |

3 Position Selector Switches

| | Contact | Mounting | Operator Position | | | |
|--------------------------|--------------------------|----------|-------------------|--------|-------|--|
| | Contact | Position | | Center | Right | |
| | HW-U10-F (NO) | L | Χ | 0 | 0 | |
| | HVV-010-F (INO) | R | 0 | 0 | Χ | |
| | LIVA / LIGA E (NIG) | L | 0 | Χ | X | |
| ASD0302T8 | HW-U01-F (NC) | R | Χ | X | 0 | |
| ASLD0302T8 ASD0302KT8 | LIVA / LIAOD E (NIO ENA) | L | X | . 0 | 0 | |
| | HW-U10R-F (NO-EM) | R | 0 | _0_ | Χ | |
| | UNATION FAMOUR | L | 0 | — X | —X | |
| | HW-U10R-F (NC-LB) | R | X | X | 0 | |

| | Contact | Contact Mounting | | Operator Position | | | |
|---------------------------------------|-------------------------|------------------|------|-------------------|---------------|--|--|
| | Contact | Position | Left | Center | Right | | |
| | HW-U10-F (NO) | L | Χ | 0 | Χ | | |
| | HVV-010-F (IVO) | R | 0 | 0 | Χ | | |
| ASD0306T8 ASLD0306T8 ASD0306KT8 | HW-U01-F (NC) | L | 0 | Χ | 0 | | |
| | | R | X | X | 0 | | |
| | HW-U10R-F (NO-EM) | L | X | . 0 | X | | |
| | TIVV-OTOII-I (IVO-LIVI) | R | 0 | 0 | Χ | | |
| | HW-U01R-F (NC-LB) | L | 0 | X | 0 | | |
| | HVV-UUTN-F (IVU-LD) | R | Χ | X | 0 | | |

Accessories — TWND Series

| Item | Appearance | | Description/Usage | Part Number | |
|----------------------|-------------|---|---|--|--|
| Lamp Removal Tool | | Rubber tool used to install or rer | move LED's | OR-55 | |
| Metal Bezel | 0 | Replacement locking ring/ bezel | Standard octagonal units (chrome-pl.). Extended, non-illuminated (chrome-pl.). Extended, illuminated (chrome-pl.). Jumbo Mushroom Shallow Shroud Jumbo Mushroom Deep Shroud | OG-81 OG-82 OG-83L ABN4G ABN4F | |
| Plastic Bezel | 0 | Black plastic locking ring/bezel | | OGP11B | |
| Boot/Cover | | Used to cover and protect pushbuttons | In place of ①, specify Neoprene Rubber Boot color: B (black), G (green), R (red), Y (yellow) Flush units (clear plastic -40° to +60°C). | 0C-11 ① 0C-121 | |
| | | Plastic washer For nameplates or panels that should not be scratched. | | OC-122 OGL-D1T | |
| Anti-Rotation Ring | | Thrust washer/Anti-rotation ring | OGL-D1S | | |
| Mounting Hole Plug | | Plugs used to fill unused 30mm panel cutouts. | Plastic with locking nut attached. Metal with locking nut attached Grey rubber (-5° to +60°C) | OBP-11 OB-11 OB-13 | |
| Terminal Tab Adaptor | | Tab #250 17/64" x 3/64" (6.35m | m x 0.8mm): Single tab | TW-FA4 | |
| Long Lamp Holder | | Used with Transformer and two | | TW-LH2 | |
| Lead Holder | - | Used with TW-LH2 holder whe | en using four contact blocks | HW-LH3 | |
| Lock Out Adaptor | (90) | Used to provide lockout protection 1-13/64" (30mm) | on for TWTD pushbuttons and knob selectors. | OL-KL1 | |
| Full Voltage Clips | Per | | Primary Voltage (50/60Hz) Required for all full voltage pilot lights. Two pieces each. 2 clips required for full voltage pilot lights. | | |
| Replacement Keys | do | Pair of keys (#0) | | TW-SK | |

Accessories TWND Series continued

| Item | Appearance | Description/Usage | Part Number | |
|--|------------|---|---|---|
| | | | 1NC | 1NO |
| Contact Blocks (with side entry) | | These contacts are applicable for wires terminated by ring, fork, terminals, not recommended for bare wire connections . | HW-U01 HW-U01-MAU HW-U01R HW-U01R-MAU (with side entry) | HW-U10 HW-U10-MAU HW-U10R HW-U10R-MAU (with side entry) |
| Contact Blocks (without side entry) | | These contacts are applicable for wires terminated by ring, fork, or ferule terminals, and also bare wire connections . | HW-U01-F HW-U01-MAU-F HW-U01R-F HW-U01R-MAU-F (no side entry) | HW-U10-F HW-U10-MAU-F HW-U10R-F HW-U10R-MAU-F (no side entry) |

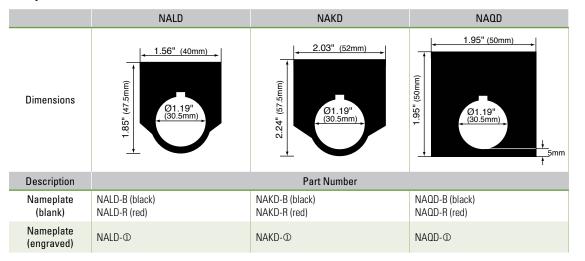
Fingersafe Covers for TWND Series

| ltem | Description | Used with | Part Number |
|------|---|---------------------------|-------------|
| | Fingersafe terminal cover, for full voltage pilot lights, adds 3mm to overall depth | Full voltage pilot lights | APD-PVL |
| | Fingersafe terminal cover, adds 1.5mm to overall depth | Transformer pilot lights | N-VL3 |



Nameplates — TWND Series

Faceplates





- 1. Nameplates are made of 0.031" aluminum. Lettering is white letters engraved on black background.
- 2. In place of ①, insert either the standard legend code from table below or custom engraving delimited by " ".

Standard Legend Codes

| Pushbuttons | | | Pushbuttons/Selector Switches | | | Selector Switches | | | |
|--|---|---|---|---|---|--|--|---|---|
| Legend | Code | Legend | Code | Legend | Code | Legend | Code | Legend | Code |
| AUTO CLOSE DOWN EMERG.STOP* FAST FORWARD HAND HIGH IN INCH JOG LOW LOWER OFF | 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 | OPEN OUT RAISE RESET REVERSE RUN SLOW START STOP* STOP TEST UP I (Int'l On) O (Int'l Off) EMO | 116 117 118 119 120 121 122 123 124 125 126 127 150 151 152 | AUTO-MAN CLOSE-OPEN DOWN-UP FAST-SLOW FOR-REV HAND-AUTO HIGH-LOW JOG-RUN LEFT-RIGHT LOWER-RAISE MAN-AUTO OFF-ON ON-OFF OPEN-CLOSE RAISE-LOWER | 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 | REV-FOR RUN-JOG RUN-SAFE SAFE-RUN SLOW-FAST START-STOP STOP-START UP-DOWN | 216 217 218 219 220 221 222 223 | AUTO-MAN-OFF AUTO-OFF-MAN CLOSE-OFF-OPEN DOWN-OFF-SLOW FAST-OFF-SLOW FOR-OFF-REV LEFT-OFF-RIGHT LOWER-OFF-RAISE OFF-MAN-AUTO OFF-SLOW-FAST OFF-1-2 OPEN-OFF-CLOSE SLOW-OFF-FAST SUMMER-OFF-WINTER UP-OFF-DOWN 1-OFF-2 HAND-OFF-AUTO | 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 |



- *Available in Red as standard legend code 104 and 124. To order engraved nameplate and codes, add legend code to nameplate part number. Character height based on the number of characters, space and size of nameplate. Standard character size is 3/16".
- 2. Nameplates with standard legends are the same list price as blank nameplates. Special engravings, additional cost.

To specify engraving instructions, use the Nameplate order form on next page.

770

Custom engraved Nameplates Order Form — TWND Series

| Copy this order form and use it to spe To ensure engraving accuracy, fax it to Your Company Name: | cify Letter Height, Custom Engravings, Loca your IDEC representative. or Distributor. | | or Contact: | |
|---|---|--|---|---|
| | | | if known): | |
| Telephone: | | IDEC Rep/Distribu | tor Phone: | |
| Fax & Email: | | IDEC Rep/Distributor Fa | x & Email: | |
| NALD Nameplate | Step 1. Choose Letter Size - 7/64" or 1/8". | Sample Letter Sizes | 1/01 | haracters max —— 7/64" size letters) |
| Engraving Location | Check the box for the letter size you want. Then write your lettering in box below checkboxes. Note: 1/8" size letters cannot exceed 13 characters. | 7/64" Letters: A B C D 1/8" Letters: A B C D | 1/8" | characters max 1/8" size letters) |
| | Step 2. Specify Quantity. | | | · _ |
| | Enter the number of nameplates desired in the box on the right. | 1 2 3 4 | 5 6 7 8 9 10 11 12 | i I |
| NAKD Nameplate | Step 1. Choose Letter Size - 7/64" or 1/8". | | | |
| Engraving Location | Check the box for the letter size you want. Then write your lettering in box below checkboxes. Note: 1/8" size letters cannot exceed 9 characters. | | | |
| | Step 2. Specify Quantity. | 1 2 3 4 5 | 6 7 8 9 10 11 12 13 | 14 15 16 17 |
| | Enter the number of nameplates desired in the box on the right. | 0 . 0 | Sample Letter Sizes | 14 13 10 17 |
| | in the box on the right. | | 1/8" Letters: A B C D | |
| NAQD Nameplate | Step 1. Choose Letter Size - 7/64" or 1/8" | 7/64" Letter Size | 20 characters max ——————————————————————————————————— | |
| Engraving Location | Check the box for the letter size you want. Then write your lettering in below checkboxes. Note: 1/8" size letters cannot exceed the characters. | box 1/8" | 16 characters max (for 1/8" size letters) | |
| | | | | |
| Step 2. | 1 2 | | 9 10 11 12 13 14 15 16 | 17 18 19 20 |
| Specify Quantity. | 7 | | nple Letter Sizes " Letters: ABCD | |
| Enter the number of nameplates desired in the box on the right. | | | Letters: A B C D | |

Switch Engraving Order Form -TWND Series

| T | n insure e | naravina | accuracy | fay it to | VOUR IDEC | renresent | ative o | r Distributor | |
|---|------------|----------|----------|-----------|-----------|-----------|---------|---------------|--|

| Your Company: | Telephone: | |
|---------------|-----------------------------|--|
| Name: | Fax: | |
| Address: | Email: | |
| PO: | Part Number to be Engraved: | |

Please check one of the boxes below to indicate your choice of engraving options:

Square Switch

| | # of Lines | Letter Height | Max. Characters Per Line | | |
|--|---------------|------------------|-----------------------------|--|--|
| | 1 | 5/32 | 7 | | |
| | l | 1/8 | 8 | | |
| | 2 | 5/32 | 7 | | |
| | | 1/8 | 8 | | |
| | 3 | 1/8 | 8 | | |
| | 4 | Custom* | | | |

^{*}Engraving is possible, but character size will be smaller than standard sizes.

Round Switch

| | # of Lines | Letter Height | Max. Characters Per Line | | |
|--|---------------|------------------|-----------------------------|--|--|
| | 1 | 5/32 | 7 | | |
| | | 1/8 | 8 | | |
| | 2 | 5/32 | 7 | | |
| | | 1/8 | 8 | | |
| | 3 | 1/8 | 8 | | |
| | 4 | Custom* | | | |

^{*}Engraving is possible, but character size will be smaller than standard sizes.



| | # of Lines | Letter Height | Max. Characters Per Line |
|--|---------------|------------------|-----------------------------|
| | 1 | 3/4 | 4 |
| | ' | 5/16 | 5 |
| | | 5/16 | 5 |
| | 2 | 1/4 | 6 |
| | | 5/32 | 8 |
| | | 5/32 | 8 |
| | 3 | 1/8 | 9 |
| | 4 | 1/8 | 9 |

ø29mm, ø40mm Mushroom Head



| | # of Lines | Letter Height | Max. Characters Per Line |
|-----------|---------------|------------------|-----------------------------|
| Engraving | 1 | 5/32 | 5 |
| Area 1 | I | 1/8 | 5 |
| Engraving | 1 | 5/32 | 7 |
| Area 2 | ! | 1/8 | 7 |
| | | | |



- 1. Above mentioned specifications hold true for standard size pushbuttons (round and square).
- 2. †Engraving Area 2 can be engraved for 40mm mushroom head non-Illuminated pushbutton only.
- 3. Engraving is done on the button itself for non-Illuminated push buttons and on marking plate for illuminated push buttons and pilot
- 4. Please enter text exactly how you want it engraved, take care to emphasize capital or small letters.

| ciilei lext to be eiiui | t to be engraved: |
|-------------------------|-------------------|
|-------------------------|-------------------|

Line 1: Line 2: Line 3:

Sample Letter Sizes

1/8 Letters:

5/32 Letters:

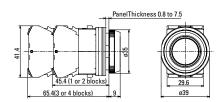
| \triangle | All engravi |
|-------------|-------------|
| 1 | wide. |

ng is 5/8mm

| For IDEC Internal U | Ise Only: | | |
|---------------------|-----------|--|--|
| Work Order #: | | | |
| • | | | |

Line 4:

Pushbutton

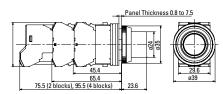


Mushroom Pushbutton w/Full Shroud



Illuminated Pushbuttons

w/Transformer



Lever

45.4 (1 or 2 blocks)

| Illuminated Pushbuttons | Dimension A | Dimension B |
|--|-----------------------------------|------------------------------------|
| Flush w/Full Shroud | 0.975" (25mm) 0.995" (25.5mm) | ø 0.936" (24mm) ø 0.936" (24mm) |
| Extended w/Full Shroud | 0.741" (19mm) 0.761" (19.5mm) | ø 0.936" (24mm) ø 0.936" (24mm) |
| ø 1.56" (40mm) Mushroom Pushlock Turn Reset, Push-Pull | *0.975" (25mm) **0.975" (25mm) | ø 1.56" (40mm) ø 1.56" (40mm) |

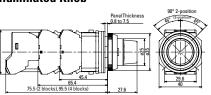


- *Dimension when operator is in reset position.
 **Dimension when operator is in pull position.

Selector Switches

Knob 45.4 (1 or 2 blocks) i.4 (3 or 4 blocks)

Illuminated Knob



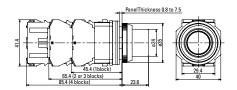
Dimensions (mm)

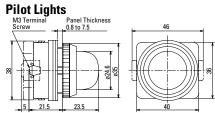
| Pushbuttons | Dimension A | Dimension B |
|--|--|---|
| Flush Extended Extended w/Full Shroud | 0.351" (9mm) 0.566" (14.5mm) 0.663" (17mm) | ø 0.975" (25mm) ø 0.975"(25mm) ø 1.11" (28.5mm) |
| Mushroom Mushroom w/Full Shroud Jumbo Mushroom ø 1.56" (40mm) | 0.858" (22mm) 0.936" (24mm) 1.13" (29mm) | ø 1.56" (40mm) ø 1.87" (48mm) ø 2.54" (65mm) |
| Mushroom, Pushlock Turn Reset and Push-Pull ø 1.56" (40mm) | *0.975" (25mm) **0.975" (25mm) | ø 1.56" (40mm) ø 1.56" (40mm) |



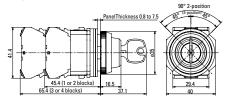
- *Dimension when operator is in reset position.
- *Dimension when operator is in pull position.

Full Voltage



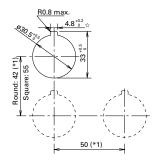


Key





Selector Switches Panel Cut-Out





1. *Jumbo Mushroom < 2.61" (66mm)

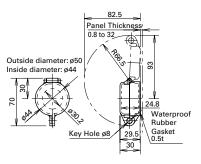
Switches & Pilot Devices

- Minimum mounting centers are applicable to switches with one stack of contact blocks. When mounting two stacks of contact blocks, minimum centers should allow for access to wiring.
- 3. The ø 0.195" (ø 5mm) recess is necessary when either the nameplate or anti-rotation ring is used.

IlluminatedSelector Switches

OL-KL1

Lock-Out Adaptor

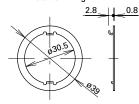


OC-31 **Pushbutton Clear Boot**

ø32.6 18 (OC-31) 22 (OC-32)

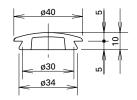
OGL-31

Anti-Rotation Ring



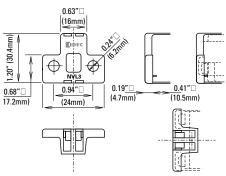
OB-31

Mounting Hole Rubber Plug

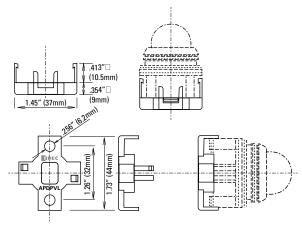


Finger-Safe Cover

N-VL3



APD-PVL

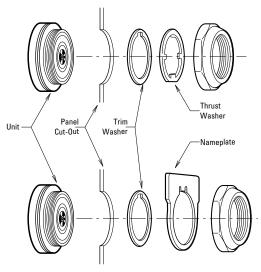




Operating Instructions

Adjustment for Panel Thickness

Each unit is shipped with several waterproof gaskets which are 0.06" (1.5mm) and 0.12" (3mm) thick. Combine the gaskets for a dimension approximately equal to panel thickness and install between the bezel and the body of the unit.

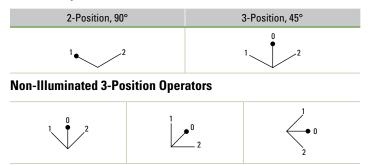


A trim washer must be used with a thrust washer or a nameplate to prevent the control unit from rotating in the mounting hole. When using anti-rotation rings (trim washer with thrust washer or nameplate), install as shown below.

Selector Switches

The operator shaft of each unit has a recess to identify in which direction to install the handle. Align the handle with the recess. Press color insert (TW-HC1) into the Standard Operating Positions.

Standard Operation Positions



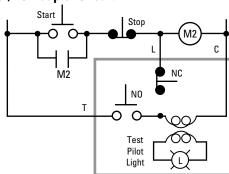
Insallation of LED Illuminated Units

Transformer units are recommended for use in areas subjected to inductive noise.

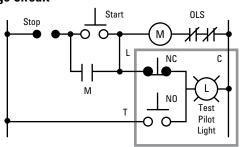
Application Example For Push-To-Test Pilot Light

A typical application of illuminated pushbuttons is a push-to-test pilot light which can be used to check the lamp/LED circuit.

Transformer/AC-Adapter Circuit



Full Voltage Circuit

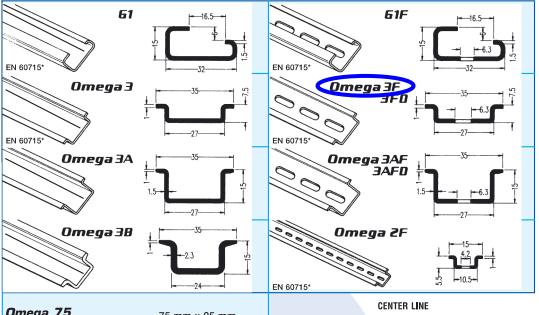






RoHS compliant

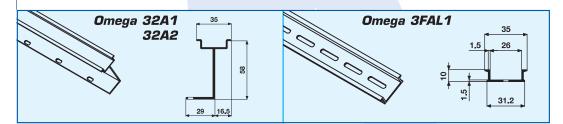
The most comprehensive range of **Din metal mounting rails**



Omega 75 EN 60715*

75 mm x 25 mm

The unperforated mounting rails (G1/OMEGA 3/OMEGA 3A/ OMEGA 3B) have a center line in order to expedite the drilling of the mounting holes.

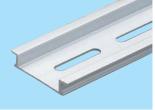


| Catalog | Lengths |
|------------|----------|
| Number | Per Pack |
| G1 | 12 |
| G1F | 12 |
| OMEGA 2F | 20 |
| OMEGA 2F1 | 40* |
| OMEGA 3 | 20 |
| OMEGA 3F | 20 |
| OMEGA 3F1 | 40* |
| OMEGA 3FD | 20 |
| OMEGA 3A | 10 |
| OMEGA 3AF | 10 |
| OMEGA 3AF1 | 20* |
| OMEGA 3AFD | 10 |
| OMEGA 3B | 10 |
| OMEGA 3B1 | 10* |
| OMEGA 75 | 2 |

| Number | Per Pack |
|---|----------------|
| ALUMINUM | |
| OMEGA 32A1 OMEGA 32A2 OMEGA 3FAL1 | 6* 6 40* |
| GROMMET | |
| IG-11 | 10 |
| COPPER | |
| OMEGA 3ACU | 1 |
| STAINLESS STEEL | |
| OMEGA 3SS OMEGA 3SS1 | 2 6* |
| | |

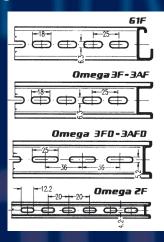
^{*}One meter long



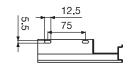


Treated with galvanic zinc plating and passivation (gal Zn 8c according to Din 50960) Minimum thickness 6 microns Standard length: 2 meters (6'63/4")

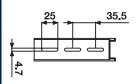
Bottom perforation



Omega 32A1 32A2



Omega 3FAL1



In compliance with EN 60715 standard

DUCT SERIES

Material

Rigid PVC, self-extinguishing

Color

Light GREY RAL 7030 WHITE

Standard Length

6 Feet 6 3/4 Inches

Standard Unit

Duct complete with cover

| Catalog | Nominal | Dimen: | sions in | inches (| Actual) | Dimensions | Standard Cart | on (Qty) |
|-----------|------------|--------|----------|----------|---------|----------------------|---------------|----------|
| Number | Size (WxH) | | H | E | F | WxH (in millimeters) | Lengths (1) | Feet |
| T1E-1015* | 1 x 1½ | 1.00 | 1.57 | .16 | .24 | 25 x 40 | 18 | 108 |
| T1E-1022* | 1 x 2¼ | 1.00 | 2.36 | .16 | .24 | 25 x 60 | 24 | 144 |
| T1E-1030* | 1 x 3 | 1.00 | 3.15 | .16 | .24 | 25 x 80 | 24 | 144 |
| T1E-1040* | 1 x 4 | 1.00 | 3.94 | .16 | .24 | 25 x 100 | 8 | 48 |
| T1E-1515* | 1½ x 1½ | 1.57 | 1.57 | .16 | .24 | 40 x 40 | 20 | 120 |
| T1E-1522* | 1½ x 2¼ | 1.57 | 2.36 | .16 | .24 | 40 x 60 | 18 | 108 |
| T1E-1530* | 1½ x 3 | 1.57 | 3.15 | .16 | .24 | 40 x 80 | 16 | 96 |
| T1E-1540* | 1½ x 4 | 1.57 | 3.94 | .16 | .24 | 40 x 100 | 8 | 48 |
| T1E-2215G | 2½ x 1½ | 2.36 | 1.57 | .16 | .24 | 60 x 40 | 12 | 72 |
| T1E-2222* | 2¼ x 2¼ | 2.36 | 2.36 | .16 | .24 | 60 x 60 | 12 | 72 |
| T1E-2230* | 2¼ x 3 | 2.36 | 3.15 | .16 | .24 | 60 x 80 | 12 | 72 |
| T1E-2240* | 2¼ x 4 | 2.36 | 3.94 | .16 | .24 | 60 x 100 | 4 | 24 |
| T1E-3015G | 3 x 1½ | 3.15 | 1.57 | .16 | .24 | 80 x 40 | 12 | 72 |
| T1E-3022* | 3 x 2¼ | 3.15 | 2.36 | .16 | .24 | 80 x 60 | 12 | 72 |
| T1E-3030* | 3 x 3 | 3.15 | 3.15 | .16 | .24 | 80 x 80 | 12 | 72 |
| T1E-3040* | 3 x 4 | 3.15 | 3.94 | .16 | .24 | 80 x 100 | 4 | 24 |
| T1E-4015G | 4 x 1½ | 3.94 | 1.57 | .16 | .24 | 100 x 40 | 8 | 48 |
| T1E-4022G | 4 x 2¼ | 3.94 | 2.36 | .16 | .24 | 100 x 60 | 8 | 48 |
| T1E-4030* | 4 x 3 | 3.94 | 3.15 | .16 | .24 | 100 x 80 | 8 | 48 |
| T1E-4040* | 4 x 4 | 3.94 | 3.94 | .16 | .24 | 100 x 100 | 4 | 24 |

C€

Available in 1 meter length contact sales office

All wiring ducts come complete with cover. Wiring duct covers can

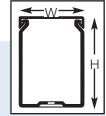
be sold separately: see page 8 and IBOCO Corp. Price List.

Example: T1E-1015 G = $1"x1\frac{1}{2}"$ light GREY duct with cover

(1) Each standard length is actually 6'6 3/4" but is counted as 6 feet for packaging and pricing

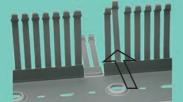
* Color - add suffix "G" for light GREY "W" for WHITE

ADHESIVE BACKING - add suffix "A" to catalog number - contact sales office for pricing (see page 22)





Restricted slot opening for wire retaining.

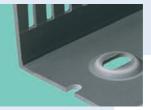


Two predetermined breaklines:

- for breaking off and removal of sidewall finger segments only.
- for removal of sidewall finger and base segments.



Burr-free edges.



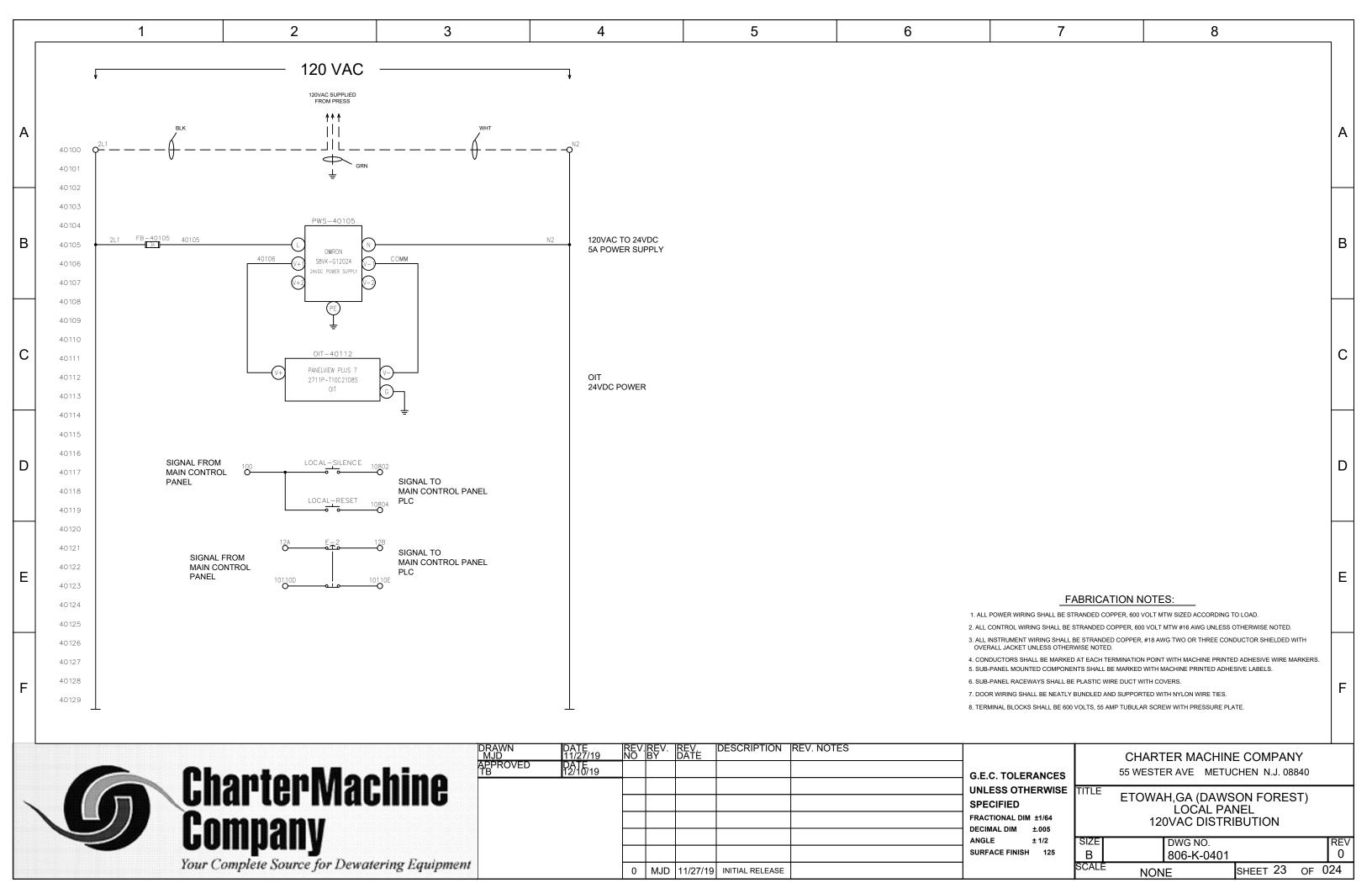
Recess boss for rapid mounting of components.



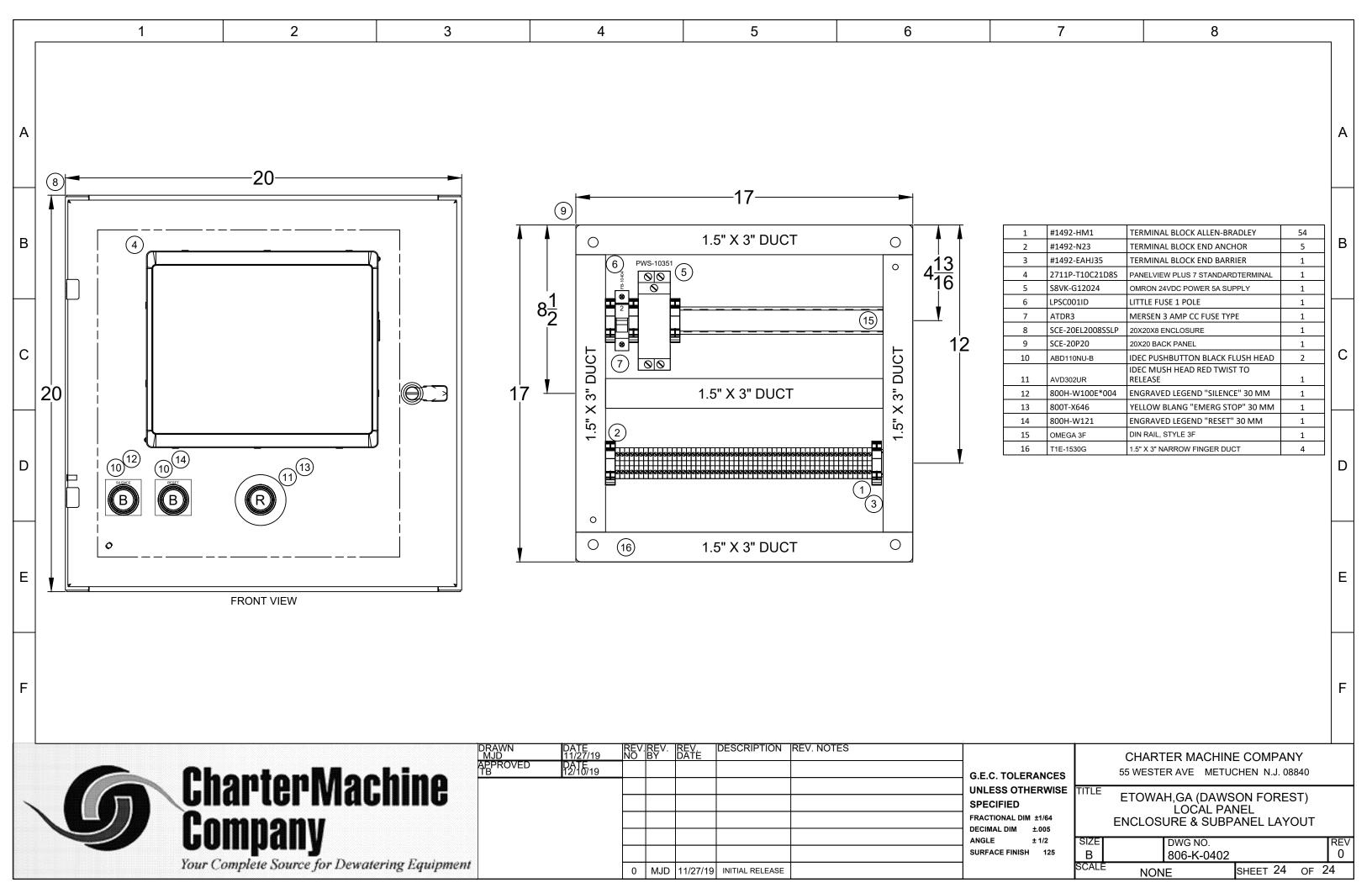
Non- slip cover design of minimun encumbrance and maximum grip.

For wire fill capacity and base perforation of the wiring duct, see page 18.











ATTACHMENT B

Southern Geotechnical Consultants Geotechnical Report No. 73536 – Dated January 16, 2020



REPORT OF SUBSURFACE EXPLORATION

PROPOSED SLUDGE DEWATERING BUILDING SITE DAWSON FOREST WRF 1349 MARTIN ROAD DAWSONVILLE, GEORGIA SGC Project No. 12674G, Report No. 73536

January 16, 2020



January 16, 2020

Wiedeman and Singleton, Inc. 3091 Governors Lake Drive Suite 430 Norcross, Georgia 30071

Attention: Mr. Peter Johns, P.E.

Subject: Geotechnical Exploration

Proposed Sludge Dewatering Building
Dawson Forest Water Reclamation Facility

1349 Martin Road Dawsonville, Georgia

SGC Project No. 12674G, Report No. 73536

Gentlemen:

Southern Geotechnical Consultants (SGC), LLC has completed the subsurface exploration at the referenced site. Our services were provided in general accordance with our Proposal No. GP-1998 dated October 14, 2019. The exploration report provided herein was performed to obtain a general assessment of subsurface conditions at select locations relative to the existence of rock, groundwater, and other site grading considerations, and to provide grading recommendations and foundation support capabilities of the in-place soils. This report explains our understanding of the project, documents our findings, and presents our conclusions and engineering recommendations.

PROJECT INFORMATION

We understand that a new Sludge Dewatering Building is planned for the Dawson Forest Water Reclamation Facility. As shown on the aerial plan provided to us, the building will be sited north of the treatment pond and south of the office building at the plant. Plate 1 in the Appendix is a site location plan. The planned building will total about 3,300 square feet, will be single story, steel framed and have a masonry exterior. The interior will house equipment used as part of the sludge dewatering process. While no specific structural design information is available at this time, we assume for the purposes of this evaluation that maximum column loads for the building and equipment will be 125 kips or less, wall loads will be 1 to 2 kips per linear foot and floor loading will be 150 psf or less. Also, we expect individual equipment foundations will be utilized. Topographically, the site is characterized as sloping to the south/southeast from a high to the north/northwest. Topographic relief across the proposed building footprint is estimated at less than 5 feet. Based upon the noted finish floor elevation of 1,049.88, we expect cuts and fills for site grading will be minimal; however, utility excavations and backfills will be greater.

GEOLOGIC INFORMATION

The project site is in Georgia's Piedmont physiographic province. The soil overburden of this area is residuum formed by in-place weathering of the parent rock. A typical upland soil profile consists of thin topsoil underlain by a few feet of clayey soils that transition with increasing depth into less clayey, coarser grained silts and sands with varying mica content. Separating the completely

weathered soil overburden from the unaltered parent rock is a transition zone of residuum with penetration resistances of more than 100 blows per foot (bpf) which is locally described as *partially weathered rock*. Partially weathered rock retains much of the appearance and fabric of the parent rock formations and may consist of thinly bedded layers of very hard dense soil and rock. Based upon limited exposure of boulders at the site and the general nature of the soil samples collected, it would appear that the bedrock at the site consists of granitic gneiss to more quartz rich schist rock types.

The weathering processes that formed the overburden soils and partially weathered rock were extremely variable, depending on such factors as rock mineralogy, past groundwater conditions, and the tectonic history (joints, faults, and igneous intrusions) of the specific area. Differential weathering of the rock mass has resulted in erratically varying subsurface conditions, evidenced by abrupt changes in soil type and consistency in relatively short horizontal and vertical distances. Depths to rock can be irregular and isolated boulders, discontinuous rock layers, or rock pinnacles can be present within the overburden and transition zones.

Fill soils have been placed by man in conjunction with past construction activities. Fill can be composed of many different soil types from several sources and can also include debris from building demolition, organics, topsoil, trash, etc. The quality of the fill depends primarily on its composition, density, and moisture content. While no fill was encountered in our limited borings, it is possible given the previous development of the site that some fill exists. To the best of our knowledge, no documentation (e.g., density tests, etc.) regarding fill placement exists for this site. If such data exist, we would request the data.

EXPLORATION METHODS

The procedures used by SGC for field sampling and testing are according to ASTM procedures and established engineering practice. The appendix contains brief descriptions of the procedures used in this exploration as well as descriptions of the data obtained.

As part of this exploration four soil test borings were drilled to generally explore the subsurface conditions. The Boring Location Plan (Plate 2) in the Appendix shows the approximate boring locations and general site topography. Prior to drilling, Mr. Glenn Motes of our firm performed a brief site reconnaissance, noting pertinent site and topographic features as well as surface indicators of the site's geology. During this reconnaissance, all borings were field located by estimating headings and pacing distances from existing site features identified on the existing site plan provided to us. Because of the location methods used, the boring locations shown on the Boring Location Plan in the Appendix are approximate. If more precise elevation or location information is desired for the borings, a surveyor should be retained to obtain such information.

Soil samples obtained as part of the soil test borings were returned to our laboratory and reviewed by a member of our staff. The purposes of this review were to check the field descriptions, visually estimate the percentages of the soil's constituents (sand, clay, etc.), identify pertinent structural features such as foliation planes and slickensides, etc., and observe evidence of soil origin. All boring data, including sampling levels, penetration resistances, and soil descriptions are presented on the attached Test Boring Records. The stratification lines shown on the boring records represent the approximate boundaries between soils, but the transitions may be more gradual.

SUBSURFACE CONDITIONS

The following description of subsurface and groundwater conditions encountered is general and brief. Please refer to the Boring Location Plan (Plate 2) and, Test Borings Records located in the Appendix for more specific descriptions and locations.

In general, the borings penetrated a thin topsoil vegetative layer. Beneath this layer in all but Boring No. 1 about 2 to 6 feet of variable consistency existing fill was penetrated. The existing fill as sampled is generally described as soft to very stiff yellow-brown, brown and red-brown clayey sandy silts with varying mica content. Standard penetration resistance values in the fill as sampled ranging from 4 to 17 blows per foot (bpf).

Beneath the fill residual soils were encountered. As sampled the residual soils consist of soft to very hard sandy silts with varying mica and clay content. Standard penetration resistance values in the residual soils as sampled range from 3 to 65 blows per foot (bpf). No partially weathered rock or hard rock was encountered in the borings within the depths explored. The borings were terminated at a depth of 20 feet in residual soils.

Groundwater was encountered at the time of drilling at depths ranging from about 8 to 15 feet below the existing ground surface. We note that groundwater levels will fluctuate with seasonal and yearly rainfall variations, local heavy precipitation events, etc. and could exist at different levels in the future. Given the unusually heavy rainfall experienced during this time, it may be possible that groundwater levels have been accentuated over normal levels. As such, variations should be accounted for in the construction process.

LIMITATIONS OF REPORT

This report is for the exclusive use of Etowah Water and Sewer Authority, Wiedeman and Singleton, Inc., and their designers for specific application to the subject project. Our conclusions and recommendations have been prepared using generally accepted standards of geotechnical engineering practice in the State of Georgia. No other warranty is expressed or implied. This company is not responsible for the conclusions, opinions, or recommendations of others based on these data.

Our conclusions and recommendations are based on the conceptual development information furnished to us, the data obtained from this subsurface exploration, the assumptions outlined herein, and our past experience. They do not reflect variations in the subsurface conditions which likely exist between our borings and in unexplored areas of the site due to the inherent variability of the subsurface conditions in this geologic region as well as past site use (grading, farming, etc.). If such variations become apparent during construction, it will be necessary for us to re-evaluate our conclusions and recommendations based upon on-site observation of the conditions.

If the overall design or location of the proposed building is changed, the recommendations contained in this report must not be considered valid unless the changes are reviewed by our firm and our recommendations modified or confirmed in writing. When the design is finalized, we should be given the opportunity to review the foundation plan, grading plan, and applicable portions of the project specifications. This service will allow us to determine whether these documents are consistent with the intent of our recommendations.

The report sections include comments about excavation, foundation construction, earthwork, and other geotechnical aspects of the proposed construction. The recommendations contained herein are not intended to dictate construction methods or sequences. They are based on findings from this subsurface exploration and are furnished solely to help designers understand subsurface conditions related to foundation and earthwork plans and specifications. Depending on the final design of the project, the recommendations also may be useful to personnel who observe construction activity.

Field observations, monitoring, and quality assurance testing during earthwork and foundation installation are an extension of the geotechnical design. We recommend that the owner retain these services and that we be allowed to continue our involvement in the project through these phases of construction. Our firm is not responsible for interpretation of the data contained in this report by others, nor do we accept any responsibility for job site safety which is the sole responsibility of the contractor.

CONCLUSIONS AND ASSESSMENTS

GENERAL DISCUSSIONS

As previously noted, existing fill was encountered in our borings within the footprint of the planned building. The fill as sampled appears to thicken to the south with a maximum thickness recorded in Boring No. 3 approximating 6 feet. As sampled, the fill appears to be insufficiently compacted to adequately support the planned building. In dealing with the fill and the risks associated with leaving it in-place as support for any future building we offer two options for consideration. The least risk option would be to remove and replace all of the existing fill within the building footprint and ten feet beyond with new compacted structural fill that is observed and tested for compaction compliance during placement. We expect that most of the fill could be re-used; however, given the in-place moisture of the soils sampled we expected that moisture conditioning will be required to allow for adequate compaction. Also, given the potential for the shallow groundwater levels to soften the exposed soils below the fill, we expect that crushed stone stabilization will be required to allow for replacement with compacted structural fill. For budgeting we would expect that stabilization will require about 1½ feet of coarse crushed stone like No. 4 gradation or small surge capped with serval includes of roadway base. Additionally, depending upon the conditions of the exposed soils once the fill is removed a heavy weight geotextile fabric or geogrid such as Tensar model TX140 may be required. The need and approach are best left as a field decision by one of our representatives at the time of the construction.

As a second option the site can be brought to grade and any undercutting and replacement of the existing fill limited to the building and/or equipment foundation excavations. With this approach, all of the foundation excavations would need to be extended through the existing fill and any soft residual soils to expose high consistency residual soils. The excavation would then need to be backfilled using compacted No. 57 gradation crushed stone. The amount of over-excavation cannot be accurately determined at this point in time. Furthermore, the width of over excavation would need to occur in conjunction with the depth of removal. As a general guideline, the foundation will need to be widened where feasible ½ foot on all sides per foot of depth extended below the foundation subgrade. We note that with this approach no undercutting of softer zones beneath the floor slab will occur short of any near surface soft zones discovered as part of subgrade evaluations during construction. However, given the depth of undercutting required in the deeper sections of the fill extension into the slab area is likely.

Depending upon final grades, groundwater may directly impact construction. Therefore, pumping of groundwater from the excavation to facilitate stabilization with crushed stone is possible.

Specific of staging and logistics is best left as a field decision during construction. However, as a general guideline we have found that excavation of a sump at one end of a stretch of foundation excavation can provide an efficient means to help keep water levels down in the trench. Furthermore, having a stockpile of crushed stone on-site as undercutting is progressing so that stone can quickly be placed once a small section of trench has been excavated can limit fall-in or cave-in of trench walls from groundwater seepage. It can also help limit softening of the exposed residual soils from groundwater upwelling where the groundwater table is penetrated by excavation.

EXCAVATION DIFFICULTY

Based upon the boring data we do not expect widespread difficult excavation associated with very high consistency residual soils and/or partially weathered rock. Also, based upon the available data, and the grades shown, any blasting of hard rock if encountered will be isolated. We note that in such cases it is also possible that boulders will be encountered in the soil overburden that may require blasting or removal by pneumatic hammers to break down to a size that can be effectively used as fill or moved and isolated to minimize impact. As such we recommend that the construction budget include a modest provision for some difficult excavation techniques such as blasting or pneumatic tool removal of isolated rock.

We anticipate that the overburden soils can be excavated with conventional heavy earthmoving equipment such as pusher-assisted scrapers and moderate-size front-end loaders. In trench excavations through the overburden soils of this site, moderate-size rubber-tired or track-mounted backhoes can be used. However, because of the depths required and the possible isolated presence of partially weathered rock, a large tracked backhoe, such as a Caterpillar 225 likely will be more efficient in excavating for utilities.

As with any project such as this, we recommend use of a performance-type rock definition. *Rock* excavation can be defined in many ways. In our opinion, rock excavation should be defined in a method specification based on the grading equipment commonly used in the project's area. We have attached a guideline rock excavation specification for your review in the Appendix.

SUBGRADE PREPARATION

Subgrade preparation should be relatively routine and include stripping any topsoil and debris from the proposed building area. Clean topsoil may be stockpiled for landscaping, placed in non-structural fill areas. Depending upon the option chosen as discussed in the "General Discussions" report section all or portions of the existing fill present in structural areas at the site can be removed and replaced with new compacted structural fill prior to fill placement.

Any underground utilities if present will need to be re-routed, abandoned and removed before new fill is placed in building areas. Some remediation of soft utility backfill should be expected. In proposed pavement areas, dependent upon finished grades, utilities can possibly be left in place provided a satisfactorily stable pavement subgrade can be achieved where they cross.

After stripping, the surface should be observed by a representative of our engineering staff. At-grade areas and areas that are to receive fill should be evaluated by observing proofrolling with a heavily loaded dump truck or other piece of construction equipment. Proofrolling consists of applying repeated passes to the subgrade with this equipment. Any materials judged to deflect excessively under the wheel loads, and which cannot be densified by continued rolling should be undercut to more stable soils or stabilized in place before placing fill. Any previously undetected abandoned

utilities that are discovered by this evaluation process should be removed and/or any soft associated backfill which falls within any proposed building pad should be undercut and replaced with compacted structural fill. It must be noted that proofrolling typically only detects surficial (upper 2 to 3 feet) deflections in the subgrade and there is a chance that undetected utilities could go unnoticed if this is the only means of remediation conducted.

Some minor localized areas of old backfill may be encountered that will not perform satisfactorily during proofrolling. We recommend that the budget contain a contingency for having to selectively undercut these areas, haul the undercut material off-site if found to not meet the structural fill criteria, and possibly import new structural fill.

FILL PLACEMENT

Any fill soils placed within building areas should be classified as structural fill. Structural fill is defined as inorganic natural soils with a maximum particle size of 6-inches or less in mass-graded areas and 4-inches or less in trench or retaining wall backfill. All structural fill must be compacted to 95 percent of its standard Proctor maximum dry density (ASTM D698). In-place density tests must be performed as a check that the previously recommended compaction criteria have been achieved. Where floor slabs are to be constructed and in pavement areas, it is advisable to compact the upper 12- to 18-inches of these subgrades to a higher degree of compaction (98 percent).

FILL DENSITY TESTING

In-place density testing must be performed as a check that the previously recommended compaction criteria are achieved. We recommend that density testing be performed on a frequency of testing determined by our personnel based on the rate of placement, equipment being used, etc. Density testing should be performed by one of our qualified soil technicians working under the direction of our engineers.

MATERIAL USAGE

As previously discussed, structural fill should be defined as inorganic natural soils with maximum particle sizes of 6-inches or less in mass-graded areas and 4-inches or less in trench or retaining wall backfill. The following paragraphs will discuss the usage of the materials which will likely be encountered at this site.

Residual Soils

Piedmont residual soils like those encountered by our borings at the site are generally compatible with achieving a high degree of compaction as indicated for structural fill in building and parking areas. However, it is likely that moisture content adjustments will be necessary to achieve the recommended compaction criteria.

Existing Fill

Existing fill soils which do <u>not</u> contain topsoil and/or organic debris can likely be reused as structural fill. However, we expect that moisture adjustments will be necessary to achieve proper compaction. We recommend that any material containing topsoil be cleaned to remove organic debris and reused in landscaped areas, hauled off site, or placed at the base of the deep fills in the parking areas. All organic debris should be burned or hauled off site.

Partially Weathered Rock

Partially weathered rock and very dense soils if encountered will require ripping with a large bulldozer prior to loading by scraper or excavation with a front-end loader or tracked backhoe. The excavated partially weathered rock will have an extremely variable gradation ranging from silt- and clay-size particles through cobble- and boulder-size. Some breakdown of the larger particles can be expected during the excavation-placement-compaction process, depending upon rock type, degree of weathering, and jointing frequency. Weathered rock and dense soils that break down into particles less than about 6-inches can be used as structural fill to support buildings, roadways, and pavements. Partially weathered rock that does not break down to this maximum particle size criterion can be used as fill in lower portions of pavement areas or in non-structural areas. A recommended maximum lift thickness for this coarser partially weathered rock (particles exceeding the 6-inch maximum size criterion) is 1 foot. At least 3 feet of soil structural fill should be placed between coarse graded partially weathered rock and the pavement subgrade.

Partially weathered rock should be compacted with a heavy self-propelled sheepsfoot roller such as a Caterpillar 815. This device can typically break down the partially weathered rock to a gradation comparable with both the maximum particle size criterion for structural fill and in-place density testing. The partially weathered rock should be compacted to at least 95 percent of its standard Proctor maximum dry density. If the partially weathered rock does not break down to a gradation compatible with in-place density testing, then compactive effort should be applied until there is no perceptible increase in fragmentation of the particles or observable consolidation of the fill beneath the equipment. Qualified geotechnical personnel should be present to identify when this condition has been achieved.

Boulders and/or Shot Rock

While no auger refusal was encountered in the borings, we offer the following for your information if an isolated rock or large boulder is encountered. Boulders and/or shot rock with a maximum particle size of 3 feet can be used as rock fill in the deep roadway, parking area, or non-structural area fills or hauled off site. If this material is used, it should be placed in accordance with Georgia GDOT standards. Also, a minimum of 5 feet of soil fill cover should separate the top of any rock fill from pavement subgrades. To limit raveling of soil into the rock fill, several inches of graded aggregate base or a geotextile may need to be placed at the contact between any rock fill and soil structural fill. It may be possible to substitute a mixture of gravel- and silt-size particles resulting from the blasting operation; however, the use of this material should be left as a field decision and monitored by one or our personnel.

Boulders or shot rock pieces larger than 3 feet in any dimension should be broken down so that they may be placed as described above.

GROUNDWATER

Groundwater was encountered at the time of drilling at depths ranging from 8 to 15 feet below the existing ground surface. We note that groundwater levels will fluctuate with seasonal and yearly rainfall variations, local heavy precipitation events, etc. and could exist at different levels in the future. Also, given the closeness of the emergency treatment pond at the facility to the project site it is possible that the levels are influenced by the pond level. Additionally, given the unusually heavy rainfall experienced during this time, it may be possible that groundwater levels have been accentuated over normal levels. As such, variations should be accounted for in the construction process.

EARTH SLOPES

The following are our general recommendations for slopes to assist you in developing a grading plan. Generally, permanent cut and fill slopes should be no steeper than 2H:1V and temporary slopes no steeper than 1½H:1V. These slope recommendations are based on our previous experience with similar conditions since no detailed slope stability analysis was performed to justify steeper slopes.

We recommend a building setback of at least 10 feet from the tops of all slopes and a setback of at least 3 feet for parking area curbs. Drop inlets or storm sewers should not be installed at the crests of slopes because leakage can result in maintenance problems or possible slope failure. Crest areas should be sloped to prevent surface runoff from flowing over the slope faces.

It is difficult to construct fill at the recommended inclinations without leaving a loose, poorly compacted zone on the slope face. For this reason, we recommend that any fill slopes be slightly over-built, then cut back to firm, well compacted soils prior to applying a vegetative cover. If the slopes cannot be slightly over-built and cut back, we recommend that finished soil slopes be compacted to reduce, as much as practical, the thickness of this soft surficial veneer. The compaction may be done by making several coverages from top to bottom of the slopes using a bulldozer.

RETAINING WALLS

While the site plan provided to us does not indicate site retaining walls being constructed, there is some chance that once grading commences a site wall may be needed. Also, any loading dock wall will act as a retaining wall to provide the required grade change from the building slab to the pavement subgrade. Where retaining walls are not free to rotate, such as the loading dock wall, we recommend using the "at-rest" earth pressure condition. For site retaining walls where some rotation is usually permissible, the "active" earth pressure condition can be used in design.

Soils behind the retaining walls are assumed to exert a triangular stress distribution which can be modeled in terms of an "equivalent fluid" for both the active and at-rest cases. If a <u>uniform area surcharge</u> is applied behind the wall, a portion of the surcharge is transferred to the wall in the form of a uniform or rectangular lateral stress distribution. The magnitude of the lateral stress transferred to the wall is a function of the soil's strength and the permissible degree of deflection or rotation. It is computed by multiplying the soil's "earth pressure coefficient" by the magnitude of the surcharge. The following table contains values of earth pressure coefficients and equivalent fluid unit weights for the at-rest and active earth pressure conditions.

| Earth Pressure Condition | Earth Pressure Coefficient | Recommended Equivalent Fluid Unit Weight, pcf |
|------------------------------|-------------------------------|--|
| At-Rest, Horizontal Backfill | 0.53 | 60 |
| Active, Horizontal Backfill | 0.36 | 40 |

The above values assume there is a horizontal surface beyond the toe of the wall.

Passive earth pressure of soil adjacent to the footing as well as soil friction at the footing base may be used to resist sliding. The ultimate friction coefficient between the concrete footing and soil can be

assumed to be 0.4. For computations, the ultimate passive soil resistance may be assumed to act as a fluid with an equivalent unit weight of 300 pcf. In computing soil friction at the footing base, compacted soil placed above the footing can be assumed to have a unit weight of 110 pounds per cubic foot. We recommend that a safety factor of 2 or more be used when computing restraining forces.

The recommended equivalent fluid pressures also assume that constantly functioning drainage systems are installed between walls and soil backfill to prevent the build-up of hydrostatic pressures and lateral stresses in excess of those calculated for drained conditions. Wall drainage systems should consist of a filtered granular backfill (No. 57 size crushed stone) or a manufactured material such as Enkadrain or Miradrain. The drainage medium should extend to within 2 feet of the ground surface in exterior locations with compacted structural fill placed over the drainage medium to prevent direct surface water inflow. For the loading dock wall, the drainage media should be connected to a positive draining footing drain. If crushed stone drainage is used, we recommend that it be separated from the surrounding soil by a non-woven geotextile filter cloth. A non-woven geotextile fabric should also be placed between the weephole openings and crushed stone.

Compacted structural fill should be used as backfill behind the retaining walls. We recommend that these materials be compacted to at least 95 percent of their standard Proctor maximum dry density. Either light, hand-operated compaction equipment must be used within 4 feet of walls to reduce the risk of over-stressing the walls, or the walls must be designed to resist the stresses imposed by large compaction equipment.

The previously recommended soil parameters are "average" values based on our experience. Triaxial shear tests and standard Proctor compaction tests of soils in this geologic region indicate that there could be a potential scatter of 30± percent in soil parameters. Both remolded triaxial shear tests and standard Proctor compaction tests on retaining wall backfill are necessary to obtain more precise design parameters. This testing was not included in our present scope of work. If authorized, we will perform laboratory tests to obtain site-specific design soil parameters.

FOUNDATIONS

The exploration findings indicate that the building can be supported by footings bearing on high consistency residual soil, and/or new structural fill. We recommend that a maximum allowable net soil bearing pressure of 2,500 psf be used to size wall and column footings supported by these materials. As indicated in the "General Discussions" report section, we recommend that undercutting and replacement of the building footprint with new compacted soil structural fill, or as an option the foundation soils with No. 57 gradation crushed stone where existing fill exists.

Even though computed footing dimensions may be less, column footings should be at least 24-inches wide and strip footings should be at least 18-inches wide. These dimensions facilitate hand cleaning of the footing subgrades disturbed by excavation and also reduce the potential for localized punching shear failure. The bottoms of all exterior footings and footings in unheated areas should be at least 12-inches below minimum adjacent grade elevation to protect against frost heave.

We note that all footing excavations should be evaluated by our firm to observe the field conditions in light of our reported design recommendations. We can also provide geotechnical guidance to the design team should any unforeseen foundation problems develop during construction.

Footing excavation often produces a thin veneer of disturbed soil at the footing subgrade. We recommend that this disturbed soil be hand cleaned prior to placing reinforcing steel. Furthermore, the footing bottom should be free of all fall-in prior to placing concrete.

The strength properties of soils exposed at the footing subgrade will change when exposed to weather extremes (wetting, desiccation, or freezing). Every effort should be made to place concrete the same day as the footing excavation is completed. If subgrades are to be left open for more than one day, they should be covered with polyethylene sheeting. If inclement weather is expected, a lean (1,000 psi) concrete veneer about 3-inches thick should be placed on the exposed subgrade. If these protective measures are not implemented, excavation of disturbed soils may be required.

SLAB SUPPORT

The on-grade floor slab may be supported on undisturbed residual soils, new compacted structural fill and/or existing fill further evaluated at the time of construction. To reduce the possibility of slab cracking due to minor differential settlement, the floor slab should be structurally separate from the foundations. Since groundwater was not encountered within 5 feet of the finished floor grades, we believe that an underslab drainage layer is optional. In finished areas, the subgrade should be covered by an effective vapor barrier to reduce the possibility of slab dampness due to soil moisture. We recommend that the most current version of ACI 302 be consulted for reference on the use of a vapor barrier. For increased durability consideration may be given to using a vapor barrier meting ASTM E 1745 Class A but thicker or more puncture resistant than the 10 mils recommended by ACI 302.

Both cut and fill soils exposed at slab subgrades will consist primarily of micaceous sandy silts to silty sands. These materials are particularly susceptible to disturbance and are difficult to repair in place. One way to reduce this disturbance and the resulting repairs would be to leave the subgrade at least 4- to 6-inches above the proposed subgrade elevation, cutting it down immediately before constructing the slab/pavement. Another option would be to cover the subgrade soils within the building pad with 4- to 6-inches of compacted graded aggregate base (GAB). From a construction aspect, the granular layer will help protect the underlying soil and reduce the construction delays caused by wet weather. During summer months and/or drier conditions use of water applied to surface subgrade materials should be used keep the materials at or near optimum moisture content.

FINAL FLOOR SLAB AND PAVEMENT SUBGRADE PREPARATION

Between completion of grading and slab or pavement construction, floor slab and pavement area subgrades are often disturbed by weather, footing and utility line installation, and other construction activities. For this reason, the subgrades should be evaluated by a geotechnical engineer immediately prior to placing the vapor barrier and constructing the floor slab or placing the pavement base course. During this evaluation, the subgrade, where possible, should be proofrolled with a loaded dump truck. Areas judged by the geotechnical engineer to perform unacceptably under the moving load should be undercut and replaced with compacted crushed stone or structural soil fill. We note that silty soils will likely be present at the finished subgrade elevation in large portions of the building and pavement areas. Such soils are easily disturbed and are difficult to compact and stabilize during wet seasonal conditions.

EXISTING UTILITIES

Based on the expected layout of the facility, it is possible that some existing utilities will be encountered. Ideally, to eliminate the risk of existing soft backfill or breaks in the conduit affecting

the performance of the structures, all existing utilities should be identified, abandoned, removed, and relocated to outside the building footprint. Where existing utility lines are removed, we recommend that the excavated trench be evaluated by one of our representatives prior to backfilling. At this time, any additional soft backfills identified should be removed. If the existing utility line is to be left in place beneath the building footprint, we recommend that the existing backfill be evaluated by one of our representatives to determine if it is satisfactory for support of the structure. This evaluation should include test pits excavated along the alignment of the utility trench to check the compaction and composition of the fill. Any backfill not meeting the structural fill criteria previously outlined will need to be removed and replaced with new compacted soil structural fill. In addition, we recommend that any utility line left in place beneath the building be evaluated to determine if it would be impacted by additional structural loads.

Any utility lines to be abandoned should be filled with a lean non-shrink grout. We recommend that prior to grouting, the volume of the line be determined, and the down slope termination point in the line be plugged. The grouting of the line should begin at the plugged end by use of a grout tube extending the full length of the line to prevent voids from forming as grout is placed. We recommend that a representative of our firm be present to monitor the grouting operations.

ACKNOWLEDGMENT

SGC appreciates the opportunity to assist you by performing this preliminary exploration. We hope this information will aid you in your development plans. We remain available to provide further services and consultation as the project progresses. Please contact us if you have any questions.

Respectfully submitted,

Southern Geotechnical Consultants, LLC

Rodney Clark Project manager A. Glenn Motes, III, P.E., P.G.

Senior Geotechnical Engineer/Geologist

Reg. Ga. Nos. 23774, 920

AGM/ads

Enclosures





APPENDIX

SITE LOCATION PLAN (PLATE 1)

BORING LOCATION PLAN (PLATE 2)

SITE PHOTOGRAPHS

BORING RECORDS

PROCEDURES

ROCK DEFINITION



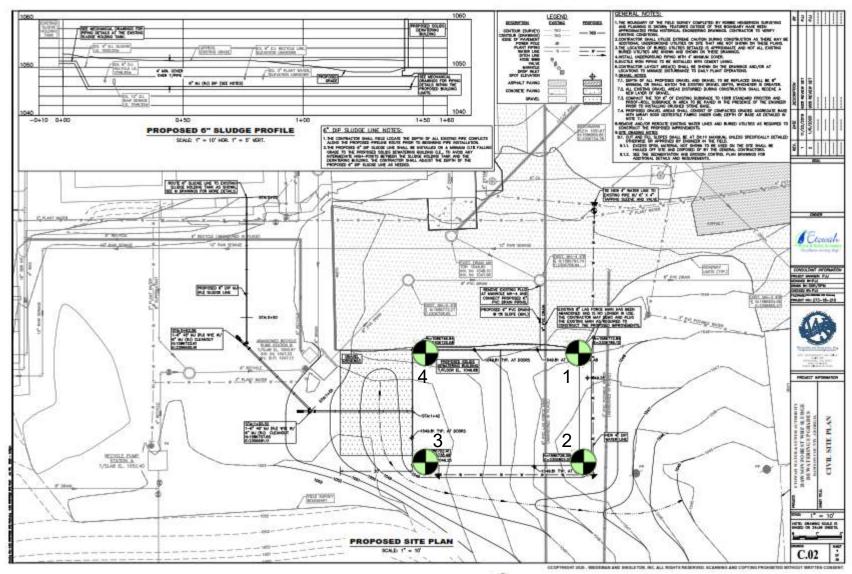
Adapted from Google Maps



SITE LOCATION PLAN
PROPOSED SLUDGE DEWATERING BUILDING SITE
DAWSON FOREST WRF
1349 MARTIN ROAD
DAWSONVILLE, GEORGIA

| DATE: 1/17/20 | REPORT NO: 73536 |
|--------------------|---------------------|
| DRAWN BY : AGM | PROJECT NO.: 12674G |
| HORIZ. SCALE : NTS | PLATE NO.: 1 |





Adapted from Wiedeman & Singleton Drawing



Approximate Boring Location



BORING LOCATION PLAN
PROPOSED SLUDGE DEWATERING BUILDING SITE
DAWSON FOREST WRF
1349 MARTIN ROAD
DAWSONVILLE, GEORGIA

| DATE: 1/17/20 | REPORT NO : 73536 |
|--------------------|---------------------|
| DRAWN BY : AGM | PROJECT NO.: 12674G |
| HORIZ. SCALE : NTS | PLATE NO.: 2 |















BORING NUMBER 1

PAGE 1 OF 1

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| GPJ | | | reiephone: 770.556.52207 904.374.2252 | | | | | | | | | |
|--|---------------|----------------|--|------------------|-----------------------|----------------|-----------------------------|-------------------|-----------------------|--|-------------------|----------------|
| GS.G | CLIEN | Ι Τ _ \ | iedeman and Singleton, Inc. | PROJEC' | Γ NAME | Daws | on Forest V | Vater F | Reclam | ation Facility | | |
| 3 LO | PROJ | ECT N | UMBER 12674G, 73536 | PROJEC | T LOCAT | ION _[| Dawsonville | , Georg | gia | | | |
| RIN | DATE | STAI | TED 1/7/20 COMPLETED 1/7/20 | GROUND | ELEVA | TION _ | | | HOLE | SIZE _inch | es | |
| FBC | DRILL | ING (| ONTRACTOR Drilling Solutions | GROUND | WATER | LEVE | LS: | | | | | |
| WR | DRILL | ING I | IETHOD Automatic Hammer | $ar{igstyle}$ at | TIME OF | DRILI | ING 9.00 | ft | | | | |
| REST | LOGG | | AGM CHECKED BY AGM | | | | | | | | | |
| OF Z | NOTE | | | | | | | | | | | |
| vsor | | _ | | | | | | I | | | | |
| 3 DAV | | () | | | SAMPLE TYPE NUMBER | % / | , (ii) | ż | DRY UNIT WT. (pcf) | ≜ SP1 | ΓN VALU 10 60 | |
| 7353(| DEPTH (ft) | GRAPHIC LOG | MATERIAL RECORDERION | | FF | RECOVERY (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | <u>†</u> € | PL | | LL |
| 4G, | JEP (ft | RAF LO | MATERIAL DESCRIPTION | | IPLE UM | SOV (RC | BLC OUI | ភ | 28 | 20 4 | 10 60 | ⊣ 80 |
| 1267 | _ | 9 | | | NAS N | ZEC | υZ | ပ္က | ЛRУ | □FINES | CONTEN | T (%) 🗆 |
| Y SE | 0 | * 1 * | | | • | | | _ | | 20 4 | 0 60 | 80 |
| Ë | | | TOPSOIL/VEGETATION (ML) RESIDUUM - FIRM TO STIFF YELLOW-BROWN CL | AVEV | | | 3-5-6 | | | | : : | |
| I FAC | | | SILT | A1L1 | | | (11) | | | ··Ŧ·‡····· | : : | |
| TIO | | | | | | | | | | | <u>.</u> | |
| -AM/ | | | | | | | | | | | | |
| REC | | | | | | | | | | | | |
| TER | | | | | | | 2-3-5 | | | | | |
| T WA | 5 | | | | | | (8) | | | 🕇 🗎 | | |
| RES | | | | | | | | | | | | |
| N P | | | (ML) FIRM YELLOW-BROWN AND RED-TAN SLIGHTLY | CLAYEY | | | | | | · · · · · · · · · · · · | <u>.</u> | |
| wso | | | SANDY <u>SILT</u> (MOIST) | 001121 | | | | | | <u> </u> | <u>.</u> | |
| 3 DA | | | | | | | | | | | | |
| 26740 | | | Ā | | | | | | | · · · · · · · · · · · · | ļ . | |
| TS/12 | | | $ar{\Sigma}$ | | | | 2-2-3 | | | | <u> </u> | |
| POR | 10 | | | | | | (5) | | | ↑ : | | |
| E\RE | 10 | | | | | | | 1 | | \ | : : | |
| DRIV | | | | | | | | | | \ | <u>.</u> | |
| ORK | | | | | | | | | | \ | | |
| ETW | | | (ML) STIFF TO VERY STIFF YELLOW-BROWN, BROWN | , BLACK | | | | | | \\ \ \ | : : | |
| ED N | | | ÀNÓ RED-BROWN MICACEOUS SANDY <u>SILT</u> (WET) | | | | | | | \≟ | ļ <u>.</u> | |
| HAR | | | | | | | | - | | | | |
| CHS | | | | | | | 6-13-8 (21) | | | À | | |
| OTE | 15 | | | | | | | - | | ····· | <u>.</u> | |
| S:\GE | | | | | | | | | | l <u>E</u> | <u>.</u> <u>.</u> | |
| :40 - | | | | | | | | | | | | |
| 20 13 | | | | | | | | | | :- | | |
| 1/16/ | | | | | | | | | | <u>:</u> | <u>.</u> | |
| DT - | | | | | | | | - | | | | |
| AB.G | | | | | | | 3-4-10 (14) | | | · · · · <u> </u> . · · · · · | :····: | ••••• |
| US L | 20 | | DODING TERMINATED AT 20 FEET | | | | (14) | | | <u> </u> | <u>: :</u> | <u> </u> |
| GEOTECH BH PLOTS - GINT STD US LAB.GDT - 1/16/20 13:40 - S.\GEOTECH SHARED NETWORK DRIVE\REPORTS\12674G DAWSON FOREST WATER RECLAMATION FACILITY SE\12674G, 73536 DAWSON FOREST WRF BORING LOGS. | | | BORING TERMINATED AT 20 FEET Bottom of borehole at 20.0 feet. | | | | | | | | | |
| GINT | | | | | | | | | | | | |
| TS- | | | | | | | | | | | | |
| 1 PLC | | | | | | | | | | | | |
| 出田 | | | | | | | | | | | | |
| OTEC | | | | | | | | | | | | |
| GEC | | | | | | | | | | | | |

BORING NUMBER 2

PAGE 1 OF 1

Southern Geotechnical Consultants, LLC 2660 White Sulphur Road / 14476 Duval Place West Suite 803 Onsultants Gainesville, Georgia 30501 / Jacksonville, Florida 32218 Telephone: 770.536.5220 / 904.374.2252

| 2 | | Telephone: 770.536.5220 / 904.374.2252 | | | | | | | | | | |
|--|---|---|--------|-----------------------|------------------|-----------------------------|-------------------|--------------------|---|--|--|--|
| CLIEN | IT Wi | edeman and Singleton, Inc. | ROJECT | Г NAME | Daws | on Forest V | Vater F | Reclam | ation Facility | | | |
| PROJ | | UMBER _12674G, 73536 | | | | | | | | | | |
| DATE | DATE STARTED 1/7/20 COMPLETED 1/7/20 GI | | | | | | | | | | | |
| DRILL | | | | WATER | | | | | | | | |
| E DRILI | | ETHOD Automatic Hammer | | | | | 0 ft | | | | | |
| LOGG | | AGM CHECKED BY AGM | | | | | | | | | | |
| NOTE | | | | | | LLING 14 | | | | | | |
| NSOI | | | | | | | | 1 | | | | |
| NETWORK DRIVENREPORTS/12674G DAWSON FOREST WATER RECLAMATION FACILITY SE/12674G, 73536 DAWSON FOREST WATER RECLAMATION FACILITY SE/12674G, 73536 DAWSON FOREST WATER BORING LOGS. O DEPTH O D D D D D D D D D D D D D D D D D D | GRAPHIC LOG | MATERIAL DESCRIPTION | | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | A SPT N VALUE A 20 40 60 80 PL MC LL 20 40 60 80 □ FINES CONTENT (%) □ 20 40 60 80 | | | |
| LIT | | TOPSOIL/VEGETATION | | | | 2-5-6 | | | | | | |
| FAC | | (ML) FILL - STIFF YELLOW-BROWN AND BROWN SLIGHTLY MICACEOUS CLAYEY SANDY <u>SILT</u> | | | | (11) | | | | | | |
| NO - | | | | | | | | | | | | |
| LAM | | | | | | | | | | | | |
| REC | | (ML) RESIDUUM - STIFF YELLOW-BROWN CLAYEY SANDY SILT (MOIST) | | | | | | | | | | |
| - AER | | SILI (MOIST) | | | | 1-4-6 | | | | | | |
| § 5 | | | | | | (10) | | | | | | |
| ORES | | | | | | | | | | | | |
| NO - | | | | | | | | | | | | |
| AWS | | | | | | | | | | | | |
| 4G D | | | | | | | | | | | | |
| 11267 | | | | | | | - | | | | | |
| DRTS | | | | | | 6-7-7 | | | | | | |
| 10 | | | | | | (14) | | | | | | |
| ZIVE) | | | | | | | | | | | | |
| X - 1호 | | | | | | | | | | | | |
| <u> </u> | | (ML) SOFT YELLOW-BROWN CLAYEY SANDY <u>SILT</u> (MOIST | | | | | | | . | | | |
| | | WET) | . • | | | | | | | | | |
| 4ARE | | 77 | | | | | 1 | | | | | |
| 하는 - | | $ar{m{\Lambda}}$ | | | | 1-1-2 (3) | | | | | | |
| <u> 15</u> | | $ar{\Delta}$ | | | | (0) | | | | | | |
| S:\GE | | | | | | | | | | | | |
| - 40 - | | (ML) VERY HARD BLACK, RED-BROWN AND BROWN MICACEOUS SANDY <u>SILT</u> | | | | | | | | | | |
| 20 13 | | WIG 102000 0 1121 <u>0121</u> | | | | | | | | | | |
| 1/16/ | | | | | | | | | | | | |
| - TOS | | | | | | 10.0- | 1 | | | | | |
| LAB.C | | | | | | 12-30-35 (65) | | | \ | | | |
| <u>20</u> | 1.1111 | BORING TERMINATED AT 20 FEET | | | | | <u> </u> | | | | | |
| GEOTECH BH PLOTS - GINT STD US LAB.GDT - 1/16/20 13:40 - S:\GEOTECH SHARED O O O O O O O O O O O O O | | Bottom of borehole at 20.0 feet. | | | | | | | | | | |
| PLOT(| | | | | | | | | | | | |
| HE I | | | | | | | | | | | | |
| HOH | | | | | | | | | | | | |
| GEO | | | | | | | | | | | | |

Southern Geotechnical Consultants, LLC

eotechnical 2660 White Sulphur Road / 14476 Duval Place West Suite 803

Gainesville, Georgia 30501 / Jacksonville, Florida 32218

| ROJEC ATE ST RILLIN RILLIN | TAR ⁻ G C | edeman and Singleton, Inc. UMBER 12674G, 73536 TED 1/7/20 COMPLETED 1/7/20 ONTRACTOR Drilling Solutions | PROJEC [*] | T LOCAT | ION _ | Dawsonville | , Georg | gia | | | |
|-------------------------------------|---|---|--|--|---|--|--|---|---|---|---|
| ATE ST RILLIN RILLIN | TAR | TED _1/7/20 | | | | | | | | | |
| RILLIN RILLIN | G C | | GROUND | ELEVA | LION | | | | | | |
| RILLIN | | ONTRACTOR Drilling Solutions | | | | | | HOLE | SIZE inche | es | |
| RILLIN | | Oliticate of the Brining Columbia | GROUND | WATER | LEVE | _S: | | | | | |
| | ig Mi | ETHOD Automatic Hammer | | | | | 0 ft | | | | |
| | D BY | AGM CHECKED BY AGM | | | | | | | | | |
| | | | | | | _ING15.0 | | | | | |
| | | | | | | | | | | NI VALUE | |
| GRAPHIC | 907 F00 | MATERIAL DESCRIPTION | | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | 20 4 PL 20 4 D FINES 0 | MC L | 80 _L 1 80 |
| | | TOPSOIL/VEGETATION | | | | 2-3-6 | | | : : | : | : |
| - | \bowtie | (ML) FILL - STIFF RED-BROWN AND BROWN SLIGHTLY MICACEOUS CLAYEY SANDY <u>SILT</u> WITH ROCK FRAGME | NITO | | | 2-3-6 (9) | | | | | |
| | \bowtie | WICACEOUS CLATET SAINDT SILT WITH ROCK FRAGINE | NIS | | | | | | | : | : |
| Ti | | (ML) FILL - SOFT RED-BROWN SLIGHTLY MICACEOUS | | | | | | | | | |
| | | OLATET GANGT <u>GIET</u> | | | | | | | - | | |
| _:]: | | | | | | 1-2-2 | | | | | |
| 5 | | | | | | (4) | | | 1 | : | : |
| | | | | | | | | | | : | |
| | | (ML) RESIDUUM - STIFF TO VERY STIFF GRAY AND | | | | | | | | | |
| | | YELLOW-TAN MICACEOUS SANDY SILT | | | | | | | | | |
| | | | | | | | | | \ | : | i |
| 7: | | | | | | | | | | ••••• | ••••••• |
| | | | | | | 4-8-9 | | | \ | | |
| 10 | | | | | | (17) | | | lT | | |
| | | | | | | | | | | : | |
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| - : | | | | | | | | | | | |
| | | | | | | | | | | : | : |
| 7:1 | | | | | | | - | | | | |
| - :[. | | | | | | 3-4-5 | | | | | |
| 15 | | $ar{oldsymbol{\Lambda}}$ | | | | (9) | - | | \ | | |
| | | ∇ | | | | | | | \ | : | • |
| 7:1 | $ \cdot $ | (ML) HARD GREEN-GRAY SANDY <u>SILT</u> | | | | | | | | | |
| - : - | | | | | | | | | | | |
| <u> </u> :] | $\left\{ \left \cdot \right \right\}$ | | | | | | | | | | |
| | | | | | | | 1 | | : ' | \ : | : |
| 7:1 | | | | | | | | | | X | |
| 20 : | <u> </u> | BORING TERMINATED AT 20 FEET | | | | (- / | | | : : | - | -: |
| | | Bottom of borehole at 20.0 feet. | | | | | | | | | |
| <u>1</u> | 0 | 0 | (ML) FILL - SOFT RED-BROWN SLIGHTLY MICACEOUS CLAYEY SANDY SILT (ML) RESIDUUM - STIFF TO VERY STIFF GRAY AND YELLOW-TAN MICACEOUS SANDY SILT (ML) HARD GREEN-GRAY SANDY SILT BORING TERMINATED AT 20 FEET | (ML) FILL - SOFT RED-BROWN SLIGHTLY MICACEOUS CLAYEY SANDY SILT (ML) RESIDUM - STIFF TO VERY STIFF GRAY AND YELLOW-TAN MICACEOUS SANDY SILT (ML) HARD GREEN-GRAY SANDY SILT (ML) HARD GREEN-GRAY SANDY SILT | (ML) FILL - SOFT RED-BROWN SLIGHTLY MICACEOUS CLAYEY SANDY SILT (ML) RESIDUM - STIFF TO VERY STIFF GRAY AND YELLOW-TAN MICACEOUS SANDY SILT (ML) HARD GREEN-GRAY SANDY SILT BORING TERMINATED AT 20 FEET | (ML) FILL - SOFT RED-BROWN SLIGHTLY MICACEOUS CLAYEY SANDY SILT (ML) RESIDUUM - STIFF TO VERY STIFF GRAY AND YELLOW-TAN MICACEOUS SANDY SILT (ML) HARD GREEN-GRAY SANDY SILT BORING TERMINATED AT 20 FEET | (ML) FILL - SOFT RED-BROWN SLIGHTLY MICACEOUS CLAYEY SANDY SILT 1-2-2 (4) (ML) RESIDUUM - STIFF TO VERY STIFF GRAY AND YELLOW-TAN MICACEOUS SANDY SILT 4-8-9 (17) (ML) HARD GREEN-GRAY SANDY SILT 7-16-30 (46) | (ML) FILL - SOFT RED-BROWN SLIGHTLY MICACEOUS CLAYEY SANDY SILT 1-2-2 (4) (ML) RESIDUUM - STIFF TO VERY STIFF GRAY AND YELLOW-TAN MICACEOUS SANDY SILT 4-8-9 (17) (ML) HARD GREEN-GRAY SANDY SILT 7-16-30 (46) | (ML) FILL - SOFT RED-BROWN SLIGHTLY MICACEOUS CLAYEY SANDY SILT 1-2-2 (4) (ML) RESIDUUM - STIFF TO VERY STIFF GRAY AND YELLOW-TAN MICACEOUS SANDY SILT 4-8-9 (17) (ML) HARD GREEN-GRAY SANDY SILT 7-16-30 (46) | (ML) FILL - SOFT RED-BROWN SLIGHTLY MICACEOUS CLAYEY SANDY SILT (ML) RESIDUUM - STIFF TO VERY STIFF GRAY AND YELLOW-TAN MICACEOUS SANDY SILT 4-8-9 (17) (ML) HARD GREEN-GRAY SANDY SILT (ML) HARD GREEN-GRAY SANDY SILT 7-16-30 (48) | (ML) FILL - SOFT RED-BROWN SLIGHTLY MICACEOUS CLAYEY SANDY SILT (ML) RESIDUM - STIFF TO VERY STIFF GRAY AND YELLOW-TAN MICACEOUS SANDY SILT 4-8-9 (17) (ML) HARD GREEN-GRAY SANDY SILT BORING TERMINATED AT 20 FEET |

BORING NUMBER 4
PAGE 1 OF 1

Southern Geotechnical Consultants, LLC eotechnical 2660 White Sulphur Road / 14476 Duval Place West Suite 803

| MATERIAL DESCRIPTION TOPSOIL/VEGETATION (ML) POSSIBLE FILL - VERY STIFF RED-BROWN CLAYEY SANDY SILT | I I I I I I I I I I I I I I I I I I I | SAMPLE 17PE NUMBER | ERY % D) | တ 🛈 | _ <u></u> | | |
|---|---------------------------------------|-----------------------|----------------|-----------------------------|-------------------|-----------------------|--|
| (ML) POSSIBLE FILL - VERY STIFF RED-BROWN CLAYEY | | NA A | RECOVERY (RQD) | BLOW COUNTS (N VALUE) | POCKET PEN. (tsf) | DRY UNIT WT. (pcf) | A SPT N VALUE A 20 40 60 80 PL MC LL 20 40 60 80 FINES CONTENT (%) D 20 40 60 80 |
| | | | | 3-6-11 (17) | | | |
| (ML) RESIDUUM - STIFF GRAY AND YELLOW-TAN CLAYEY SANDY SILT (MOIST) | 7 | | _ | 2-5-10 (15) | | | • |
| 10 | | | _ | 4-5-6 (11) | | | |
| (ML) VERY HARD YELLOW-TAN AND BROWN SLIGHTLY MICACEOUS SANDY SILT WITH QUARTZ STRINGERS (MC | DIST) | | _ | 19-28-22 (50) | | | * |
| 15 (ML) VERY STIFF GREEN-GRAY MICACEOUS SANDY SILT (MOIST) | | | | | | | |
| 20 BORING TERMINATED AT 20 FEET | | | | 11-8-12 (20) | | | A |

INTRODUCTION

SGC, LLC. performs tests in general accordance with the American Society for Testing and Materials (ASTM) or the United States Army Corps of Engineers procedures. These procedures are generally recognized as the basis for uniformity and consistency of test results in the geotechnical engineering profession. All work is initiated and supervised by qualified engineers. Our tests are performed by skilled technicians trained in either ASTM or Corps procedures. Our equipment is well maintained, and our laboratory equipment is calibrated at least yearly.

Subsequent portions of this Appendix present briefly describe of our testing procedures. Where applicable, we have referenced these procedures to either ASTM or the Corps of Engineers standards which contain specific descriptions of apparatus, procedures, reporting, etc.

<u>Annual Book of ASTM Standards, Section 4, Volumes 4.08 and 4.09: Soil and Rock.</u> American Society for Testing and Materials, Latest Edition

EM 1110-2-1803. Subsurface Investigations, Soils, Chapter 3. U.S. Army Corps of Engineers, 1972.

EM 1110-1-1801, Geological Investigations. U.S. Army Corps of Engineers, 1978.

EM 1110-2-1907, Soil Sampling. U.S. Army Corps of Engineers, 1972.

EM 1110-1-1802, Geophysical Exploration. U.S. Army Corps of Engineers, 1979.

EM 1110-2-1906, Laboratory Soils Testing. U.S. Army Corps of Engineers, 1970.

SOIL TEST BORING, ASTM D-1586

The borings were made with a hollow-stem auger powered by a 125-horsepower drill rig. At regular intervals, soil samples were obtained through the hollow augers with a standard 1.4-inch I.D., 2.0-inch O.D. split-tube sampler.

The sampler was initially seated 6 inches to penetrate any loose cuttings; then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated as the *standard penetration resistance*. Penetration resistance, when properly evaluated, is an index to soil strength and density.

In the field, the driller logged and described the samples as they were obtained. Representative portions of each soil sample were then sealed in labeled glass jars and transported to our laboratory. The samples were examined by a graduate geotechnical engineer or engineering geologist to visually check the field descriptions. Boring data, including sample intervals, penetration resistances, soil descriptions, and groundwater level are shown on the attached Test Boring Records.

CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE COMPACTNESS AND CONSISTENCY

Sand and Gravel

| Standard Penetration Resistance Blows/Foot | Relative Compactness |
|--|----------------------|
| 0-4 | Very Loose |
| 5-10 | Loose |
| 11-20 | Firm |
| 21-30 | Very Firm |
| 31-50 | Dense |
| Over 50 | Very Dense |

Silt and Clay

| Consistenc | | | |
|------------|--|--|--|
| Very Soft | | | |
| Śoft | | | |
| Firm | | | |
| Stiff | | | |
| Very Stiff | | | |
| Hard | | | |
| Very Hard | | | |
| | | | |

We note that for the soil test borings an automatic trip drop hammer was used. The automatic hammer has a higher efficiency than a manual hammer and thus yields lower standard penetration resistance values. This reduction in noted values is recognized and compensated for in our evaluation. However, the consistency descriptions on our Test Boring Records are based on customary relationships between soil consistency and recorded standard penetration test values.

ROCK DEFINITION

We suggest that *Rock* be defined as the following:

General Excavation:

Any material which cannot be excavated with a single-tooth ripper drawn by a crawler tractor having a draw bar pull rated at not less than 56,000 pounds (Caterpillar D9K or equivalent) or excavated by a front-end loader with a minimum bucket breakout force of 25,600 pounds (Caterpillar 977 or equivalent).

Trench Excavation:

Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 33,000 pounds (Caterpillar 225B or equivalent).