



A Community of **Pride** • A County of Vision • Endless Opportunities
PROFESSIONALISM • RESPECT • INTEGRITY • DEDICATION • EXCELLENCE

Columbia County Board of Commissioners Procurement Department

Bid# 2021008-BID5100

**UV/Advanced Oxidation Treatment
Jim Blanchard WTP & Clarks Hill WTP**

Solicitation Issued on: **February 10, 2021**

Bids will be received **electronically** via columbiacountyga.bonfirehub.com
until **March 11, 2021** no later than **12:00 PM EST**.

The public opening will be **VIRTUAL** and submissions will be unsealed and read aloud
at **2:00 PM EST, on the same day**, via **WebEx** at <https://ccgagov.webex.com/meet/gosteen>.

Columbia County Board of Commissioners
Procurement Department
500 Faircloth Drive, Bldg E
Evans, GA 30809

Contact: cgoff@columbiacountyga.gov

Last day to submit questions will be **March 03, 2021** at **5 PM EST** via
Bonfire Interactive at columbiacountyga.bonfirehub.com

INVITATION TO BID

BID#: 2021008-BID5100

BID ITEM: UV/Advanced Oxidation Treatment, Jim Blanchard WTP & Clarks Hill WTP

Electronic bids will be **received by the BOARD OF COMMISSIONERS OF COLUMBIA COUNTY, PROCUREMENT DEPARTMENT, 500 FAIRCLOTH DRIVE, EVANS, GEORGIA 30809**, until **12:00 PM EST MARCH 11, 2021**. The public opening will be **VIRTUAL** and submissions will be read at **2:00 PM EST**. No submitted bid may be withdrawn after the scheduled closing time for receipt of bids for a period of sixty (60) days.

**Bids are to be submitted electronically at columbiacountyga.bonfirehub.com
(Sealed written bids WILL NOT be accepted)**

Bids for the **complete work in one general contract** shall be made on the electronic forms provided for all materials, equipment and labor for the construction of: Additions to two separate water treatment plants, modify existing piping, plant parking, plant structures and construct new equipment building.

All Bidders must have a State of Georgia Contractors License and adhere to project specific licensing requirements outlined in the bid documents.

All proposals shall be accompanied by a Bid Bond drawn in favor of Columbia County, Georgia, in the amount of at least ten percent (10%) of the lump sum bid for the complete work; such Bid Bond representing that the Bidder, if awarded the contract, will promptly enter into a contract and furnish Performance Bond and Payment Bond as provided by law and approved by the Attorney for Columbia County, Georgia.

Each bond shall be equal to one hundred percent (100%) of the contract amount. The Bid Bond shall be forfeited to Columbia County, Georgia as liquidated damages if the Bidder fails to execute the contract and provide Performance and Payment Bonds within ten (10) days after being notified that he has been awarded the contract. **Letters of credit will not be accepted.**

Bid bonds for electronic bids should be uploaded as directed via columbiacountyga.bonfirehub.com. Questions regarding Bonfire Interactive may be directed to Bonfire Customer Care at 800-354-8010 Ext. 2.

Drawings and Specifications may be downloaded free of charge at columbiacountyga.bonfirehub.com. All questions should be submitted online via Bonfire Interactive before **5:00 PM EST on March 3, 2021**, and receipt of any/all addenda must be acknowledged prior to contract award.

Engineer:

Zimmerman, Evans and Leopold, Inc., 435 Telfair Street, Augusta, GA 30901

The Owner reserves the right to reject any or all bids and to waive informalities. Any objections to the specifications/contract documents as set forth should be submitted online five days prior to bid openings. *Any addenda must be acknowledged prior to award.*

**COLUMBIA COUNTY BOARD OF COMMISSIONERS
GLENN O'STEEN
PROCUREMENT MANAGER
*NO FAXED BIDS WILL BE ACCEPTED***

TABLE OF CONTENTS

Contract Documents

Instructions to Bidders..... IB-1 - IB-4

Bid Form UPLOADED SEPARATE ON BONFIREBF-1 - BF-2

Articles of Agreement.....AG-1- AG-2

Performance Bond PB-1

Payment BondPMB-1

General Provisions..... SP-1 - SP-7

Special Provisions.....SP-8 – SP-2

INSTRUCTIONS TO BIDDERS

Table of Contents

<u>Item No.</u>	<u>Title</u>	<u>Page No.</u>
1	Intent	IB-1
2	Definitions.....	IB-1
3	Location of Work.....	IB-1
4	Work to be Done.....	IB-1
5	Examination of Location, Conditions and Requirements	IB-1
6	Additions to or Eliminations from Contract.....	IB-1
7	Materials to be furnished by the Contractor.....	IB-1
8	Time Limit.....	IB-1
9	Commencing Work.....	IB-1
10	Interpretation of Drawings and Specifications	IB-2
11	Proposals	IB-2
12	Bid Bond.....	IB-2
13	Bonds	IB-2
14	Return of Checks.....	IB-2
15	Bids Opened in Public.....	IB-2
16	Right to Reject Bids.....	IB-2
17	Determination of Low Bid	IB-2
18	Construction Stakes	IB-3
19	Right-of-Way.....	IB-3
20	Weather.....	IB-3
21	Protective Work	IB-3
22	Sanitary Regulations	IB-3
23	Shanties	IB-3
24	Electric Light and Power.....	IB-3
25	Water Supply.....	IB-3
26	Georgia State Sales Tax	IB-3
27	Utilities.....	IB-3
28	Relocations.....	IB-3
29	Reference Specifications.....	IB-4
30	Signs	IB-4
31	NPDES Certification	IB-4
32	Letter of Permission.....	IB-4

INSTRUCTIONS TO BIDDERS

1. Intent: It is intended that the Instructions to Bidders, Proposal form, Standard Provisions, Special Provisions, General Conditions, Articles of Agreement and Contract Drawings shall provide for the complete work to which they relate. These documents shall hereinafter collectively be referenced as the "Specifications, " or "Contract."
2. Definitions: Where the following words, or pronouns in their stead, occur herein, they shall have the following meanings:
 - a. "Owner" or "County" shall mean Columbia County, Georgia or its authorized and legal representatives.
 - b. "Engineer" shall mean the County Engineer of Columbia County or his duly designated representative.
 - c. "Department" shall mean the Columbia County Water Utility Department.
 - d. "Contractor" shall mean the party of the second part of the Articles of Agreement, or the legal authorized representative of such party.
3. Location of Work: The location of the work is in Columbia County, Georgia, as further depicted and described in the Specifications.
4. Work to be Done: The work to be done under this Contract consists of furnishing all materials, furnishing all construction equipment, and performing all labor necessary for the construction, including all work and appurtenances shown in the Specifications, or such other work as may be added to the Contract (hereinafter, the "Work").
5. Examination of Location, Conditions and Requirements: The bidder is required to make a field examination of the proposed construction site, and to inform himself fully as to the actual requirements of the Specifications, the conformation of the ground, the character of materials to be encountered, the character of equipment and facilities needed preliminary to and during the prosecution of the Work, the general and local conditions, and all other matters which may in any way affect the Work to be done under this Contract. This examination shall be made prior to submitting a bid; by submitting a bid, the bidder represents that it has complied with the provisions of this paragraph.
6. Additions to, or Eliminations from, Contract: The Owner reserves the right to add to, or eliminate from the Contract, components of Work, at the unit prices bid in the Contractor's Proposal.
7. Materials to be Furnished by the Contractor: The Contractor shall furnish all materials necessary for the completion of the Work.
8. Time Limit: The time allowed for completion of all work under this Contract, shall be **AS SHOWN IN THE SPECIAL PROVISIONS OF THIS CONTRACT** (the "Time Limit").
9. Commencing Work: Immediately upon completion of Contractual agreements, the Contractor shall submit to the Engineer for approval a construction schedule arranged to be within the Contract Time Limit. Actual construction operations shall commence within 10 days from date specified in the Work Order.
 - a. Work Order: Notification by the Engineer and County to commence work will be issued to the Contractor; the Contract time will start at the date specified in this Order. The Contractor shall be prepared immediately upon such notification to commence work.
 - b. Personnel and Equipment: The Contractor shall commence work with adequate personnel and equipment to complete the Work within the Time Limit.
 - c. Order to Work: The Work shall begin at such points as the Engineer/or Department shall designate and shall be prosecuted in the order they shall direct. This applies to both location and items of construction. The Contractor shall have no claim for extra compensation because of restrictions and limitations of work prescribed by the Owner, the Engineer or the Department.

10. Interpretation of Drawings and Specifications: If any person contemplating submitting a bid for the proposed Contract is in doubt as to the true meaning of any part of the Specifications, he may submit to the Engineer a written request for an interpretation not less than 3 days prior to the bid due date; the party submitting such request is responsible for its prompt delivery. Any interpretation will be made only by duly issued Addendum and a copy of such Addendum will be mailed or delivered to each person receiving a set of bid documents. No other explanations or interpretations will be deemed valid or binding.
11. Proposals: All proposals must be made on the Forms provided and shall include all materials and work shown in the Specifications. Proposals are to be submitted ELECTRONICALLY via <https://columbiacountyga.bonfirehub.com>.
12. Bid Bond: Each Proposal must be accompanied by a Bid Bond or a Certified Check, in an amount equal to ten (10%) percent of the amount bid, to guarantee that the successful bidder will, within ten (10) days after the date of notification of award of Contract, enter in a Contract with the Owner for performance of the Work and execute satisfactory bond. If for any reason whatsoever the bidder withdraws his bid after the opening of bids, or refuses to execute the required Contract and bond (if his bid is accepted) the Bid Bond or Certified Check accompanying his bid, and the monies payable thereon, shall be paid into the funds of the Owner as liquidated damages for such failure.
13. Bonds: The successful bidder will be required to execute a Performance Bond in favor of the Owner in an amount equal to one hundred (100%) percent of the Contract amount, and a Payment Bond in an amount to one hundred (100%) percent of the Contract amount, each to be in the form hereinafter set forth. The Surety on the Performance Bond and the Payment Bond shall be a Surety Company authorized to do business in Georgia, and shall be subject to approval by the Attorney for the Owner.
14. Return of Checks: The Owner will, within ten (10) days following the opening of bids, return any Certified Checks posted by bidders, except for Certified Checks which may have been posted by the three (3) lowest bidders, and upon the final award and execution of Contract the remaining checks will be promptly returned. Bid Bonds posted by Bidders will be returned upon request of the Bidder.
15. Bids Opened in Public: Bidders are requested to attend the opening of Proposals, which will be **VIRTUAL** via **WebEx** at <https://ccgagov.webex.com/meet/gosteen>.
16. Right to Reject Bids: The Owner reserves the right to reject any or all bids and to waive informalities. No bids will be received after the time set for opening Proposals. Any unauthorized conditions, limitations or provisions attached to the Proposal, will render it informal and may, at Owner's discretion, be cause for its rejection. Incomplete bids will be subject to rejection. Any bidder may withdraw their bid, either personally or by written request, at any time prior to the scheduled closing time for receipt of bids.
17. Determination of Low Bid: The County has set out in the proposal form estimated quantities for each item. The Bidder is to insert the Unit Price that the Bidder proposes for each item. The Unit Price shall be inserted as a numerical dollar and cents amount for each item. The Unit Price shall then be multiplied by the estimated quantity resulting in the amount that is put in the Estimated Cost Column. The sum of the Estimated Costs is inserted in the Estimated Total Price box. The Estimated Total Price will be used to compare bids. If there is a mathematical error in the computation of the Estimated Cost for any item, the error will be corrected by the Owner and the amount set forth in the Estimated Total Price box will be adjusted accordingly. Upon opening of the bids, Unit Prices set out in the proposal cannot be changed. Bidders should further understand that the amount in the Estimated Total Price box is not likely to be the amount that the Bidder will be paid. During the course of the job, as the quantities are increased or decreased, the price of the work will be increased or decreased accordingly, using the set Unit Price to make such calculations. Bidder understands that payment will be made on only the basis of actual quantities utilized at the Unit Prices bid. The Contract will be awarded, if it is awarded, to the lowest responsible bidder. The Owner, in its sole discretion, will decide which is the lowest responsible bidder.

18. Construction Stakes: The Engineer will furnish and lay out upon the ground a sufficient number of controlling lines to enable the Contractor to lay out the necessary construction lines. All subsequent subsidiary lines shall be laid out by the Contractor from the controlling lines furnished by the Engineer or from measurements provided in the Specifications. The Contractor shall check and verify elevation of the forms prior to pouring any concrete. All lines shall be subject to checking by the Engineer, but this checking shall in no way relieve the Contractor from responsibility for their compliance with the Specifications. The Contractor shall provide such stakes, materials, and such labor and assistance as the Engineer may require in laying out control lines and checking and measuring the Work. Columbia County will provide the initial staking of the right of way at a frequency determined by the Engineer. The Contractor shall be responsible for maintaining the original staking at the discretion of the Engineer.
19. Right of Way: The necessary right of way for the construction of the Work will be furnished by the Owner. The Owner will provide no right of way over other property. The Contractor shall take every possible precaution not to inconvenience the owners or tenants of adjacent property. Railroad lines and public highways shall not be obstructed in such a way as to cut off traffic except as per agreement with the various owners. The Contractor shall, at his own expense, repair any damage or injury to either public or private property caused during the progress of the Work.
20. Weather: During unseasonable weather, all Work must stop when the Engineer so directs, and all Work must be suitably protected.
21. Protective Work: The Contractor shall furnish and install all necessary temporary measures for the protection of the Work.
22. Sanitary Regulations: Necessary sanitary facilities for the use of the workmen on the Work shall be erected and maintained by the Contractor, in such a manner and at such points as shall be approved by the Engineer. Their use shall be strictly enforced.
23. Shanties: With approval of the County the Contractor may build shanties or other structures for housing tools, machinery and supplies. Their surroundings shall be maintained at all times in a sanitary and satisfactory manner. On or before the completion of the Work, all such structures shall be removed, together with all rubbish and trash, at the expense of the Contractor.
24. Electric Light and Power: The Contractor shall provide temporary electric service and meter and also provide outlets at convenient point or points so that extension cords of not over 150'-0" will reach all areas of the Work requiring artificial light or power. The Contractor shall furnish extension cords, sockets, light bulbs, etc.
25. Water Supply: The Owner will furnish all water necessary for construction operations. The Contractor must provide all connections and other means of conducting water. The Contractor shall submit water usage monthly reports to the County at the Construction and Maintenance office.
26. Georgia State Sales Tax: Bidders shall include in amounts bid in the Proposal an allowance for payment of State Sales Tax on all taxable materials specified to be furnished by the Contractor and incorporated into the Work under this Contract.
27. Utilities: The attention of the bidders is called to the presence within the construction limits of the Work of overhead and underground utilities (consisting of water mains, gas mains, electrical power transmissions, communication cables, together with their service lines, and appurtenances incidental thereto). The Contractor shall be required to coordinate the General Construction procedure with the necessary removal and/or reconstruction, or relocation of utilities in a cooperative manner so as to spare the property of the utilities from damage and expedite the progress of the Work as a whole.
28. The Owner will arrange with the respective owners for any removal, relocation or reconstruction of their own utilities, other than those shown on the plans or included in the Specifications. The Contractor will not be paid directly for any delays or extra expense caused by the change in the various utilities, and should include the anticipated cost of any such expense in the bid price.

29. Reference Specifications: In order to reduce the bulk of the Specifications, any roads and storm sewers in this project will be constructed in accordance with the most recent edition of the Standard Specifications for Construction of Roads and Bridges of the Georgia Department of Transportation in addition to the Standard and Special Provisions included herewith. The water and sanitary sewer lines will be constructed in accordance with the most recent Columbia County specifications, in addition to the Standard and Special Provisions included herewith. All work within wetland areas shall conform to any permits issued for such work by the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency and/or Georgia EPD, as applicable. Should there be any conflicts between the referenced Standard Specifications and the Specifications of this Contract, the latter prevails.
30. Signs: No signs or advertisement shall be displayed without approval of the Engineer. All warning signs, Construction signs, etc. will conform to the most recent edition of the "Manual on Uniform Traffic Control Devices" as revised.
31. Contractor must have proof of a level IA or greater, NPDES certification through the Georgia Soil and Water Conservation Commission (GSWCC) (O.C.G.A. 12-7-19) which must be furnished to Owner prior to execution of the Contract. If the Contractor is required to sign the Notice of Intent (NOI) as the "Operator", the Contractor must retain level 1B GSWCC certified personnel. The Owner will file a Notice of Intent for the project with the Contractor as the Operator. A copy of the NOI will be provided to the Contractor. The Contractor is responsible for all monitoring, recording keeping, stormwater sampling & testing, agency correspondence, and all other requirements under NPDES to meet the Plan (by Architect) and NOI (by Owner). The Owner shall be hard copied on any and all correspondence to EPD. This work shall be included in Grading Complete. Upon acceptance of the Notice of Termination (NOT), the Contractor shall provide Columbia County a copy of any and all records pertaining to the NPDES permit.
32. The Contractor shall obtain a letter of permission from any property owner who allows equipment and/or materials to be placed on their property beyond the boundaries of acquired permanent or temporary construction easements. Columbia County shall be held harmless for any damages incurred or caused by Contractor. Contractor shall provide a copy of the letter signed by both the Contractor and property owner of record, to County before initiating use of property.

ARTICLES OF AGREEMENT

STATE OF GEORGIA)
COUNTY OF COLUMBIA)

This Agreement made and entered into on the ____ day of _____, 2021 and between Columbia County, Georgia, party of the first part, (hereinafter known as the Owner) and ***CONTRACTOR***, party of the second part (hereinafter known as the Contractor).

WITNESSETH:

That the Contractor, for the consideration hereinafter fully set out, hereby agrees with the Owner as follows:

1. The Contractor will furnish all equipment, tools, materials, skill and labor of every description (except that specified to be furnished by the Owner) necessary to carry out and to complete in good, firm, substantial and workmanlike manner, the Work specified, in strict conformity with the CONTRACT DOCUMENTS FOR THE **“UV/Advanced Oxidation Treatment, Jim Blanchard WTP & Clarks Hill WTP, 2021008-BID5100”** PROJECT FOR COLUMBIA COUNTY, GEORGIA and the Specifications therein. Together with the foregoing Proposal made by the Contractor, this Agreement and Bonds and Addenda attached thereto shall form essential parts of this Agreement, as is fully contained herein. The Work covered by this Agreement includes all requirements shown in the Specifications and listed in the Proposal under the following items, to-wit:

Lump Sum

2. That the Contractor shall commence the Work to be performed under this Agreement on a date to be specified in a written order of the Owner's Engineer and the County and shall fully complete the Work **WITHIN THE TIME LIMIT PROVIDED IN THE CONTRACT**, except as otherwise provided herein and in the Specifications for extension of the Time Limit.
3. Time is of the essence of this Contract, and the Contractor agrees to pay the Owner, not as a penalty, but as liquidated damages, the sum of \$500.00 Dollars for each calendar day that he shall be in default of completing the Work within the Time Limit. Because of the difficulty of fixing damages suffered by the Owner due to Contractor's default, these damages are herein agreed upon as stated.
4. The Owner hereby agrees to pay to the Contractor for the faithful performance of the Agreement, and as full compensation for everything furnished and done by the Contractor under this Contract (subject to additions and deductions as provided in the Specifications or Proposal) in lawful money of the United States, the sum of *****BID AMOUNT*****, which sum shall also compensate for any and all loss or damages arising out of the nature of the Work, or from the action of nature or the elements, or from unforeseen obstructions or difficulties encountered in the prosecution of the Work, and for all expense incurred by, or in consequence of the Work, its suspension or discontinuance, and for well and faithfully completing the Work and the whole thereof, as herein provided, and for replacing defective work, material or equipment for a period of one year after completion.
5. Payments on Account: Not later than the 15th day after receipt of the Contractor's estimate, as the Work progresses, the Owner shall make partial payment to the Contractor, up to 90% of the value of labor and materials furnished by the Contractor and incorporated in the Work and of materials furnished by the Contractor on hand at the site of the Work for and including the last day of the preceding month, (**however no such payment on account shall exceed 33% of the Bid Amount**), less payments already made and less deductions for any unaccepted or defective work. The Owner may also withhold from time to time payment to the Contractor in such an amount or amounts as may be necessary to pay and fully satisfy all claims and demands for labor and services rendered and materials furnished in and about the Work as elsewhere provided for in this Agreement or the Specifications.
6. Final Payment: Upon written notice given to the Owner by the Contractor of the final completion of the Work, the Engineer will make an inspection of the Work, and if acceptable under the Contract, shall issue a final certificate that the balance is due the Contractor. The Owner shall then make final payment to the Contractor of the balance due under the Contract, less such amounts as may have been withheld and employed by the Owner from time to time, as provided in the preceding paragraph, to pay all claims and demands for labor, service, and material furnished; provided that before the Contractor shall be entitled to final payment, the Contractor shall submit satisfactory evidence under oath that all payrolls and all amounts due for labor and materials and other indebtedness connected with the Work have been fully paid and satisfied and that there are no outstanding claims or demands against the Contractor connected with the Work.
7. It is further mutually agreed between the parties hereto that if, at any time after the execution of this Agreement and the bonds hereto attached, the owner shall deem the surety or sureties upon such bonds to be unsatisfactory, or if, for any reason, such bonds cease to be adequate to cover the performance of the Work, the Contractor shall, at his expense, 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 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.

8. "In satisfaction of the requirements of O.C.G.A. 13-10-91, and the Rules of the Georgia Department Labor relating to the Georgia Security and Immigration Compliance Act of 2006, it is agreed that compliance with the requirements of O.C.G.A. 13-10-91 and Rule 300-10-1-.02 are conditions of this Agreement.

IN WITNESS WHEREOF the parties hereto have executed this Agreement on the day and date first above written in five (5) counterparts, each of which shall, without proof or accounting for the other counterparts, be deemed an original Contract.

(As to Owner):

COLUMBIA COUNTY, GEORGIA

ATTEST: _____

By: _____
Clerk of Commission

By: _____

As its: _____

(Seal)

(As to Contractor):

ATTEST: _____

Contractor

As its: _____

By: _____

Title: _____

(Corporate Seal)

APPROVED AS TO FORM

By: _____
County Attorney

PERFORMANCE BOND

STATE OF GEORGIA)
) ss:
COUNTY OF COLUMBIA)

KNOW ALL MEN BY THESE PRESENTS, THAT: We ***CONTRACTOR*** (hereinafter known as the "Contractor") as principal, and we _____ as Surety do hereby acknowledge ourselves indebted and firmly bound and held unto Columbia County, Georgia (herein called the "Owner"), in the sum of ***BID AMOUNT*** for the payment of which well and truly to be made, in lawful money of the United States, we do hereby bind ourselves, successors, assigns, heirs and personal representatives, jointly and severally, firmly by this bond.

BUT THE CONDITION OF THE FOREGOING OBLIGATION OR BOND IS THIS:
BID AMOUNT to construct UV/Advanced Oxidation Treatment, Jim Blanchard WTP & Clarks Hill WTP, 2021008-BID5100 as more fully appears in a written agreement or Contract bearing date of _____, 2021, a copy of which said agreement or Contract is by reference hereby made a part hereof, and it is the desire of the said Owner that the said Contractor shall assure all undertakings under said agreement or Contract.

NOW THEREFORE, if the said Contractor shall fully and faithfully perform all the undertaking and obligations under the said agreement or contract referenced above and shall fully indemnify and save harmless the said Owner from all costs and damage whatsoever which Owner may suffer by reason of any failure on the part of the Contractor to perform said contract, 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 by Contractor, and shall guarantee all materials and workmanship against defects for a period of one year, then this obligation or bond shall be null and void, otherwise to remain in full force and effect. Should Contractor fail to fully and faithfully perform its obligations under the said agreement, Owner shall be entitled to call due to the above-referenced sum from Surety.

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 agreement or Contract or in the Work to be performed there under or the specifications accompanying the same shall in any way affect the obligations under this bond, and notice is hereby waived of any such change, extension of time, alteration or addition to the terms of the agreement or Contract or to the specifications.

This bond is given pursuant to the terms of Section 13-10-1 et seq. of the Official Code of Georgia Annotated, as now or hereafter amended, and all the provisions of law with reference to this character of bond as set forth in said section or as may be hereinafter enacted are hereby made a part hereof to the same extent as is set out herein in full.

IN WITNESS WHEREOF the said Contractor and said Surety have hereunto caused to be affixed their respective corporate signatures and seals, by duly authorized officers, on this _____ day of _____, 2021.

(As to Contractor):

ATTEST: _____
As: _____

(SEAL)

_____ (Contractor)
By: _____
Title: _____

(As to Surety):

ATTEST: _____
As: _____

(SEAL)

_____ (Surety)
By: _____
Title: _____

APPROVED AS TO FORM

By: _____
County Attorney

PAYMENT BOND

STATE OF GEORGIA)
COUNTY OF COLUMBIA)

KNOW ALL MEN BY THESE PRESENTS, That we *****CONTRACTOR***** As Principals (hereinafter known as the "Contractor") and we _____, as Surety, are held and firmly bound unto Columbia County, Georgia (hereinafter called the "Owner") in the sum of *****BID AMOUNT***** in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, or heirs, personal representatives, successors and assigns, jointly and severally, firmly by this bond.

WHEREAS, the Owner has engaged the said Contractor for the sum of *****BID AMOUNT***** to construct **“UV/Advanced Oxidation Treatment, Jim Blanchard WTP & Clarks Hill WTP, 2021008-BID5100”**; as more fully appears in a written agreement or Contract bearing date of _____, **2021**, a copy of which said agreement or Contract is by reference hereby made a part hereof, and it is the desire of the said Owner that the said Contractor shall assure all undertakings under said agreement or Contract.

NOW, THEREFORE, if the said Contractor promptly makes payment to all persons having a direct relationship with the Contractor, or a subcontractor of the Contractor, for furnishing labor, material or both in the prosecution of the Work provided for in the Contract identified above, and any authorized modifications of the contract that subsequently are made, this obligation shall be void. Should Contractor, or a subcontractor of the Contractor, fail to promptly make such payments to any party, Owner shall be entitled to call due this bond from Surety. The Surety hereby waives notice of any modifications to the Contract.

PROVIDED, however, that this bond is subject to the following conditions and limitations:

- A. Any person, firm or corporation that has furnished labor, materials or supplies for or in the prosecution of the work provided for in said contract shall have a direct right of action which shall be asserted in a proceeding, instituted in the County in which the Work provided for in said Contract is to be performed or in any County in which said Contractor or Surety does business. Such right of action shall be asserted in a proceeding instituted in the name of the Claimant or Claimants for his or their use, and benefit against such Contractor and Surety or either of them (but not later than one year after the final settlement of said Contract) in which action such claim or claims shall be adjudicated and judgment rendered thereon.
- B. The Principal and Surety hereby designate and appoint the Owner as the agent of each of them to receive and accept service of process of 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 proceeding thereon that is instituted later than one year after final settlement of said Contract.
- D. This bond is given pursuant to the term of Section 13-10-1 et seq. of the Official Code of Georgia Annotated, as now or hereafter amended, and all the provisions of law with reference to this character of bond as set forth in said section or as may hereinafter be enacted are hereby made a part hereof to the same extent as if set out herein in full.

IN WITNESS WHEREOF the said Contractor and said Surety have hereunto caused to be affixed their respective corporate signatures and seals, by duly authorized officers, on this _____ day of _____, **2021**.

(As to Contractor):

ATTEST: _____	_____
	(Contractor)
As: _____	By: _____
	Title: _____
(SEAL)	

(As to Surety):

ATTEST: _____	_____
	(Surety)
As: _____	By: _____
	Title: _____
(SEAL)	

APPROVED AS TO FORM

By: _____
County Attorney

GENERAL PROVISIONS
Table of Contents

<u>Item No.</u> <u>No.</u>	<u>Title</u>	<u>Page</u>
1	Contract Security.....	SP-2
2	Contractors' and Subcontractors Insurance	SP-2
3	Protection of Persons and Property	SP-3
4	Subcontracting	SP-3
	Assignments	SP-3
6	Cooperation of Contractor	SP-3
7	Corrections.....	SP-3
8	Disagreement.....	SP-3
9	Competent Labor	SP-4
10	Time for Completion.....	SP-4
11	Construction Schedule and Periodical Estimates.....	SP-4
12	Mutual Responsibility of Contractors.....	SP-4
13	Laws or Regulations.....	SP-4
14	Extras	SP-4
15	Changes in Work.....	SP-4
16	Claims for Extra Cost	SP-5
17	Materials, Services and Facilities	SP-5
18	Patents.....	SP-5
19	Inspection.....	SP-5
20	Right of the Owner to Terminate Contract.....	SP-5
21	Delays - Damages.....	SP-6
22	Notice and Service Thereof.....	SP-6
23	Measurement and Payment	SP-6
24	Payments by Contractor.....	SP-6
25	Evidence of Payment by the Contractor.....	SP-7
26	Acceptance of Work and Final Payment	SP-7
27	Acceptance of Final Payment	SP-7
28	Guarantee	SP-7
29	Indemnification.....	SP-7
30	Agreement	SP-7

GENERAL PROVISIONS

1. **Contract Security:** The Contractor shall furnish a surety performance bond in an amount at least equal to one hundred (100%) percent of the Contract amount, and a payment bond in an amount at least equal to one hundred (100%) percent of the Contract amount (form attached) as security for the faithful performance of this Contract, and to indemnify the Owner against liability for personal injury and property damage, and for the payment of all persons performing labor and furnishing materials in connection with this Contract. The surety on the above bond shall be a duly authorized surety company satisfactory 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.

2. The Contractor agrees at all times during the Term of this agreement to maintain in full force and effect the following insurance coverages in at least the limits set forth in Section 9.2: Worker's Compensation (including occupational disease in accordance with applicable statutory and regulatory requirements); Employer's liability insurance (including coverage on all of Contractor's employees engaged in the performance of the Work); and Comprehensive General Liability insurance (including protective liability covering death or bodily injury and contractual liability). Before commencement of any of the Work hereunder, the Contractor agrees to furnish to the County, on an annual renewal basis, certificates of insurance or other evidence satisfactory to the County to the effect that such insurance has been procured and is in force. The certificates shall accurately reflect the required insurance coverages, including any and all limitations, exclusions and restrictions, and provide that in the event of cancellation or material change in a policy affecting the certificate holder, thirty (30) days prior written notice shall be given to the County. Contractor's insurance coverage shall be primary noncontributing insurance as respects to any other insurance or self-insurance maintained by the Insured Parties shall be in excess of Contractor's insurance and shall not contribute to it. Coverage shall state that the Contractor's insured shall apply separately to each insured against whom claim is made or suite is brought, except with respect for limits of insurance provided. Coverage shall be provided on a "Pay on Behalf" basis, with defense costs payable in addition to policy limits. There shall be no cross liability exclusion.
Subcontractors: Contractor shall either (1) ensure that its insurance policies (as described herein) cover all subcontractors and the Work performed by such subcontractors or (2) ensure that any subcontractor secures separate policies covering that subcontractor and its Work.

For the purpose of this Agreement, Contractor shall not commence Work under this Agreement until they have obtained all the insurance required under this paragraph and such insurance has been approved by the County, nor shall Contractor allow anyone acting on their behalf to commence work pursuant to this Agreement until all similar insurance has been so obtained and approved from said person/entity.

- a. Worker's Compensation Insurance: Contractor shall procure and shall maintain during the life of this Agreement Workers Compensation Insurance for all of his employees to be engaged in work on this Agreement.

- b. Public Liability and Property Damage Insurance: Contractor shall take out and maintain during the life of this Agreement such Public Liability and Property Damage Insurance and Automobile Liability Insurance as shall protect them and anyone working on their behalf from claims for damages for personal injury, including accidental death, as well as from claims for property damages, which may arise from operations under this Agreement, whether such operations are by Contractor or by any subcontractor or by anyone directly or indirectly employed by either of them. The amount of such insurance shall be as follows:
 - i. Public Liability and Property Damage Liability Insurance: Contractor shall carry, with respect to the operations they perform, regular General Liability Insurance providing for a limit of not less than one million dollars (\$1,000,000) for all damage arising out of bodily injuries to or death of one person, and subject to that limit for each person, a total of one million dollars (\$1,000,000) for all damage arising out of bodily injuries to or death of two or more persons in any one accident, and regular Employer's Property Damage Liability Insurance providing for a limit of not less than five hundred thousand dollars (\$500,000) for all damages arising out of injury to or destruction of property in any one accident and subject to that limit per accident, a total (or aggregate) limit of two million dollars (\$2,000,000) for all damages arising out of injury to or destruction of property during the Policy period. If any part of the work is sublet, similar insurance, in the same amounts as required of the Contractor shall be provided by or in behalf of the subcontractor to cover their operation.
 - ii. Automobile Liability Insurance: (a) Bodily injury in an amount not less than five hundred thousand dollars (\$500,000) including accidental death to any one person, and, subject to the same limit for each person, in an amount not less than one million dollars (\$1,000,000 on account of one accident, (b) Property damage in an amount not less than one hundred thousand dollars (\$100,000) for any one damage claim, and in an aggregate amount up to two hundred fifty thousand dollars (\$250,000) during the Policy Period.

- c. Proof of Carriage of Insurance: Contractor shall furnish the County with a certificate showing satisfactory proof of carriage of the insurance required. Contractor shall likewise furnish County with a certified endorsement(s) indicating that the County is an additional insured under all relevant policies and showing that said policies may not be modified or cancelled without thirty (30) days written notice to County. All of the insurance hereinbefore specified by Article 9 shall be carried until all work required to be performed under the terms of the Agreement is satisfactorily completed as evidenced by the formal acceptance by County. Should such insurance be canceled before such completion of the Agreement, Contractor shall suspend all work or operations until such time as

Contractor shall provide another policy or policies of insurance of equivalent coverage or effect. The certificate holder should read: Columbia County, GA, Attn: Procurement, P O Box 498, Evans, GA 30809. Any failure to comply with reporting provisions of the policies shall not affect coverage provided to the County.

3. Protection of Persons and Property: The Contractor shall be responsible for all injuries or damages to persons or property that occur in connection with the performance or work under this Contract. He shall take all necessary precautions and exercise adequate diligence to prevent injuries or damages of any nature to persons or to the property of others during the prosecution of this Contract. Contractor shall prevent the construction site from being contaminated with any substance in quantities or under circumstances prohibited by environmental protection laws of the United States or the State of Georgia.

Contractor shall be responsible to Owner if, at any time, state and federal authorities make a claim or demand against the Owner on account of contamination of the site caused or allowed by Contractor or any of its forces or subcontractors.

4. Subcontracting:
 - a. The Contractor shall utilize the services of specialty subcontractors on those parts of the work that, under normal Contracting practices, are performed by specialty subcontractors: **Provided** - That if the Owner shall determine that the specialty work in question has been customarily performed by the Contractor's own organization and that such organization is presently competent to perform such work, the Contractor shall be permitted to do so: **Provided Further** - That if the Owner shall determine that the performance of any specialty work by specialty subcontractors will result in materially increased costs or inordinate delays, the requirements of this paragraph shall not apply.
 - b. The Contractor shall not subcontract the complete work, or any major portion thereof, and shall not award any work to any subcontractor without prior written approval of the Owner, which request shall contain written statements containing such information as the Owner may require.
 - c. The Contractor shall be as fully responsible to the Owner for the acts and omissions of his subcontractors, and of persons either directly or indirectly employed by said subcontractors as he is for the acts and omissions of persons directly employed by him.
 - 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 this Contract.
 - e. Nothing contained in this Contract shall create any contractual relation between any subcontractor and the Owner.
5. 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, with written consent of the Owner, 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 in this Contract.
6. Cooperation of Contractor: The Contractor will be supplied with three (3) sets of the Drawings and Specifications. The Contractor shall have available on the Work site, at all times, one (1) set of each of said Drawings and Specifications. He shall give the Work the constant attention necessary to facilitate the progress thereof and shall cooperate with the Engineer, County and authorized parties in every way possible. The Contractor shall at all times have a Superintendent, satisfactory to the Engineer, capable of acting as his agent on the Work, who shall receive instructions from the Engineer, County or authorized representatives. The Superintendent shall have full authority to execute the orders or directions of the Engineer or County without delay and to promptly supply such materials, tools, plant equipment and labor as may be required. Work requiring utility relocations performed by others will be performed concurrently; Contractor shall coordinate operations in order that maximum speed in construction is attained.
7. Corrections: Should any portions of the Contract 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 any errors or omissions at any time when such corrections are necessary for the proper fulfillment of said Plans and Specifications. It shall be the Contractor's responsibility to timely advise the Owner or Owner's representative of any questions concerning, or defects with, the drawings or specifications, or of any other conditions or circumstances which the Contractor believes the Owner has the responsibility to correct or change.
8. Disagreement: Should any disagreement or difference arise as to the estimate, quantities or classifications or as to the meaning of the Drawings or Specifications, or any point concerning the character, acceptability and nature of the several kinds of Work, and materials and construction thereof, the decision of the Engineer shall be final and conclusive and binding upon all parties to the Contract.
9. Competent Labor: The Contractor shall employ only competent and skilled personnel on the Work. The Contractor

shall have a competent Superintendent or Foreman present at all times when the Work is in progress, with authority to receive orders and execute the Work. The Contractor shall, upon demand from the Engineer, immediately remove any Superintendent, Foreman or workman whom the Engineer may consider incompetent or undesirable.

10. Time for Completion: The Work shall be commenced at the time stated in the notice to the Contractor to proceed and shall be completed within the Time Limit specified in the Specifications except as otherwise provided in these documents for extension of the time itself. **See Special Provisions.**
11. Construction Schedule and Periodical Estimates: Immediately after execution and delivery of the Contract, and before the first partial payment is made, the Contractor shall deliver to the Owner a construction program schedule in form satisfactory to the Owner, showing the proposed dates of commencement and completion of each of the various phases of the Work and the anticipated amount of each monthly payment that will become due the Contractor in accordance with the progress schedule. The Contractor shall also furnish a detailed estimate giving a complete breakdown of estimates of Work done for the purpose of making partial payments thereon. The values employed in making up any of these schedules will be used only for determining the basis of partial payments and will not be considered as fixing a basis for additions to or deductions from the Contract Price.
12. Mutual Responsibility of Contractors: If, through acts of neglect 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 party if they will so settle. If such other Contractor or subcontractor shall assert any claims against the Owner on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor, who shall indemnify and save harmless the Owner against any such claim.
13. Laws or Regulations: The Contractor shall keep himself fully informed of all federal, state and local laws, ordinances and regulations which in any manner affect those engaged or employed in the Work, or the materials used in the Work, or in any way affect 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 shall be discovered in this Contract, or in the Specifications herein referred to, in relation to any such law, ordinance, regulation, order or decree, Contractor shall forthwith report the same in writing to the Owner. 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 its agents against any claim or liability arising from or based on the violation of any such law, ordinances, regulation, order or decree, whether by Contractor, its employees or subcontractors.
14. Extras: Except as otherwise provided herein, no charge for any extra work or material will be allowed unless the same has been ordered in writing by the Owner and the price stated in such order.
15. Changes in Work:
 - a. The Owner may at any time, by a written order, and without notice to the Sureties, make changes in the Specifications of this Contract and within the general scope thereof. In making any changes, the change or credit for the change shall be approximately determined by the Owner in one of the following methods prior to the issuance of the order for the change.
 - i. The Owner shall fix the total lump sum value of the change in the Work of the Contractor, and shall set out the price, which shall be added to or deducted from the Contract price (which price shall include the Contractor's overhead and profit). On any change, which involves a net credit to the Owner, no allowance for overhead and profit shall be figured.
 - ii. By estimating the number of unit quantities of each part of the Work which is changed and then multiplying the estimated number of such unit quantities by the bid price (which price shall include the Contractor's overhead and profit) for a unity quantity thereof.
 - iii. By ordering the Contractor to proceed with the Work as changed 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 may include an allowance for overhead and profit not to exceed 10% of the net cost. The cost may also include all items of labor or materials, the use of power tools and equipment actually used, power and all items of cost such as increased public liability and Workmen's Compensation Insurance, charges for foremen, also social security, old age and unemployment insurance; however, no percentage for overhead and profit shall be allowed on items of social security, old age and unemployment insurance. If deductions are ordered, the credits shall be the net cost. Among the items considered as overhead are included insurance (other than mentioned above), bond or bonds, superintendent, timekeeper, clerks, watchmen, use of small tools, incidental job burdens and general office expenses.
 - b. The Contractor shall, when required by the Owner, furnish to the Owner an itemized breakdown of the quantities and prices used in computing the value of any change that might be ordered.
 - c. In figuring changes, instructions for measurement of quantities set forth in the Specifications shall be followed.
 - d. 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 or indicated in the Specifications, or unknown

conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Specifications, the attention of the Owner shall be called immediately to such conditions before they are disturbed. The Owner shall promptly investigate the conditions, and if he finds that they do so materially differ, the Contract shall, with the written approval of the Owner, be modified to provide for any increase or decrease of cost or difference in time resulting from such conditions.

- e. No amount of Work is guaranteed under this Contract. Owner may at any time determine the Work, or any portion thereof, is no longer desired and cancels this Contract by written notice to Contractor. In such event Contractor shall be entitled to payment in accordance with this Contract only for such Work actually performed and accepted by Owner.
16. Claims for Extra Cost: If the Contractor claims that any instructions or directions involve extra cost or an extension of time, he shall so notify the Owner in writing within 10 days after the receipt of such instructions and in any event before proceeding to execute the work affected by said instruction. Thereafter, the procedure shall be the same as that described in paragraph 15 above, for Change in Work. No such claim shall be valid unless made in accordance with the terms of this section.
 17. Materials, Services and Facilities:
 - a. It is understood that, except as otherwise specifically stated in the Specifications, the Contractor shall provide and pay for all material, labor, tools, equipment, water, lights, power, transportation and other incidental general expenses.
 - b. Temporary construction of every nature, and all other services and facilities of every nature whatsoever necessary to execute, complete and deliver the Work within the specified time.
 - c. Any work necessary to be performed after regular working hours, on Sundays, or legal holidays, shall be performed without additional expense to the Owner.
 18. Patents: The Contractor shall hold and save the Owner and its officers, agents, servants and employees, harmless from liability of any nature or kind, including cost and expenses 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 Contractor or Owner, unless otherwise specifically stipulated in the Specifications.
 19. Inspection:
 - a. Authority and Duties of Inspectors: Engineer and/or County shall be authorized to inspect all work done and all materials furnished. They shall call the attention of the Contractor to any failure of the Work or materials furnished to conform to the Specifications. They may reject materials or suspend the Work until any question at issue can be investigated and decided by the Owner.
 - b. Inspection of Work and Materials: The Contractor shall furnish the Engineer with every reasonable facility for ascertaining whether or not the Work performed and materials furnished are in accordance with the requirements and intent of the Specifications. No work shall be done or materials used without suitable supervision or inspection by the Engineer or his representative. Failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered or obligate the Owner to final acceptance. All materials furnished and work done not in accordance with the Specifications, will be rejected and shall immediately be removed and other work done and materials furnished in accordance with the Specifications. If the Contractor fails to remove defective work and materials as above ordered within forty-eight hours, then the Engineer shall have the right and authority to stop the Contractor from work at once and to supply men and material to remove the rejected material or work, and replace same in accordance with the Specifications, at the cost and expense of the Contractor.
 - c. Defective Work and Material: The inspection of the work shall not relieve the Contractor of any of his obligations to fulfill his Contract. Defective work shall be made good, notwithstanding that such work and materials have been previously inspected by the Engineer and accepted or estimated for payment. The failure of the Engineer to condemn improper materials or workmanship shall not be considered as a waiver of any defect which may be discovered later, or as preventing the Owner at any time subsequently from recovering damages for work actually defective. All work **shall be guaranteed against defects in workmanship for a period of one year, after final acceptance**, and all materials furnished by the Contractor shall be guaranteed for a period of one year. This guarantee of work shall be in addition to and not in limitation of any other guaranty, warranty or remedy arising by law or elsewhere in the Specifications.
 20. Right of the Owner to Terminate Contract: If the Contractor should be adjudged bankrupt, or make a general assignment for the benefit of creditors, or if a receiver should be appointed for the Contractor or any of its property, or if Contractor should persistently or repeatedly refuse or fail to supply enough properly skilled workmen, or proper materials, or refuse or fail to make prompt payment to persons supplying labor or materials for the Work, or persistently disregard instructions of the Engineer, County or Owner, or fail to observe or perform any provisions of the Specifications, or otherwise be guilty of a substantial violation of any provision of the Contract, then the Owner may, by at least 5 days prior written notice to the Contractor, without prejudice to any other rights or remedies of the Owner, terminate the Contractor's right to proceed with the Work. In such event, the Owner may take over the Work and prosecute the same to completion, by Contract or otherwise, and the Contractor and his Sureties shall be liable to the Owner for any excess cost incurred by the Owner; and in any case the Owner may take possession of and utilize in

completing the Work such materials, appliances, and equipment as may be on the site of the Work and necessary therefore. The foregoing provisions are in addition to, and not in limitation of, the rights of Owner under any other provisions of the Contract.

21. Delays - Damages:

- a. If the Contractor refuses or fails to prosecute the Work or any separable part thereof, with such diligence as will insure its completion within the Time Limit, or any extension thereof, or fails to complete the Work within such Time Limit, the Owner may, by written notice to the Contractor, terminate Contractor's right to proceed with the Work or such part of the Work for which there has been delay. In such event, the Owner may take over the Work and prosecute the same to completion, by contract or otherwise, and the Contractor and his Sureties shall be liable to the Owner for any excess cost, loss of use of the project, or other damages associated with the delay, incurred by Owner. If the Contractor's right to proceed is terminated, the Owner may take possession of and utilize in completing the Work such materials, appliances, and equipment as may be on the site of the Work and necessary therefore. If the Owner does not terminate the right of the Contractor to proceed, the Contractor shall continue the Work, in which event the actual damages for the delay will be impossible to determine and in lieu thereof the Contractor shall pay to the Owner as fixed, agreed, and liquidated damages for each calendar day of delay until the work is completed or accepted the amount as set forth in this section and the Contractor and his Sureties shall be liable for the amount thereof provided: If the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or the Engineer, or by an employee of either, or by any separate Contractor employed by the Owner, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in transportation, adverse weather conditions not reasonably anticipatable, unavoidable casualties, or any causes beyond the Contractor's control, or by delay authorized by the Owner, or by any other cause which the Engineer determines may justify the delay, then the Time Limit shall be extended by change order for such reasonable time as the Owner may determine. The Contractor shall make any claim for extension of time in writing to the Engineer not more than three (3) days after the commencement of the delay and shall provide in its notice an explanation for the delay and the probable effect of the delay on the progress of the Work. Any extension of time to the Contractor pursuant to this paragraph of the Contract shall be the sole remedy to Contractor for any such delay, suspension, interruption or effect thereof.
- b. Where actual damages for any delay in completion contemplated by this section are impossible of determination by reason of the Owner's election under said sections not to terminate the right of the Contractor to proceed, the Contractor and his sureties shall be liable for and shall pay to the Owner the sum of \$500.00 as fixed, agreed and liquidated damages for **each calendar day** of such delay until the Work is completed or accepted. Provided. That the Owner, in its sole discretion, may accept the Work if there has been such a degree of completion as will, in its opinion, make the project reasonably safe, fit, and convenient for the use and accommodation for which it was intended. In such case, the Contractor shall not be charged with liquidated damages, but the Owner may assess the actual damages caused by such delay.

22. Notice and Service Thereof:

- a. All notices, demands, requests, instructions, approvals and claims shall be in writing.
- b. Any notice to or demand upon the Contractor shall 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 deposited in the United States mail in a sealed, postage-prepaid envelope, or delivered by private delivery service, in each case addressed to such office.
- c. All papers required to be delivered to the Owner shall, unless otherwise specified in writing to the Contractor, be delivered to the Owner and any notice to or demand upon the Owner shall be sufficiently given if delivered to said office of the Owner or if deposited in the United States mail in a sealed, postage-paid envelope, or delivered by private delivery service, in each case addressed to the Owner or to such 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 or made as of the time of actual delivery or (in the case of mailing) when the same should have been received.

23. Measurement and Payment: The work for which payment will be made shall be limited to that listed and enumerated in the Specifications. The unit prices or lump sum prices stated in the Proposal will be used in determining the amount to be paid. The Engineer in charge shall approve all measurement of quantities and check all calculations of quantities. The Engineer shall have access to notes and calculations made by the Contractor. The Contractor shall verify quantities with the Engineer prior to submitting pay requests.

24. Payments by Contractor: The Contractor shall pay (a) for all transportation and utility services not later than the 20th day of the calendar month following that in which such services are rendered, (b) for all materials, tools and other expendable equipment to the extent of 90 percent of the cost thereof, not later than the 20th day of the calendar month following that in which such materials, tools and equipment are incorporated or used, and (c) each of his subcontractors not later than the 5th day following the payment to the Contractor, the respective amounts allowed the Contractor on account of the Work performed by his subcontractors, to the extent of each subcontractor's interest therein.

25. Evidence of Payment by the Contractor: The Contractor shall furnish the Owner, whenever requested, with satisfactory evidence that all persons who have done Work, or furnished materials under this agreement have been duly paid or satisfactorily secured. In case such evidence is not furnished as aforesaid, such amount as may be necessary to meet the claim of such unsatisfied person may be retained from monies due the Contractor under this Contract, until the liabilities aforesaid shall be fully discharged.
26. Acceptance of Work and Final Payment: Before final acceptance of the Work and payment to the Contractor of the percentage retained by the Owner, the following requirements shall be complied with:
 - a. Final Inspection: Upon notice from the Contractor that Work is completed, the Engineer shall make a final inspection of the Work, and shall notify the Contractor of all instances where the Work fails to comply with the Specifications, as well as any defects discovered. The Contractor shall immediately make such alterations as are necessary to make the Work comply with the Specifications, and to the satisfaction of the Owner.
 - b. Liens: Final acceptance of the Work will not be granted and the retained percentage will not be due or payable until the Contractor has furnished the Owner proper and satisfactory evidence under oath that all claims for labor and material employed or used in the construction of the Work under this Contract have been settled, and that no legal claims can be filed against the Owner for such labor or material.
 - c. Final Estimate: Upon completion of all alterations and repairs required by the final inspection, and upon submitting proper and satisfactory evidence to the Owner that all claims have been settled, the Engineer shall issue a certification of final acceptance of the Work. The Contractor shall then prepare and deliver his final estimate; the payment shall then become due.
27. Acceptance of Final Payment: The submission of the final estimate to the Owner, and the acceptance of payment of same, shall operate as a release to the Owner for all claims and liabilities to the Contractor for all work done or materials furnished or for any act of the Owner or its agents affecting the Work.
28. Guarantee: The Contractor shall guarantee all Work performed under this Contract against defective workmanship or materials, and shall replace all such defective work, materials or equipment furnished by the Contractor, for a period of one year from the date of final acceptance of the work, unless a longer period is otherwise provided for within the Contract.
29. Indemnification: Contractor shall indemnify and hold harmless the Owner, its employees, agents, representatives and officers from and against all claims, damages, losses, expenses, suits, demands and judgments, including the cost of defense and attorney's fees, on account of bodily injury, sickness, disease, death or injury, or damage to property, including the loss of use thereof, arising out of or resulting from the performance of the Work, whether caused in whole or in part by any act, omission or negligence of the Contractor, its subcontractors, or anyone directly or indirectly employed by any of them or for whose acts and omissions they may be liable.
30. Agreement: the laws of Georgia shall govern this agreement. In addition to any others, the parties consent to venue in the courts of Columbia County and Federal Courts in Richmond County. This agreement may be modified only in writing signed by the parties.

SPECIAL PROVISIONS ASSOCIATED WITH COUNTY SPECIFICATIONS

Section 1.0	General
Section 2.0	Clearing and Grubbing
Section 3.0	Roadway Excavation & Embankment
Section 4.0	Construction of Sub-base
Section 5.0	Construction of Base Course
Section 6.0	Bituminous Prime and/or Tack Coat
Section 7.0	Asphalt Surface Course
Section 8.0	Concrete Construction
Section 9.0	Construction of Concrete Curb & Gutter
Section 10.0	Concrete Sidewalks & Driveways
Section 11.0	Excavation, Trenching and Backfill for Pipelines
Section 12.0	Construction of Sanitary Sewer
Section 13.0	Construction of Sanitary Sewer Manholes, Cleanouts & Appurtenances
Section 14.0	Construction of Aerial Lines, Cradles & Collars
Section 15.0	Construction of Water Distribution System
Section 16.0	Construction of Storm Sewer (Closed System)
Section 17.0	Storm Sewer (Open System)
Section 18.0	Construction of Storm Sewer Structures
Section 19.0	Soil Erosion Control
Section 20.0	Grassing
Section 21.0	Fencing

** Landscape will be replaced in as good as or better condition

** Contractor to video job site before construction begins

**SPECIAL PROVISIONS FOR
UV/Advanced Oxidation Treatment, Jim Blanchard WTP & Clarks Hill WTP**

1. In an effort to minimize traffic disruptions, work should be planned in a manner so as to prevent road closures.
2. The Time Limit for construction is 630 calendar days. Contractor may work 6 days per week, Monday – Saturday. Construction and transport activities shall not commence before 7 am on weekdays and 8 am on Saturdays. No construction activities shall be performed on Sundays or Holidays.
3. All work performed under this contract shall conform to GA. Department of Transportation Standard and Specifications, 1993 Edition, (or current issue) and Columbia County Standards and Specifications.
4. All work shall be coordinated with designated Columbia County manager of Columbia County Water Utility, 2140 William Few Parkway – Building C, Grovetown, GA 30813, 706-868-4243. A pre-construction conference shall be required prior to commencing construction.
5. It shall be the responsibility of the Contractor to locate any and all utilities within the proposed construction areas. Any damage to the utilities during construction shall be at the Contractor's expense.
6. The Contractor shall submit to Columbia County a work schedule by the first day of each month for that month. The schedule shall include, but not limited to, original bid price, approved change orders, adjusted contract price the original number of days in contract, the adjusted number of days in contract, the number of days to be claimed as "rain days" due to unseasonable weather and projection dates for completion of the grading, drainage, or other discrete events or tasks.
7. The Contractor is responsible for notifying the United States Postal Service that is responsible for mail delivery in this area. The United States Postal Service shall approve the method of mail delivery during construction. Mail delivery shall not be interrupted during construction. Mail pick-up shall not be an inconvenience to the property owners affected by construction. Prior to re-setting the mail boxes at the completion of the construction the contractor shall have the mailbox location approved by the Columbia County and the United States Postal Service.
8. ALL SOIL EROSION CONTROL MEASURES SHALL BE IN PLACE PRIOR TO COMMENCING CONSTRUCTION. See Columbia County Soil Erosion Ordinance requirements. The engineer will be responsible for the location of the preliminary erosion control devices. Contractor shall have a designated certified worksite erosion control person on call and able to respond within 45 minutes of notification by engineer.
9. Columbia County reserves the right to delete and/or remove items from the bid proposal and increase or decrease quantities as shown on the bid proposal.
10. A certificate of payment to sub-contractors and suppliers shall be submitted with each pay request. A pay request submitted for payment without said certificate of payment **shall not** be processed for payment until properly submitted to Columbia County.
11. Traffic control shall meet Georgia DOT Section 150 requirements and the Manual on Uniform Traffic Control Devices (MUTCD). Columbia County will provide traffic control signage. Maintenance of traffic control will be the responsibility of the Contractor.
12. No activity, including structures and work in navigable waters of the United States or discharges of dredged or fill material, may consist of unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.) And material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act.)
13. Land disturbance within State waters buffers and waters of the United States must be minimized or avoided to the maximum extent practical at the project sites.
14. Landscaping/yards are to be restored to the original condition or better.
15. Columbia County requires the Contractor to document the existing condition of the work area and adjacent properties with a video and still camera prior to commencement of construction.
16. In addition to the requirements set forth in the special provisions, the contractor is required to follow all special instructions or notes as stated on the bid sheet.

TABLE OF CONTENTS
 UV/ADVANCED OXIDATION TREATMENT
 JIM BLANCHARD WTP AND CLARKS HILL WTP
 COLUMBIA COUNTY, GEORGIA

Section No.	Subject	Page(s)
00005	Table of Contents.....	6
BIDDING REQUIREMENTS		
	Invitation to Bid.....	1
IB	Instructions to Bidders.....	4
BF	Bid Form.....	2
AG	Articles of Agreement.....	2
PB	Performance Bond.....	1
PMB	Payment Bond.....	1
GP	General Provisions.....	7
SP	Special Provisions.....	2
CONTRACT FORMS		
NOA	Notice of Award.....	1
NTP	Notice to Proceed.....	1
CO	Change Order.....	1
C-620	Contractor's Application for Payment.....	4
00625	Certificate of Substantial Completion.....	1
DIVISION 1 - GENERAL REQUIREMENTS		
01010	Summary of Work.....	7
01025	Measurement and Payment.....	3
01070	Abbreviations and Symbols.....	4
01090	Reference Standards.....	9
01200	Project Meetings.....	3
01310	Construction Schedules.....	4
01340	Shop Drawings, Product Data and Samples.....	10
01370	Schedule of Values.....	3
01400	Quality Control.....	6
01500	Construction Facilities and Temporary Controls.....	8
01600	Materials and Equipment.....	6
01601	Piping Schedule.....	6
01630	Product Options and Substitutions.....	4
01631	Form, Request for Substitution.....	1
01650	Starting of Systems.....	7
01700	Contract Closeout.....	7
01710	Cleaning.....	4
01720	Project Record Documents.....	4
01730	Operation and Maintenance Data.....	6

DIVISION 2 - SITE WORK

02050	Demolition	6
02100	Site Preparation.....	4
02200	Excavation, Filling and Backfilling.....	8
02205	Trench Excavation and Backfill.....	7
02210	Erosion Control.....	3
02500	Asphalt Pavement	4
02520	Concrete Sidewalks, Curb & Gutter	7
02667	Water Lines.....	16
02675	Disinfection of Water Distribution Systems	5
02936	Grassing	4

DIVISION 3 - CONCRETE

03000	Concrete.....	10
03600	Grout	4

DIVISION 4 - MASONRY

04200	Unit Masonry	7
-------	--------------------	---

DIVISION 5 - METALS

05120	Structural Steel and Miscellaneous Metal.....	5
-------	---	---

DIVISION 6 - WOOD AND PLASTIC

06100	Carpentry and Millwork.....	7
-------	-----------------------------	---

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07210	Building Insulation	2
07220	Roof and Deck Insulation	3
07530	Single Ply Membrane Roofing.....	4
07600	Flashing and Sheet Metal.....	3
07900	Joint Sealants	6

DIVISION 8 - DOORS AND WINDOWS

08220	FRP Doors and Frames	6
08331	Overhead Coiling Doors	4
08520	Aluminum Windows.....	5
08711	Door Hardware	9
08800	Glazing	7

DIVISION 9 - FINISHES

09900	Painting and Finishing	8
-------	------------------------------	---

DIVISION 11 - EQUIPMENT

11000	Equipment Erection	6
11220	Static Mixer.....	2
11245	Liquid Chemical Feed System.....	5
11260	UV-Oxidation Equipment.....	13
11610	Sample Pumps.....	2

DIVISION 13 - SPECIAL CONSTRUCTION

13216	Chemical Storage Tanks	6
13400	Instrumentation	16

DIVISION 14 - CONVEYING SYSTEMS

14300	Single Girder Crane Systems	11
-------	-----------------------------------	----

DIVISION 15 - MECHANICAL

15060	Pipe and Pipe Fittings	14
15062	Ductile Iron Pipe	15
15100	Valves, Cocks and Hydrants	16
15140	Supports and Anchors	7
15400	Plumbing	10

DIVISION 16 - ELECTRICAL

16010	Electrical - General Provisions	10
16050	Basic Materials and Methods	7
16075	Electrical Identification	2
16110	Raceways	13
16120	Conductors	8
16130	Boxes	5
16430	Low-Voltage Switchgear	8
16441	Safety Switches	4
16450	Grounding	3
16461	Dry-Type Transformers	7
16470	Panelboards	6
16500	Lighting	4

LIST OF DRAWINGS

<u>DRAWING NO.</u>	<u>TITLE</u>
--------------------	--------------

GENERAL DRAWINGS

COVER	LOCATION MAP
1X1	DRAWING LIST
1G1	GENERAL SITE ARRANGEMENT – JIM BLANCHARD WTP
1G2	GENERAL SITE ARRANGEMENT – CLARKS HILL WTP
1G3	STANDARD DETAILS - 1
1G4	STANDARD DETAILS - 2
1G5	DOOR, WINDOW, AWNING AND FINISH SCHEDULES
1G6	JIM BLANCHARD WTP SYSTEM DIAGRAM
1C1	SOIL EROSION AND SEDIMENT CONTROL SCHEDULE, NOTES AND DETAILS
1C2	SOIL EROSION AND SEDIMENT CONTROL PLAN JIM BLANCHARD PLANT
1C3	SOIL EROSION AND SEDIMENT CONTROL PLAN CLARKS HILL PLANT
1S1	STANDARD STRUCTURAL DETAILS
1S2	HEAD, JAM AND SILL DETAILS - 1
1S3	HEAD, JAM AND SILL DETAILS – 2
1S4	BLANCHARD PLANT DILUTION BLOWER AND TANK FARM STRUCTURAL SECTIONS

1M1	BLANCHARD PLANT DILUTION BLOWER AND TANK FARM DEMOLITION PLAN
1M2	BLANCHARD PLANT DILUTION BLOWER RELOCATION AND PEROXIDE TANK LOCATION PLAN
1M3	BLANCHARD PLANT DILUTION BLOWER RELOCATION SECTIONS
1M4	BLANCHARD PLANT CHEMICAL FEED ROOM POLYMER DEMOLITION PLAN AND SECTION
1M5	BLANCHARD PLANT CHEMICAL FEED ROOM PEROXIDE PUMPS PLAN AND SECTION
1M6	BLANCHARD PLANT CHEMICAL PIPING AND CONTACT POINTS
1M7	HYDROGEN PEROXIDE MONITOR DETAILS
1H1	HVAC SCHEDULES, DETAILS, LEGEND AND NOTES
1H2	HVAC DETAILS
1E1	ELECTRICAL LEGEND, SCHEDULES AND NOTES
1E2	BLANCHARD PLANT DILUTION BLOWER RELOCATION AND PROXIDE TANK LOCATION PLAN
1E3	BLANCHRD PLANT CHEMICAL FEED ROOM PEROXIDE PUMPS PLAN AND PIPING GALLRY PLAN
1E4	ELECTRICAL DETAILS
1I1	P & ID LEGEND
1I2	P & ID CHEMICAL FEED SYSTEM
1I3	P & ID TYPICAL UV REACTOR
1I4	P & I D TYPICAL UV BALLAST CABINET
1I5	P & ID SCADA SYSTEM BLOCK DIAGRAM

BLANCHARD PLANT SIDE A

2G1	BLANCHARD PLANT SIDE A UV BUILDING ELEVATIONS
2G2	BLANCHARD PLANT SIDE A UV BUILDING FLOOR PLAN
2G3	BLANCHARD PLANT SIDE A UV BUILDING SECTIONS
2C1	BLANCHARD PLANT SIDE A EXISTING CONDITIONS AND DEMOLITION PLAN
2C2	BLANCHARD PLANT SIDE A SITE STAKING PLAN
2C3	BLANCHARD PLANT SIDE A SITE GRADING AND DRAINAGE PLAN
2S1	BLANCHARD PLANT SIDE A UV BUILDING FOUNDATION PLAN
2S2	BLANCHARD PLANT SIDE A UV BUILDING FOUNDATION SECTIONS
2S3	BLANCHARD PLANT SIDE A UV BUILDING ROOF PLAN & SECTIONS
2M1	BLANCHARD PLANT SIDE A YARD PIPING DEMOLITION PLAN
2M2	BLANCHARD PLANT SIDE A YARD PIPING PLAN
2M3	BLANCHARD PLANT SIDE A ENLARGED YARD PIPING PLAN - 1
2M4	BLANCHARD PLANT SIDE A ENLARGED YARD PIPING PLAN - 2
2M5	BLANCHARD PLANT SIDE A CHEMICAL FEED VAULTS NO. 1 AND 2
2M6	BLANCHARD PLANT SIDE A UV BUILDING PIPING PLAN
2M7	BLANCHARD PLANT SIDE A UV BUILDING PIPING SECTIONS
2M8	BLANCHARD PLANT SIDE A CHEMICAL FEED DUCT BANK #1 PLAN AND SECTION
2H1	BLANCHARD PLANT SIDE A UV BUILDING HVAC PLAN
2E1	BLANCHARD PLANT SIDE A UV BUILDING LIGHTING PLAN
2E2	BLANCHARD PLANT SIDE A UV BUILDING POWER PLAN
2E3	BLANCHARD PLANT SIDE A UV BUILDING WIRING SCHEDULE
2E4	BLANCHARD PLANT SIDE A PANEL SCHEDULE AND RISER DIAGRAM

2E5	BLANCHARD PLANT SIDE A ELECTRICAL SITE PLAN
2I1	BLANCHARD PLANT SIDE A P & ID - UV TREATMENT TRAIN

BLANCHARD PLANT SIDE B

3G1	BLANCHARD PLANT SIDE B UV BUILDING ELEVATIONS
3G2	BLANCHARD PLANT SIDE B UV BUILDING FLOOR PLAN
3G3	BLANCHARD PLANT SIDE B UV BUILDING SECTIONS
3C1	BLANCHARD PLANT SIDE B EXISTING CONDITIONS PLAN
3C2	BLANCHARD PLANT SIDE B SITE STAKING PLAN
3C3	BLANCHARD PLANT SIDE B SITE GRADING PLAN
3C4	BLANCHARD PLANT SIDE B STORM PIPE PLAN AND PROFILE
3S1	BLANCHARD PLANT SIDE B UV BUILDING FOUNDATION PLAN
3S2	BLANCHARD PLANT SIDE B UV BUILDING FOUNDATION SECTIONS
3S3	BLANCHARD PLANT SIDE B UV BUILDING ROOF PLAN AND SECTIONS
3M1	BLANCHARD PLANT SIDE B YARD PIPING PLAN
3M2	BLANCHARD PLANT SIDE B UV BUILDING PIPING PLAN
3M3	BLANCHARD PLANT SIDE B UV BUILDING PIPING SECTIONS
3M4	BLANCHARD PLANT SIDE B CHEMICAL FEED VAULT NO. 3
3H1	BLANCHARD PLANT SIDE B UV BUILDING HVAC PLAN
3E1	BLANCHARD PLANT SIDE B UV BUILDING LIGHTING PLAN
3E2	BLANCHARD PLANT SIDE B UV BUILDING POWER PLAN
3E3	BLANCHARD PLANT SIDE B UV BUILDING WIRING SCHEDULE
3E4	BLANCHARD PLANT SIDE B PANEL SCHEDULE AND RISER DIAGRAM
3E5	BLANCHARD PLANT SIDE B ELECTRICAL SITE PLAN
3I1	BLANCHARD PLANT SIDE B P & ID - UV TREATMENT TRAIN

CLARKS HILL WATER TREATMENT PLANT

4G1	CLARKS HILL UV BUILDING ELEVATIONS - 1
4G2	CLARKS HILL UV BUILDING ELEVATIONS -2
4G3	CLARKS HILL UV BUILDING UPPER FLOOR PLAN
4G4	CLARKS HILL UV BUILDING SECTIONS
4G5	CLARKS HILL UV BUILDING STAIR SECTIONS AND DETAILS
4G6	CLARKS HILL WTP SYSTEM DIAGRAM
4C1	CLARKS HILL EXISTING CONDITIONS PLAN
4C2	CLARKS HILL SITE STAKING PLAN
4C3	CLARKS HILL SITE GRADING AND DRAINAGE PLAN
4S1	CLARKS HILL UV BUILDING LOWER LEVEL PLAN
4S2	CLARKS HILL UV BUILDING SECTIONS -1
4S3	CLARKS HILL UV BUILDING SECTIONS - 2
4S4	CLARKS HILL UV BUILDING SECTIONS - 3
4S5	CLARKS HILL UV BUILDING ROOF PLAN AND SECTIONS
4S6	CLARKS HILL CLEARWELL DIVERSION WALL LAYOUT PLAN AND MODIFICATIONS
427	CLARKS HILL CLEARWELL DIVERSION WALL SECTIONS AND DETAILS - 1
4S8	CLARKS HILL CLEARWELL DIVERSION WALL SECTIONS AND DETAILS - 2
4S9	CLARKS HILL CHEMICAL CONTAINMENT PLAN AND SECTIONS
4M1	CLARKS HILL YARD PIPING PLAN
4M2	CLARKS HILL LOWER LEVEL PIPING PLAN
4M3	CLARKS HILL UV BUILDING PIPING SECTIONS

4M4	CLARKS HILL CHEMICAL FEED VAULT #4
4M5	CLARKS HILL CHEMICAL FEED PIPING PLANS
4M6	CLARKS HILL CHEMICAL FEED PIPING AND CONTACT POINTS
4M7	CLARKS HILL PEROXIDE TANK MECHANICAL PLAN, SECTIONS AND DETAILS
4H1	CLARKS HILL UV BUILDING HVAC PLAN
4E1	CLARKS HILL UV BUILDING LIGHTING PLAN
4E2	CLARKS HILL UV BUILDING POWER PLAN
4E3	CLARKS HILL UV BUILDING WIRING SCHEDULE
4E4	CLARKS HILL PEROXIDE TANK ELECTRICAL PLAN
4E5	CLARKS HILL PANEL SCHEDULE AND RISER DIAGRAM
4E6	CLARKS HILL ELECTRICAL SITE PLAN
4I1	CLARKS HILL P & ID - UV TREATMENT TRAIN
4I2	CLARKS HILL P & ID - CHEMICAL FEED SYSTEM

TO: _____

PROJECT: UV/ADVANCED OXIDATION TREATMENT
JIM BLANCHARD WTP AND CLARKS HILL WTP
COLUMBIA COUNTY, GEORGIA

The OWNER has considered the BID submitted by you for the above described WORK in response to its Advertisement for Bids dated _____ and Information for Bidders.

You are hereby notified that your BID has been accepted in the amount of _____.

You are required by the Information for Bidders to execute the Agreement and furnish the required Contractor's Performance Bond and Payment Bond within ten calendar days from the date of this Notice to you. You are also required to show proof of insurance coverage as required by the General Conditions.

If you fail to execute said Agreement and to furnish said bonds within ten days from the date of the Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your Bid Bond. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this _____ day of _____, _____.

Columbia County, Georgia

By _____
As Chairman of Its Board of Commissioners

ACCEPTANCE:

Receipt of the above NOTICE OF AWARD is hereby acknowledged by

This the _____ day of _____

By _____

Title _____

Date: _____

TO:

PROJECT: UV/ADVANCED OXIDATION TREATMENT
JIM BLANCHARD WTP AND CLARKS HILL WTP
COLUMBIA COUNTY, GEORGIA

You are hereby notified that the commencement date of work in accordance with the Agreement dated _____ is _____ and you are to complete the WORK within 630 consecutive calendar days thereafter. The date of completion of all WORK is therefore _____.

COLUMBIA COUNTY, GEORGIA

By: _____

Title: _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED
is hereby acknowledged by

this the ____ day of _____

By _____

Title _____

Order No. _____

Date _____

Agreement Date _____

PROJECT: UV/ADVANCED OXIDATION TREATMENT
JIM BLANCHARD WTP AND CLARKS HILL WTP

OWNER: COLUMBIA COUNTY, GEORGIA

CONTRACTOR:

The following changes are hereby made to the CONTRACT DOCUMENTS:

Justification:

CHANGE TO CONTRACT PRICE:

Original CONTRACT PRICE \$ _____

Current CONTRACT PRICE adjusted
by previous CHANGE ORDERS \$ _____

The CONTRACT PRICE due to this
CHANGE ORDER will be (increased)
(decreased) by: \$ _____

New CONTRACT PRICE including this CHANGE ORDER \$ _____

CHANGE TO CONTRACT TIME:

The CONTRACT TIME will be (increased) (decreased) by _____ calendar days.

The date for completion of all work will be _____
(Date)

Requested by _____

Recommended by _____

Ordered by _____

Accepted by _____

Contractor's Application For Payment No. _____

	Application Period:	Application Date:
To (Owner):	From (Contractor):	Via (Engineer)
Project:	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.:

APPLICATION FOR PAYMENT

Change Order Summary

Approved Change Orders		
Number	Additions	Deductions
TOTALS		
NET CHANGE BY CHANGE ORDERS		

1. ORIGINAL CONTRACT PRICE	\$	
2. Net change by Change Orders	\$	
3. CURRENT CONTRACT PRICE (Line 1 ± 2).....	\$	
4. TOTAL COMPLETED AND STORED TO DATE (Column F on Progress Estimate)	\$	
5. RETAINAGE:		
a. ____ % x \$ _____ Work Completed	\$	
b. ____ % x \$ _____ Stored Material	\$	
c. Total Retainage (Line 5a + Line 5b)	\$	
6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5c).....	\$	
7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)	\$	
8. AMOUNT DUE THIS APPLICATION	\$	
9. BALANCE TO FINISH, PLUS RETAINAGE (Column G on Progress Estimate + Line 5 above)	\$	

CONTRACTOR'S CERTIFICATION

The undersigned Contractor certifies that: (1) all previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with Work covered by prior Applications for Payment; (2) title of all Work, materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all Liens, security interests and encumbrances (except such as are covered by a Bond acceptable to Owner indemnifying Owner against any such Liens, security interest or encumbrances); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Payment of:	\$ _____	(Line 8 or other - attach explanation of other amount)
is recommended by:	_____	_____ (Date)
	(Engineer)	
Payment of:	\$ _____	(Line 8 or other - attach explanation of other amount)
is approved by:	_____	_____ (Date)
	(Owner)	
Approved by:	_____	_____ (Date)
	Funding Agency (if applicable)	

By:	Date:
-----	-------

Progress Estimate

Contractor's Application

For (contract):				Application Number:				
Application Period:				Application Date:				
A		B	Work Completed		E	F		G
Item		Scheduled Value	C	D	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (E) B	Balance to Finish (B - F)
Specification Section No.	Description		From Previous Application (C + D)	This Period				
Totals								

Progress Estimate

Contractor's Application

For (contract):						Application Number:				
Application Period:						Application Date:				
A				B	C	D	E	F		G
Bid Item No.	Description	Bid Quantity	Unit Price	Bid Value	Estimated Quantity Installed	Value	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (E) B	Balance to Finish (B - F)
Totals										

Stored Material Summary

Contractor's Application

For (contract):					Application Number:				
Application Period:					Application Date:				
A	B	C	D		E		F		G
Invoice No.	Shop Drawing Transmittal No.	Materials Description	Stored Previously		Stored this Month		Incorporated in Work		Materials Remaining in Storage (\$) (D + E - F)
			Date (Month/Year)	Amount (\$)	Amount (\$)	Subtotal	Date (Month/Year)	Amount (\$)	
		Totals							

CERTIFICATE OF SUBSTANTIAL COMPLETION

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: Columbia County, GA

Owner's Contract No.:

Contractor:

Contractor's Project No.:

Engineer: Zimmerman, Evans and Leopold, Inc.

Engineer's Project No.: 1631-00

Project: UV/Advanced Oxidation Treatment Jim Blanchard WTP and Clarks Hill WTP

Contract Name:

This [preliminary] [final] Certificate of Substantial Completion applies to:

All Work

The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: [Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]

Amendments to Owner's responsibilities:

None

As follows

Amendments to Contractor's responsibilities:

None

As follows:

The following documents are attached to and made a part of this Certificate: [punch list; others]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:

RECEIVED:

RECEIVED:

By: _____
(Authorized signature)

By: _____
Owner (Authorized Signature)

By: _____
Contractor (Authorized Signature)

Title: _____

Title: _____

Title: _____

Date: _____

Date: _____

Date: _____

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Work covered by contract documents
- B. Contractor use of site and premises
- C. Owner occupancy
- D. Partial Owner Occupancy
- E. Protection of public and private property
- F. Maintenance of access
- G. Lines, Grades and Dimensions
- H. Regulatory requirements
- I. Coordination

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The work under this contract includes the modification of the Jim Blanchard Water Treatment Plant and the modification of the Clarks Hill Water Treatment Plant to utilize a UV/Advanced Oxidation Process (UV/AOP) for treatment of the filtered water. The UV/AOP will consist of chemical injection of hydrogen peroxide before the UV reactors.
 - 1. Jim Blanchard Water Treatment Plant: This plant consists of two separate sides for filter effluent flow identified as Side A and Side B. Because of the layout of the facility, two buildings to house the UV equipment will be constructed to provide the required treatment. Extensive underground pipe work will be required and can only be performed on one side of the facility at a time. Shutdowns will only be allowed during the winter months
 - 2. Clarks Hill Water Treatment Plant: This facility will require a two-story building for the UV treatment, modifications to the existing clearwell, and new chemical injection locations. This facility does have a backup from the Burks Mountain Booster Pumping station, but shutdowns need to be coordinated in advance and need to be kept to a minimum. Also, shutdown of this facility will not be allowed during peak season.
 - 3. The county will have another project under construction concurrently with this project. The project will include the following:
 - a. **Blanchard WTP** – Upgrades to High Service Pumping Station No. 2 main service. This will include a new transformer to serve High Service Pumping Station No. 2 which will allow the existing transformer to serve Side A UV building. Also, replacement of lighting panels around the

facility and LED lighting upgrades will take place under the separate contract.

- b. **Clarks Hill WTP** – Replacement of the existing main Motor Control Centers will be occurring under this contract. This work will be out of the way of your contract but may require shut down coordination.

1.3 CONSTRUCTION SEQUENCING

A. GENERAL

1. Columbia County Water Utility operates the Blanchard WTP continuously (24 Hours per day, every day of the year). It is imperative that all interruptions to plant operations be previously planned and submitted by the Contractor a minimum of 30 days prior to the proposed interruption and approved in writing by the Owner in advance of the interruption.
2. Columbia County Water Utility operates the Clarks Hill WTP a partial each day of the year. Night-time interruptions, as defined in night-time hours, may be utilized with 30-days prior approval by the owner.
3. Only one shutdown may occur at a time. For example: One of the two sides at Blanchard WTP and Clarks Hill WTP cannot be shutdown at the same time. Blanchard WTP may only have one side shutdown at a time.

B. DEFINITIONS

1. This schedule is intended to provide a guide for the construction of new facilities in order to facilitate current plant operations during construction. This schedule does not relieve the contractor from his responsibility to perform the work with minimal impact to existing operations or to provide a detailed construction schedule for approval. Activities are listed in the general order in which they must occur to maintain plant operations; however, due to the nature and extent of the work, it is possible to start later activities first if appropriate measures are taken to maintain continuous and full plant operations.
2. Nighttime means the time between 10:00 PM and 4:00 AM.
3. Peak Demand Season means the period between April 1 and through the second full week in September.
4. Winter construction means the period between November 1 and April 1. When an activity requires winter construction, the activity cannot be started before November 1 and MUST be completed by April 1.
5. Additionally, no construction that could affect plant operations can be ongoing during the first full week of April (Masters Golf Tournament).

1.4 CONTRACTOR USE OF SITE AND PREMISES

- A. Contractor shall limit his use of the premises for Work and storage, to allow for Owner occupancy
- B. Coordinate use of premises under direction of Engineer

- C. Assume full responsibility for the protection and safekeeping of products stored on site under this Contract
- D. Move any stored products, under Contractor's control, which interfere with operations of the Owner
- E. Obtain and pay for the use of additional storage or work areas needed for operations
- F. Contractor may use those areas indicated on the drawings for storage and such additional areas as Engineer may designate

1.5 OWNER OCCUPANCY

- A. Prior to completion of the work, the Owner (by agreement with the Contractor) may take over the operation and/or use of portions of the project. Such use of facilities by the Owner shall not be deemed as acceptance of any work or relieve the Contractor from any of the requirements of the Contract Documents

1.6 PARTIAL OWNER OCCUPANCY

- A. Owner will occupy new facilities for the purpose of conducting his normal operations
- B. Immediately prior to Owner occupancy of new facilities, Engineer shall issue a certificate of occupancy designating a date of occupancy and defining the area occupied:
 - 1. Contractor's responsibilities:
 - a. Allow access for Owner's personnel
 - b. Allow access for public
 - c. Allow operation of heating, ventilating and electrical system
 - 2. Owner's responsibilities:
 - a. Operate heating and ventilating systems
 - b. Assume responsibility for power requirements
 - c. Assume responsibility for property insurance on occupied areas
 - d. Assume responsibility for security and fire protection in occupied areas, but not extending to protection of Contractor's materials and equipment in storage or in place

1.7 PROTECTION OF PUBLIC AND PRIVATE PROPERTY

- A. It is mandatory that the Contractor locate all previously placed underground installations and construction prior to his engaging in any work in areas where such improvements may exist. The Contract drawings indicate general locations of such existing improvements solely for the purpose of initial and general representation thereof. The Owner and Engineer have not verified locations of these improvements as a basis for locations displayed on the drawings. All utilities and improvements must be located and flagged by the Contractor prior to commencing work. It is the sole responsibility of the Contractor to verify existing utilities. No additional compensation shall be made for utilities or utility locations that may vary from those shown or not shown by the drawings. Flags must be

maintained and based upon actual field determinations. The Owner's project inspector must be notified before any work begins in vicinity of existing underground improvements.

- B. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground construction uncovered or otherwise affected by construction operations.
- C. The Contractor shall carefully restore all property defaced by the operations or acts of any of his agents or employees. Such restoration shall include seeding, sodding, transplanting of lawns, hedges, or ornamental plantings, and the repair or replacement of streets, driveways, walks, fences, or other facilities in such a manner as to meet the approval of the Engineer. No structures, fences or trees shall be removed without the consent of the property owner or until condemnation procedure, if necessary, has been completed.
- D. Restoration of property shall commence immediately upon substantial completion of the proposed work at each tract of property along the construction site.
- E. Use new materials for replacements.
- F. Do not remove trees outside the permanent easement, except as authorized by Engineer:
 - 1. Where practical, tunnel beneath trees in yards and parkings when on or near the line of trench
 - 2. Employ hand excavation as necessary to prevent tree injury
 - 3. Adequately protect trees left standing against damage by construction operations
- G. Contractor shall be responsible for all damage to streets, roads, highways, shoulders, ditches, embankments, culverts, location or character, which may be caused by transporting equipment, materials, or personnel to or from the Work or any or site thereof, whether by him or his subcontractors.
- H. Make satisfactory and acceptable arrangements with the Owner of, or the agency or authority having jurisdiction over, any damaged property concerning its repair or replacement, or payment of costs incurred in connection with the damage.
- I. Keep fire hydrants and water control valves free from obstruction and available for use at all times.

1.8 MAINTENANCE OF ACCESS

- A. Conduct Work to interfere as little as possible with public and school district travel, whether vehicular or pedestrian:
 - 1. Whenever it is necessary to cross, close, or obstruct private roads, driveways and walks, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of private travel
 - 2. Give owners of private drives reasonable notice before interfering with them
 - 3. In making street or access road crossing, do not block more than one-half the street at a time:

- a. Whenever possible, widen the shoulder on the opposite side to facilitate traffic flow
 - b. Provide temporary surfacing on shoulders as necessary
 4. Maintenance of traffic is not required if Contractor obtains written permission from the owner and tenant of private property, or from the authority having jurisdiction over public property involved, to obstruct traffic at the designated point
- B. Temporary Bridges:
1. Construct temporary bridges at all points where maintenance of traffic near project site across pipeline construction as necessary
 2. Bridges erected in private roads and driveways shall be adequate for the service to which they will be subjected
 3. Bridges in public streets, roads, and highways shall be acceptable to the authority having jurisdiction there over
 4. Provide substantial guard rails and suitably protected approaches
 5. Provide foot bridges not less than 4 feet wide with handrails and uprights of dressed lumber
 6. Maintain bridges in place as long as the conditions of the work require their use for safety of the public on private property, except that when necessary for the proper prosecution of the Work in the immediate vicinity of a bridge, the bridge may be relocated or temporarily removed for such period as the Engineer may permit
- C. Detour:
1. Provide, as required, bridges across trenches, barricades, guardrail approaches, lights, signals, signs, and other devices necessary for protection of the Work and public safety
 2. Where the authority having jurisdiction requires that traffic be maintained over any construction work in a public street, road, or highway, and traffic cannot be maintained on the original roadbed, or pavements, construct and maintain a detour around the Work
- 1.9 FIELD ENGINEERING
- A. Employ a Land Surveyor registered in the State of Georgia and acceptable to the Engineer
 - B. Contractor to locate and protect survey control and reference points
 - C. Control datum for survey is that shown on Drawings
 - D. The Contractor shall make his own surveys and establish his own working lines and grades from the basic reference lines established by the Engineer. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

- E. Submit a copy of registered site drawing and certificate signed by the Land Surveyor that the elevations and locations of the work are in conformance with the contract documents.

1.10 LINES, GRADES AND DIMENSIONS

- A. Construct all Work to the lines, grades, and elevations indicated on the Drawings:
 - 1. Remove and reconstruct improperly located Work
- B. Engineer will establish or designate 2 basic horizontal and vertical control points:
 - 1. Use these points as datum for the Work
 - 2. Provide, without charge, such competent personnel and tool, stakes, and other materials as Engineer may require in establishing or designating control points, in establishing construction easement boundaries, or in checking layout survey, and measurement work performed by Contractor
- C. Provide all additional survey, layout, and measurement work required:
 - 1. Work performed by a qualified professional engineer or registered land surveyor acceptable to Engineer
 - 2. Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction:
 - a. Make no changes or relocations without prior written notice to Engineer
 - b. Report to Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations
 - c. Require surveyor to replace Project control points which may be lost or destroyed:
 - 1) Establish replacements based on original survey control
 - 3. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate mean:
 - a. Site improvements:
 - 1) Stakes for grading, fill and topsoil placement
 - 2) Utility slopes and invert elevations
 - b. Batter boards for structures
 - c. Controlling lines and levels required for the mechanical and electrical trades
 - 4. From time to time, verify layouts by the same methods
 - 5. Maintain a complete, accurate log of all control and survey work as it progresses
 - 6. On request of Engineer, submit documentation to verify accuracy or field engineering work
- D. Dimensions shown in figures or which can be determined by computation from other figures shown, shall take precedence over dimensions scaled from the drawings. When the work of the Contractor is affected by finished dimensions, these shall be determined by the Contractor at the site and he shall assume the responsibility therefore.

1.11 REGULATORY REQUIREMENTS

- A. Comply with all federal, state, and local laws, regulations, codes, and ordinances applicable to the Work
- B. Comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL91-596) and under Sec. 107 of the Contract Work Hours and Safety Standards Act (PL91-54).
- C. Other standards and codes which apply to the Work are designated in the specifications

1.12 COORDINATION

- A. Coordinate scheduling, submissions, and Work of the various Sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later. Verify all dimensions and location of items installed later
- B. Verify that utility requirement characteristics of operating equipment are compatible with building utilities
- C. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment
- D. Coordinate space requirements and installation of mechanical and electrical work, which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs
- E. In finished areas conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements
- F. Coordinate completion and clean up of Work of separate Sections in preparation for Substantial Completion

- G. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Format and Data Required
- B. Preparation of Application for each Progress Payment
- C. Substantiating Data for Progress Payments
- D. Preparation of Application for Final Payment
- E. Submittal Procedure
- F. Basis of Payment

1.2 FORMAT AND DATA REQUIRED

- A. Submit applications typed on Application for Payment and Certificate for Payment using form C-620, Contractor's Application for Payment which is included in these specifications.
- B. Provide Itemized Data on Continuation Sheet:
 - 1. Format, schedules, line items, and values: Those of the Schedule of Values

1.3 PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT

- A. Submit Applications for Payment to Engineer in accord with the schedule established by Conditions of the Contract and Agreement Between Owner and Contractor.
- B. Application Form:
 - 1. Fill in required information, including that for Change Orders executed prior to the date of submittal application.
 - 2. Fill in summary of dollar values to agree with the respective totals indicated on the continuation sheets.
 - 3. Execute certification with the signature of authorized officer of the Contractor's firm.
 - 4. Notarize signature where required on Certificate for Payment.
- C. Continuation Sheets:
 - 1. Fill in total list of all scheduled component items of Work, with time number and the scheduled dollar value for each item.
 - 2. Fill in the dollar value in each column for each scheduled line item when work has been performed or products stored.
 - 3. List each Change Order executed prior to the date of submission at the end of the continuation sheets:

- a. List by Change Order number, dollar amount, and description as for an original component item of work.
4. Use data from approved Schedule of Values: Provide dollar value in each column for each line item for portion of work performed and for stored products.

1.4 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

- A. When Owner or Engineer requires substantiating data, Contractor shall submit suitable information, with a cover letter identifying:
 1. Project
 2. Application number and date
 3. Detailed list of enclosures
 4. For stored products:
 - a. Item number and identification as shown on application
 - b. Description of specific material
- B. Submit 1 copy of data and cover letter for each copy of application.
- C. Submit an updated construction schedule with each application for payment.
- D. Submit evidence of payment and release of liens within 60 days of payment to Contractor for Work performed by subcontractors or for equipment and materials delivered to the site during construction.

1.5 PREPARATION OF APPLICATION FOR FINAL PAYMENT

- A. Fill in Application form as specified for progress payments.
- B. Use continuation sheets for presenting the final statement of accounting as specified in Section 01700, Contract Closeout of these specifications.

1.6 SUBMITTAL PROCEDURE

- A. Submit Applications for Payment to Engineer at the times stipulated in the Agreement.
- B. Submit electronically as instructed in the Pre-Construction Meeting.

1.7 BASIS OF PAYMENT

- A. No quantity measurement for payment will be made.
- B. Payment will be made on a lump sum basis relative to percent complete for each bid item.
- C. Lump Sum prices include entire work involved in the contract for the individual bid items including the necessary appurtenance features and equipment which are considered incidental to the work and as such must be included in the bid price.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Abbreviations for organizations and standards
- B. Other abbreviations and symbols

1.2 ORGANIZATIONS AND STANDARDS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Antifriction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
ASCE	American Society Civil Engineers
ASHRAE	American Society Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWPA	American Wood Products Association or American Wood Preservers Association
AWPB	American Wood Preserver's Board
AWWA	American Water Works Association
CDPHE	Colorado Department of Public Health and Environment
CDOT	Colorado Department of Transportation
CIPRI	Cast Iron Pipe Research Institute
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturer's Association of America
CRSI	Commercial Standard
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
FS	Federal Specification
HMI	Hoist Manufacturer's Institute

IEEE	Institute Electrical and Electronics Engineers
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
MIL	Military Specification
MMA	Monorail Manufacturer's Association
NAAMM	National Association Architectural Metals Manufacturers
NBHA	National Builders Hardware Association
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association or National Forest Products Association
NHPMA	Northern Hardwood and Pine Manufacturer's Association
NSF	National Sanitation Foundation Testing Laboratory
NWMA	National Woodwork Manufacturer's Association
OSHA	Occupational Safety and Health Administration
PCI	Prestressed Concrete Institute
PS	Product Standard
RCSHSB	Red Cedar Shingle and Hand-Split Shake Bureau
RIS	Redwood Inspection Service
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SJI	Steel Joist Institute
SPI	Society of the Plastics Industry
SSPC	Steel Structures Painting Council
TCA	Tile Council of America
UL	Underwriter's Laboratories
US	U.S. Bureau of Standards
USBR	U.S. Bureau of Reclamation
WCLIB	West Coast Lumber Inspection Bureau
WIC	Woodwork Institute of California
WWPA	Western Wood Products Association

1.3 OTHER ABBREVIATIONS AND SYMBOLS

ac	alternating current
amp	ampere
AV	air vent
AWG	American wire gage

BIL	basic impulse level
BCY	bank cubic yard
C	centigrade or Celsius
CIP	Complete-in-place
cu	cubic
dc	direct current
diam	diameter
F	Fahrenheit
ft (')	foot
ga	gage
gal	gallon
GSP	galvanized steel pipe
hp	horsepower
Hz	hertz
hrs(s)	hour(s)
IBBM	iron body, bronze mounted
in(")	inch
IPS	iron pipe size
kV	kilovolt
kVA	kilovoltampere
lb	pound
mA	milliampere
max	maximum
MG	million gallons
MH	manhole
NPT	national pipe thread
PL	plate
PVC	polyvinyl chloride
sq	square
lf	lineal foot
vf	vertical foot
yd	yard
°	degree

' feet

" inch

% percent

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance
- B. Schedule of references

1.2 QUALITY ASSURANCE

- A. For products or workmanship specified by association, trade, Federal Standards, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents.
- C. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. The contractual relationship, duties, and responsibilities of the parties to the Contract or those of the Engineer shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.3 SCHEDULE OF REFERENCES

	A		ABMA	American Bearing Manufacturers Association 1200 19 th St., NW, Suite 300 Washington, DC 20036-2422 www.abma-dc.org
AA	Aluminum Association 900 19 th St., NW Washington, DC 20006 www.aluminu.org		ACGIH	American Conference of Governmental Industrial Hygienists 1330 Kemper Meadow Dr., Suite 600 Cincinnati, OH 45240 www.acgih.org
AABC	Associated Air Balance Council 1518 K St., NW Washington, DC 20005 www.aabhq.com		ACI	American Concrete Institute P.O. Box 9094 Farmington Hill, MI 48333-9094 www.aci-int.org
AAMA	American Architectural Manufacturers Association 1827 Walden Office Sq., Suite 104 Schaumburg, IL 60173-4268 www.aamanet.org		ACPA	American Concrete Pipe Association 222 W. Las Colinas Blvd., Ste. 641 Irving, TX 75039-5423 www.concrete-pipe.org
AASHTO	American Association of State Highway and Transportation Officials 444 N. Capitol St., NW, Suite 249 Washington, DC 20001 www.aashto.org		ADC	Air Diffusion Council 1000 E. Woodfield Rd., Suite 102 Schaumburg, IL 60173-5921 www.flexibleduct.org

SECTION 01090
REFERENCE STANDARDS

ADSC	The International Association of Foundation Drilling 9696 Skillman Street, Suite 280 Dallas, TX 75243 www.adsc-iafd.com	AITC	American Institute of Timber Construction 7012 S. Revere Pkwy, Suite 140 Englewood, CO 80112 www.aitc-glulam.org
AF&PA	American Forest and Paper Association 1111 19 th St., NW, Suite 800 Washington, DC 20036 www.afandpa.org	ALSC	American Lumber Standard Committee PO Box 210 Germantown, MD 20875-0210 www.alsc.org
AFSA	American Fire Sprinkler Association, Inc. 9696 Skillman St., Suite 300 Dallas, TX 75243-8264 www.sprinklernet.org	AMCA	Air Movement and Control Association International, Inc. 30 W. University Dr. Arlington Heights, IL 60004-1893 www.amca.org
AFSS	American Filtration And Separation Society 252 N. Washington St., Suite A Falls Church, VA 22046 www.afssociety.org	ANSI	American National Standards Institute 1819 L Street, NW Washington, DC 20036 www.ansi.org
AGC	Associated General Contractors Of America 333 John Carlyle St., Suite 200 Alexandria, VA 22317 www.agc.org	APA/EWA	APA-The Engineered Wood Association P.O. Box 11700 Tacoma, WA 98411-0700 www.apawood.org
AHA	American Hardboard Association 1210 W. Northwest Hwy. Palatine, IL 60067 www.hardboard.org	APFA	American Pipe Fittings Association 111 Park Pl. Falls Church, VA 22046 www.apfa.com
AI	Asphalt Institute Research Park Drive P.O. Box 14052 Lexington, KY 40512-4052 www.asphaltinstitute.org	API	American Petroleum Institute 1220 L Street NW Washington, DC 20005-4070 www.api.org
AIA	American Institute of Architects 1735 New York Ave., NW Washington, DC 20006 www2.aia.org/myaia	AREMA	American Railway Engineering and Maintenance-of-Way Association 8201 Corporate Drive, Suite 1125 Landover, MD 02785-2230 www.arena.org
AICE	American Institute Of Chemical Engineers 3 Park Ave New York, NY 10016-5991 www.aiche.org	ARI	Air-Conditioning and Refrigeration Institute 4301 N. Fairfax Dr., Ste. 425 Arlington, VA 22203 www.ari.org
AISC	American Institute of Steel Construction One East Wacker Dr., Suite 3100 Chicago, IL 60601-2001 www.aisc.org	ARRA	Asphalt Recycling and Reclaiming Association #3 Church Circle, PMB 250 Annapolis, MD 21401 www.ara.org
AISI	American Iron and Steel Institute 1101 17th St., NW, Ste. 1300 Washington, DC 20036 www.steel.org	ASCE	American Society of Civil Engineers World Headquarters 1801 Alexander Graham Bell Dr. Reston, VA 20191-4400 www.asce.org

SECTION 01090
REFERENCE STANDARDS

ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers 1791 Tullie Circle, NE Atlanta, GA 30329 www.ashrae.org	B	
ASME	American Society of Mechanical Engineers 3 Park Ave. New York, NY 10016-5990 www.asme.org		BHMA Builders Hardware Manufacturers Association, Inc. 355 Lexington Ave., 17 TH Floor New York, NY 10017 www.buildershardware.com
ASNT	American Society for Non-Destructive Testing Inc. 1711 Arlingate Ln. Columbus, OH 43228-0518 www.asnt.org		BIA Brick Institute of America 11490 Commerce Park Dr. Reston, VA 22091 www.bia.org
ASSE	American Society of Sanitary Engineering 901 Canterbury, Suite A Westlake, OH 44145 www.asse-plumbing.org	C	
ASTM	American Society of Testing Materials International 100 Barr Harbor Dr. West Conshohocken, PA 19428-2959 www.astm.org		CAGI Compressed Air and Gas Institute 1300 Sumner Cleveland, OH 44115 www.cagi.org
AWI	Architectural Woodwork Institute 1952 Isaac Newton Sq. West Reston, VA 20190 www.awinet.org		CDA Copper Development Association, Inc. 260 Madison Ave., 16th Flr. New York, NY 10016 www.copper.org
AWPA	American Wood-Preservers' Association P.O. Box 5690 Granbury, TX 76049 www.awpa.com		CGA Compressed Gas Association 1725 Jefferson Davis Hwy, Suite 1004 Arlington, VA 22202-4102 www.cganet.com
AWS	American Welding Society 550 NW LeJeune Rd. Miami, FL 33126 www.amweld.org		CII Chlorine Institute, Inc. 1300 Wilson Blvd. Rosslyn VA 22209 www.cl2.com
AWWA	American Water Works Association 6666 W. Quincy Ave. Denver, CO 80235 www.awwa.org		CISCA Ceilings and Interior Systems Construction Association 1500 Lincoln Hwy, Suite 202 St. Charles, IL 60174 www.cisca.org
			CISPI Cast Iron Soil Pipe Institute 5959 Shallowford Rd., Suite 419 Chattanooga, TN 37421 www.cispi.org
			CLFMI Chain Link Fence Manufacturers Institute 9891 Broken Land Pkwy, Suite 300 Columbia, MD 21046 www.chinlinkinfo.org
			CRI Carpet and Rug Institute 310 S. Holiday Ave. Dalton, GA 30722-2048 www.carpet-rug.com

SECTION 01090
REFERENCE STANDARDS

CRSI	Concrete Reinforcing Steel Institute 933 N. Plum Grove Rd. Schaumburg, IL 60173-4758 www.crsi.org	EPA	Environmental Protection Agency US EPA/NSCEP P.O. Box 42419 Cincinnati, OH 45242 www.epa.gov
CSI	The Construction Specifications Inst. 99 Canal Center Plaza, Suite 300 Alexandria, VA 22314 www.csinet.org		F
CSSB	Cedar Shake and Shingle Bureau P.O. Box 1178 Sumas, WA 98295 www.cedarbureau.org	FAA	Federal Aviation Administration 800 Independence Ave., SW Washington, DC 20591 www.faa.gov
CTI	Cooling Technology Institute 530 Wells Fargo Drive, Suite 218 Houston, TX 77090 www.cti.org	FGMA	Glass Association of North America 2945 SW Wanamaker Dr., Suite A Topeka, KS 66614 www.glasswebsite.com
	D - E	FM	FM Global Corporate Headquarters P.O. Box 7500 Johnston, RI 02919 www.fmglobal.com
DASMA	Door and Access Systems Manufacturers Association International 1300 Summer Avenue Cleveland, OH 44115-2851 www.dasma.com	FS	Federal Specification Unit General Services Administration Federal Supply Service FSS Acquisition Management Center Environmental Programs and Engineering Policy Division Washington, DC 20406 http://pub.fss.gsa.gov
DHI	The Door and Hardware Institute 14150 Newbrook Dr., Suite 200 Chantilly, VA 20151 www.dhi.org	FSSA	Fire Suppression Systems Association 5024-R Campbell Blvd. Baltimore, MD 21236 www.fssa.net
DIPRA	Ductile Iron Pipe Research Association 245 Riverchase Pkwy E., Ste. O Birmingham, AL 35244 www.dipra.org		G - H - I
EIMA	EIFS Industry Members Association 3000 Corporate Center Dr., Suite 270 Morrow, GA 30260 www.eifsfacts.com	GA	Gypsum Association 810 First St., NE, Suite 510 Washington, DC 20002 www.usg.com www.gypsum.org
EJCDC	Engineer's Joint Contract Documents Committee American Consulting Engineers Council (www.acec.com) 1015 15th St., NW Washington, DC 20005	GANA	Glass Association of North America 2945 Southwest Wanamaker Dr., Suite A Topeka, KS 66614 www.glasswebsite.com/gana
EJMA	Expansion Joint Manufacturers Association 25 N. Broadway Tarrytown, NY 10591 www.ejma.org		

SECTION 01090
REFERENCE STANDARDS

HI	Hydraulics Institute Division of Gas Appliance Manufacturers Association 2107 Wilson Blvd., Suite 600 Arlington, VA 22201 www.gamanet.org	K – L	KCMA Kitchen Cabinet Manufacturers Association 1899 Preston White Dr. Reston, VA 20191-5435 www.kcma.org
HMMA	Hollow Metal Manufacturers Association Division of NAAMM 8 South Michigan Ave., Suite 1000 Chicago, IL 60603 www.naamm.org	LPI	Lightning Protection Institute 3335 N. Arlington Heights Rd., Suite E Arlington Heights, IL 60004 www.lightning.org
HPVA	Hardwood Plywood and Veneer Association P.O. Box 2789 Reston, VA 20195-0789 www.hpva.org		
IAS	International Approval Services U.S. Operations 8501 E. Pleasant Valley Rd. Cleveland, OH 44131-5575 www.approvals.org	M – N	MBMA Metal Building Manufacturers Association 1300 Sumner Ave. Cleveland, OH 44115-2851 www.mbma.com
ICBO	International Conference of Building Officials 5360 Workman Mill Rd. Whittier, CA 90601 www.icbo.org	MFMA	Maple Flooring Manufacturers Association 60 Revere Dr., Suite 500 Northbrook, IL 60062 www.maplefloor.org
ICC	International Code Council 5203 Leesburg Pike #708 Falls Church, VA 22041 www.intlcode.org	MIA	Marble Institute of America 30 Eden Alley, Suite 301 Columbus, OH 43215 www.marble-institute.com
IEEE	Institute of Electrical and Electronics Engineers, Inc. 3 Park Ave., 17 th Floor New York, NY 10016-5997 www.ieee.org	MIL	Military Standardization Documents Defense Automated Printing Service 700 Robbins Ave., Building 4D Philadelphia, PA 19111-5094 www.dodssp.daps.mil
IMIAC	International Masonry Industry All-Weather Council International Masonry Institute (www.imiweb.org) 815 15th St., NW Washington, DC 20005	MSS	Manufacturers Standardization Society of the Valve and Fittings Industry 127 Park St., NE Vienna, VA 22180-4602 www.mss-hq.com
IES	Illuminating Engineering Society of North America 120 Wall Street, 17 th Floor New York, NY 10005 www.iesna.org	NAA	National Arborist Association Route 101, P.O. Box 1094 Amherst, NH 03031-1094 www.natlarb.com
ILI	Indiana Limestone Institute of America 400 Stone City Bank Building Bedford, IN 47421 www.iliai.com	NAAMM	National Association of Architectural Metal Manufacturers 8 South Michigan Ave., Suite 1000 Chicago, IL 60603 www.naamm.org

SECTION 01090
REFERENCE STANDARDS

NAAMM	North American Association of Mirror Manufacturers (Division of GANA) 2945 Southwest Wanamaker Dr., Suite A Topeka, KS 66614 www.glasswebsite.com	NELMA	Northeastern Lumber Manufacturers Association 272 Tuttle Road P.O. Box 87A Cumberland Center, ME 04021 www.nelma.org
NACA	NACE International 1440 South Creek Drive Houston, TX 77084 www.nace.org	NEMA	National Electrical Manufacturers Association 1300 N. 17th St., Ste. 1847 Rosslyn, VA 22209 www.nema.org
NAIMA	North American Insulation Manufacturers Association 44 Canal Center Plaza, Suite 310 Alexandria, VA 22314 www.naima.org	NETA	International Electrical Testing Association P.O. Box 687 106 Stone St. Morrison, CO 80465 www.netaworld.org
NAPHCC	National Association of Plumbing-Heating-Cooling Contractors 180 S. Washington Falls Church, VA 22040 www.phccweb.org	NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101 www.nfpa.org
NBGQA	National Building Granite Quarries Association, Inc. 1220 L Street NW, Suite 100-167 Washington, DC 20005 www.nbgqa.com	NFRC	National Fenestration Rating Council 1300 Spring St., Suite 500 Silver Spring, MD 20910 www.nfrc.org
NCMA	National Concrete Masonry Association 2302 Horse Pen Road Herndon, VA 20171-3499 www.ncma.org	NGWA	National Ground Water Association 601 Dempsey Westerville, OH 43081
NCRP	National Council on Radiation Protection and Measurement 7910 Woodmont Ave., Suite 800 Bethesda, MD 20814-3095 www.ncrp.com	NIBS	National Institute of Building Sciences 1090 Vermont Ave., NW, Suite 700 Washington, DC 20005-4905 www.nibs.org
NDI	Nickel Development Institute 214 King West, Suite 510 Toronto, Ontario Canada M5H 3S6 www.nidi.org	NIST	National Institute of Standards and Technology 100 Bureau Dr, MS 2150 Gaithersburg, MD 20899-2150 www.nist.gov
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 www.nebb.org	NLA	National Lime Association 200 North Glebe Rd., Suite 800 Arlington, VA 22203 www.lime.org
NECA	National Electrical Contractors Association 3 Bethesda Metro Center, Ste. 1100 Bethesda, MD 20814 www.necanet.org	NLGA	National Lumber Grades Authority #406-First Capital Pl. 960 Quayside Dr. New Westminster, BC V3M6G2 CANADA www.nlga.org

SECTION 01090
REFERENCE STANDARDS

P

NOFMA	National Oak Flooring Manufacturers Association P.O. Box 3009 Memphis, TN 38173-0009 www.nofma.org	PCA	Portland Cement Association 5420 Old Orchard Rd. Skokie, IL 60077 www.portcement.org
NPCA	National Paint and Coatings Association 1500 Rhode Island Ave., NW Washington, DC 20005 www.paint.org	PCI	Precast/Prestressed Concrete Institute 209 W. Jackson Blvd. Chicago, IL 60606-6938
NRCA	National Roofing Contractors Association O'Hare International Center 10255 W. Higgins Rd., Ste. 600 Rosemont, IL 60018 www.roofonline.org	PDCA	Painting and Decorating Contractors of America 3913 Old Lee Hwy, Suite 33-B Fairfax, VA 22030 www.pdca.com
NSF	NSF International P.O. Box 130140 Ann Arbor, MI 48113-0140 www.nsf.org	PDI	Plumbing and Drainage Institute 45 Bristol Drive South Easton, MA 02375 http://PDIonline.org
NSPE	National Society Of Professional Engineers 1420 King St. Alexandria, VA 22314	PEI	Petroleum Equipment Institute P.O. Box 2380 Tulsa, OK 74101-2380 www.pei.org
NSPI	National Spa and Pool Institute 2111 Eisenhower Ave. Alexandria, VA 22314 www.nspi.org	PMI	Plumbing Manufacturers Institute 1340 Remington Rd., Suite A Schaumburg, IL 60173 www.pmihome.org
NSWMA	National Solid Wastes Management Association 4301 Connecticut Ave. NW, Suite 300 Washington, DC 20008 www.nswma.org	PPFA	Plastic Pipe And Fittings Association 800 Roosevelt Rd., Bldg. C, Ste. 20 Glen Ellyn, IL 60137 www.ppfahome.org
NTMA	National Terrazzo and Mosaic Association 110 E. Market St., Suite 200-A Leesburg, VA 20176 www.ntma.com	PPI	Plastics Pipe Institute 105 Decker Court Suite 825 Irving, TX 75062 www.plasticpipe.org
NUCA	National Utility Contractors Association 4301 North Fairfax Dr., Suite 360 Arlington, VA 22203-1627 www.nuca.com	PS	Product Standard U.S. Dept. of Commerce Washington, DC 20203
NWMA	National Woodwork Manufacturers Association 205 W. Touhy Ave. Park Ridge, IL 60068	PTI	Post Tensioning Institute 1717 W. Northern Ave., Suite 114 Phoenix, AZ 85021 www.post-tensioning.org

R			
RCSC	Research Council on Structural Connections www.boltcouncil.org	SPRI	Single Ply Roofing Institute 200 Reservoir St., 309 A Needham, MA 02494 www.spri.org
RIS	The Redwood Inspection Service 630 J Street Eureka, CA 95501	SSMA	Steel Stud Manufacturer Association 8 S. Michigan Ave Chicago, IL 60603
S			
SCDOT	South Carolina Department of Transportation 955 Park Street Columbia, SC 29201-3959 www.scdot.org	SSPC	SSPC: The Society for Protective Coatings 40 24 th St., 6 th Floor Pittsburgh, PA 15222-4656 www.sspc.org
SCMA	Southern Cypress Manufacturers Association 400 Penn Center Blvd., #530 Pittsburgh, PA 15235 www.cypressinfo.org	STI	Steel Tank Institute 570 Oakwood Rd. Lake Zurich, IL 60047 www.steel tank.com
SDI	Steel Deck Institute P.O. Box 25 Fox River Grove, IL 60021 www.sdi.org	SWI	Steel Window Institute 1300 Sumner Ave. Cleveland, OH 44115-2851 www.steelwindows.com
SDI	Steel Door Institute 30200 Detroit Rd. Cleveland, OH 44145-1967 www.steel door.org	SWRI	Sealant, Waterproofing, and Restoration Institute 2841 Main St. Kansas City, MO 64108 www.swrionline.org
SFPA	Southern Forest Product Association 2900 Indiana Avenue Kenner, LA 70065 www.sfpa.org.org	T	
SIGMA	Sealed Insulating Glass Manufacturers Association 401 N. Michigan Ave. Chicago, IL 60611 www.sigmaonline.org/sigma	TCA	Tile Council of America, Inc. 100 Clemson Research Blvd. Anderson, SC 29625 www.tileusa.com
SJI	Steel Joist Institute 3127 10 th Ave., North Ext. Myrtle Beach, SC 29577-6760 www.steeljoist.org	TIA/EIA	Telecommunications Industry Association/ Electronic Industries Alliance 2500 Wilson Blvd., Suite 300 Arlington, VA 22201 www.tiaonline.org
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 4201 Lafayette Center Dr. Chantilly, VA 20151-1209 www.smacna.org	TMS	The Masonry Society 3970 Broadway, Suite 201-D Boulder, CO 80304-1135 www.masonrysociety.org
SPIB	Southern Pine Inspection Bureau 4709 Scenic Hwy Pensacola, FL 32504-9094 www.spib.org	TPI	Truss Plate Institute 583 D'Onofrio Dr., Suite 200 Madison, WI 53719 www.tpinst.org

SECTION 01090
REFERENCE STANDARDS

TPI	Turfgrass Producers International 1855-A Hicks Road Rolling Meadows, IL 60008 www.turfgrassod.org	WH	Intertek Testing Services (Warnock Hersey Listed) 3210 American Drive Mississauga, Ontario L4V 1B3 CANADA www.etlsemko.com
U – Z			
UL	Underwriters Laboratories, Inc. 333 Pfingsten Rd. Northbrook, IL 60062-2096 www.ul.com	WIC	Woodwork Institute of California 3164 Industrial Blvd. West Sacramento, CA 95691 www.wicnet.org
VMAA	Valve Manufacturers Association Of America 1050 17th St., NW, Ste. 280 Washington, DC 20036-5503 www.vma.org	WWPA	Western Wood Products Association 522 SW 5 th Ave., Suite 500 Portland, CO 97204-2122 www.wwpa.org
WCLIB	West Coast Lumber Inspection Bureau P.O. Box 23145 Portland, OR 97281 www.wclig.org		
WDMA	Window and Door Manufacturers Association 1400 E. Touhy Ave., Suite 470 Des Plaines, IL 60018 www.nwwda.org		

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General requirements
- B. Preconstruction conference
- C. Progress meetings

1.2 GENERAL REQUIREMENTS

- A. Engineer will schedule and administer pre-construction meeting, regularly scheduled progress meetings, and specially called meetings throughout the progress of the Work:
 - 1. Prepare agenda for meetings including items requested by Owner and Contractor.
 - 2. Preside at meetings
 - 3. Record the minutes; include all significant proceedings and decisions.
 - 4. Reproduce and distribute copies of minutes within 5 days after each meeting:
 - a. To all participants in the meetings
 - b. To Owner
 - c. Furnish 3 copies of minutes to Contractor
- B. Owner may attend meetings
- C. Representatives of contractors, subcontractors, and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents.

1.3 PRECONSTRUCTION CONFERENCE

- A. Engineer will schedule a conference after Notice of Award.
- B. Location: A central site, convenient for all parties.
- C. Attendance:
 - 1. Owner's Representative
 - 2. Engineer and his professional consultants
 - 3. Resident Project Representative
 - 4. Contractor's Superintendent
 - 5. Major Subcontractors
 - 6. Major Suppliers
 - 7. Others as appropriate
- D. Agenda:
 - 1. Submission of executed bonds and insurance certificates
 - 2. Distribution of Contract Documents

3. Submission of list of subcontractors and suppliers, list of products, Schedule of Values, and progress schedule
4. Designation of personnel representing the parties in Contract, and the Engineer.
5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, cost proposal requests, Change Orders and Contract closeout procedures.
6. Construction scheduling and updates.
7. Critical work sequencing.
8. Major equipment deliveries and priorities.
9. Procedures for maintaining Record Documents.
10. Use of premises:
 - a. Office, work and storage areas
 - b. Owner's requirements
11. Construction facilities, controls and construction aids
12. Temporary utilities
13. All safety and first-aid procedures are responsibility of the Contractor
14. Security and housekeeping procedures as required by the Owner
15. Procedures for testing
16. Requirements for start-up of equipment

1.4 PROGRESS MEETINGS

- A. Engineer will schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Location of the Meetings: The project field office of the Contractor, or other locations arranged for by Contractor, convenient to all parties.
- C. Engineer will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within three (3) days to Contractor, Owner, participants, and those affected by decisions made.
- D. Attendance:
 1. Owner's Representative
 2. Engineer, and his professional consultants as needed
 3. Resident Project Representative
 4. Contractor's Superintendent
 5. Subcontractors as appropriate to the agenda
 6. Suppliers as appropriate to the agenda
 7. Others, as appropriate
- E. Agenda:
 1. Review minutes of previous meetings
 2. Review unresolved issues from last meeting
 3. Review of Work progress
 4. Field observations, problems, conflicts and decisions

5. Identification of problems which impede planned progress
6. Review of submittals schedule and status of submittals
7. Review of off-site fabrication and delivery schedules
8. Maintenance of progress schedule
9. Corrective measures to regain projected schedules
10. Planned progress during succeeding work period
11. Coordination of projected progress
12. Maintenance of quality and work standards
13. Effect of proposed changes on progress schedule and coordination
14. Other business relating to Work

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements
- B. Format
- C. Content
- D. Progress Revisions
- E. Submittals
- F. Distribution

1.2 REQUIREMENTS

- A. Within 10 days after Effective Date of Agreement, Contractor shall prepare and submit to Engineer estimated construction progress schedules for the Work, with subschedules of related activities which are essential to its progress.
- B. Submit revised progress schedules with each pay request.
- C. The Contractor shall provide a written schedule of tasks expected to be done on a weekly basis. The schedule shall be provided on the previous Friday to the RPR.
- D. Owner may require Contractor to add to his plant, equipment, or construction forces, as well as increase the working hours, if operations fall behind schedule at any time during construction period.

1.3 FORMAT

- A. General schedule format: Conform to ©Primavera, Suretrack critical path method (CPM) scheduling format, Microsoft Projects or approved equal:
 - 1. Base schedule on work days and regular working hours, Monday through Friday, as specified in General Conditions.
 - 2. Minimum sheet size: 8-1/2 inch by 11 inch
 - 3. Color format
- B. Row (Listings)—Show:
 - 1. Project Title
 - 2. Major areas of construction
 - 3. Construction activities within major areas of construction
 - 4. Provide a separate bar for each construction activity. Bars to be annotated with activity description.
 - 5. Critical path activities to be clearly identified by color and lines.

6. List in chronological order by start date each major area of construction and then by each construction activity within its respective area of construction.
7. Show project start date, finish date, data date, run date, and revision table
8. Contract milestone dates.
9. Legend

C. Column (Headings)—Show:

1. Activity ID: Define by number corresponding to major specification sections
2. Activity Description
3. Percent Complete
4. Original Duration
5. Remaining Duration
6. Total Float
7. Early Start
8. Early Finish
9. Time Scale: Identify first day of each week. Allow space for notations
10. Data date line

1.4 CONTENT

A. Construction progress schedule:

1. Submit initial construction schedule for full length of Contract time as specified in Section AGR, Agreement Between Owner and Contractor including number of days for float.
2. Initial construction schedule submitted with early substantial and final completion prior to specified Contract time will not be acceptable.
3. Initial construction schedule will be used to evaluate critical path and Contract time extensions requested by Contractor.
4. Subsequent construction schedules may reflect an accelerated schedule with early finish that may or may not include reduced number of days for float when compared to the initial construction schedule for full Contract time.
5. Show complete sequence of construction by activity or major area of construction
6. Major areas of construction to include, at a minimum, each separate stage of Work as specified in Section 01010, Summary of Work and major items of Work as specified in Divisions 02 through 16.

B. Submittals schedule for shop drawings and product data - Show:

1. The dates for Contractor's submittals
2. The dates accepted submittals will be required from Engineer. Extensions of time for delays in submittal approval shall only be allowed as provided in Section 01340, Shop Drawings, Product Data and Samples

C. Products delivery schedule - Show delivery dates for:

1. All major items of equipment and materials
2. Products specified under provisions of Section 01020, Allowances.

- D. Training program schedule—Show schedule incorporating specific equipment as listed in Section 01400, Quality Control under manufacturer's field services:
 - 1. Provide duration of each training session with start/finish times
 - 2. Use consecutive 8-hour work days with provisions for 1-hour lunch and two 15-minute breaks.
 - 3. Present a minimum of two options for the start/finish dates of training program for Owner selection.
 - 4. Duration of each training session is specified in individual equipment specification sections.
 - 5. Coordinate training program schedule with requirements of Section 01650, Starting of System.

1.5 PROGRESS REVISIONS

- A. Progress schedules are to be representative of actual construction progress and sequencing of activities. Schedules that do not accurately represent construction progress will be rejected.
- B. Indicate progress of each activity as of data date.
- C. Show changes occurring since previous submission of schedule:
 - 1. Major changes in scope
 - 2. Activities modified since previous submission
 - 3. Revised projections of progress and completion
 - 4. Other identifiable changes
- D. Provide narrative report as needed to define:
 - 1. Problem areas, anticipated delays, and impact on schedule
 - 2. Corrective action recommended, and its effect
 - 3. Effect on changes on schedules of other prime contractors

1.6 SUBMITTALS

- A. Submit initial schedules within 10 days after award of Contract:
 - 1. Engineer will review schedules and return review copy within 10 days after receipt.
 - 2. If required, resubmit within 7 days after return of review copy.
- B. Submit revised progress schedules with each Application for Payment.
- C. At each submission submit the number of opaque reproductions which the Contractor requires, plus 3 copies which will be distributed by Engineer. Do not submit fewer than 5 copies.

1.7 DISTRIBUTION

- A. Engineer will distribute copies of accepted schedules to:
 - 1. One copy to Owner

2. One copy to Resident Project Representative
3. One copy to be retained in Engineer's file
4. One copy to Contractor to be kept on file at job site
5. Remainder to Contractor for his distribution

B. Schedule recipients will report promptly to Engineer and Contractor, in writing, any problems anticipated by projections shown in schedules.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submission of all shop Drawings and product data as required by the Contract Documents for all equipment and materials to be furnished under this contract unless specifically indicated otherwise.

1.2 RELATED SECTIONS

- A. Section 01310 - Construction Schedules
- B. Section 01370 - Schedule of Values
- C. Section 01400 - Quality Control
- D. Section 01630 - Product Options and Substitutions
- E. Section 01700 - Contract Closeout
- F. Section 01730 - Operation and Maintenance Data
- G. Sections for Divisions 1 through 16 - Required Submittals

1.3 SUBMITTALS

- A. Shop Drawings—Drawings shall be presented in a clear and thorough manner:
 - 1. Identify details by reference to sheet and detail, schedule or room numbers shown on Contract Drawings.
 - 2. Identify equipment by reference to equipment name and tag number shown on Contract Drawings.
 - 3. Scale and Measurements: Make drawings accurate to a scale with sufficient detail to show the kind, size, arrangement and function of component materials and devices.
 - 4. Minimum sheet size: 8-1/2 inch by 11 inch.
 - 5. Fabrication drawing size: 11 inch by 17 inch or 24 inch by 36 inch.
- B. Product Data—Preparation:
 - 1. Contractor shall reserve the color **RED** for Engineer only for markings/comments. Any other color that stands out may be used by Contractor.
 - 2. Contractor shall show ZEL's project number on the cover of the transmittal.
 - 3. Clearly mark each copy to identify pertinent products or models submitted for review.
 - 4. Identify equipment by reference to equipment name and tag number.
 - 5. Catalog cut sheets: Cross-out or delete irrelevant data.
 - 6. Show performance characteristics and capacities.
 - 7. Show dimensions and clearances required for installation and maintenance.

8. Show wiring or piping diagrams and controls. These diagrams shall be complete and demonstrate all equipment, piping (interior and/or exterior), supports, bases and small piping. These shop drawings shall also reference building/structural features such that all conformance shall be verified.
 9. Show external connections, anchorages, and supports required.
- C. "Certificate of Compliance":
1. Provided by manufacturer or supplier in lieu of submittal data required.
 2. Certifies that product data or item identified in certificate is in total compliance with Contract Document requirements.
 3. Specifically identifies project name and that there is no deviation from Contract Documents.
 4. Identify equipment by reference to equipment name and tag number.
 5. Identify limits of equipment, materials or work provided.
 6. Provide for specific product data or item only as indicated herein.
- D. Construction Schedule: Designate in the construction schedule, or in a separate coordinated shop drawing schedule, the dates for submission and the dates that reviewed Shop Drawings and Product Data will be needed.
- E. Samples—Office samples shall be of sufficient size and quantity to clearly illustrate:
1. Functional characteristics of the product, with integrally related parts and attachment devices.
 2. Full range of color, texture and pattern.
 3. Comply with requirements identified in individual specification sections.
- F. Manufacturer's standard schematic drawings and diagram or project specific schematic drawings and diagrams:
1. Modify drawings and diagrams to delete information which is not applicable to the Work by crossing out or omitting irrelevant data.
 2. Supplement standard information to provide information specifically applicable to the Work.
 3. Determine proper sizes and lengths, jointing and details.
- G. Field samples and mock-ups:
1. Contractor shall erect, at the Project site, at a location acceptable to the Engineer.
 2. Size or area: That specified in the respective specification section.
 3. Fabricate each sample and mock-up complete and finished.
 4. Remove mock-ups at conclusion of Work or when acceptable to the Engineer.
- 1.4 CONTRACTOR RESPONSIBILITIES
- A. Review shop drawings and product data prior to submission for accuracy and completeness of each submission.
- B. Approve and stamp each submission before submitting it.

- C. Determine, verify and/or generate:
 - 1. Field measurements
 - 2. Field construction criteria to include practical schedules
 - 3. Catalog numbers and similar data
 - 4. Conformance with specifications
 - 5. Equipment layout and comparisons with all components of the project.
- D. Prior to each submission, carefully review and coordinate all aspects of each item being submitted.
- E. Verify that each item and the submittal for it conform in all respects with specified requirements of the Work and of the Contract Documents with respect to means, methods, techniques, sequences, and operations of construction, and safety precautions and programs incidental thereto.
- F. Make submissions promptly in accordance with Construction Schedule, and in such sequence as to cause no delay in the Work or in the work of any other contractor. Shop drawing submittal may dictate scheduling of construction such that without submission, review and approval, the work may be required to cease until proper submittal and approval is achieved.
- G. Limit requirements for expedited submittal review by Engineer to no more than 10 percent percent of total number of submittals:
 - 1. Expedited submittal review period: Less than 7 calendar days
- H. Notify Engineer in writing, at time of submission, of any deviations in the submittals from Contract Document requirements:
 - 1. Identify and tabulate all deviations in transmittal letter.
 - 2. Indicate essential details of all changes proposed, including modifications to other facilities that may be a result of the deviation.
 - 3. Include required piping and wiring diagrams.
- I. Provide resubmissions within 30 calendar days following return of reviewed submissions for submittal items with disposition of either “Rejected” or “Revise and Resubmit”. Promptly address noted Contract Document requirements, unresolved issues and all other comments of Engineer prior to final review and approval by Engineer of resubmissions. Contractor will be notified by Engineer of any deficient submittal items after the specified number of calendar days required for resubmissions has expired.

1.5 SUBMISSION REQUIREMENTS

- A. Make submissions far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmissions, and for placing orders and securing delivery.

- B. In scheduling, allow a minimum of 21 calendar days for review by Engineer following receipt of submission in Engineer's office.
- C. Consecutively number all submissions:
1. Assign unique number to include all shop Drawings, product data and other information required for individual specification sections.
 2. Each specification section may still have more than one submittal number for later submissions (i.e., Preliminary O&M Manuals, Final O&M Manuals, etc.).
- D. Electronic Submittals:
1. Shop Drawings and Product Data: Transmit to Engineer in electronic (PDF) format.
 2. Engineer will return the completed review to the Contractor via e-mail or uploaded to Engineer's FTP site as warranted by file size.
 3. Distribution of reviewed submittals to subcontractors or suppliers is the responsibility of the Contractor.
- E. Sample and Color submittals: Submit 3 copies of each sample unless specified otherwise in individual section.
- F. Accompany each submission with letter of transmittal showing all information required for identification and checking. Submittals shall contain:
1. Submittal number
 2. Date of submission and dates of any previous submissions
 3. Project title and number
 4. Owner Contract identification number if applicable
 5. The names of:
 - a. Contractor
 - b. Supplier
 - c. Manufacturer
 6. Identification of the product, with specification section number
 7. Field dimensions, clearly identified as such
 8. Relation to adjacent or critical features of the Work or materials
 9. Applicable standards, such as ASTM or Federal Specification numbers
 10. Identification of deviations from Contract Documents:
 - a. If Contractor proposes to provide material or equipment of work which deviates from the Contract Documents, indicate so under "deviations" on the transmittal form accompanying the submittal.
 - b. Identify all requested deviations as specified and on copies of Specifications and Drawings required per paragraph 1.5.F.11
 - c. If deviations from specifications are indicated and, therefore requested by Contractor, the submittal shall be accompanied by a detailed, written justification for each deviation

- d. Failure to include a copy of marked-up specification sections, along with justification for any requested deviations to specification requirements, with the submittal shall be cause for rejection of the entire submittal with no further consideration by Engineer
- 11. Confirmation of compliance with Contract Documents:
 - a. Unless a Certificate of Compliance is permitted for material or equipment where specified, provide the following documents to demonstrate compliance with the Contract Documents:
 - 1) Copy of relevant Drawings with all addendum updates that apply to equipment in Divisions 11, 13, 14 and 15 marked to show specific changes necessary for equipment proposed in Contractor's submittal:
 - a) If no changes are required, Drawing(s) shall be marked "no changes required"
 - b) Failure to include copies of relevant drawings with submittal, whether changes are required or not, shall be cause for rejection of entire submittal with no further review by Engineer
 - c) Relevant Drawings include as a minimum control diagrams, process and instrumentation diagrams (P&IDs), and Process (P) drawings
 - 2) A copy of each pertinent specification section in Divisions 11, 13, 14 and 15 with all addendum updates included, and all referenced and applicable specification sections, with their respective addendum updates included, with each paragraph check-marked to indicate specification compliance. Otherwise mark to indicate requested deviations from specification requirements per paragraph 1.5.F.10
- 12. Identification of revisions on resubmissions
- 13. An 8 inch by 4 inch blank space for Contractor's and Engineer's stamps
- 14. Stamp cover sheet of each submittal as identified in letter of transmittal

15. Contractor's stamp: Initialed or signed, certifying review and approval of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents. Use stamp to include wording similar to the following:

<p>This submittal has been reviewed by [<i>name of contractor</i>] and approved with respect to the means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incidental thereto. [<i>Name of contractor</i>] also warrants that this submittal complies with contract documents and comprises no deviations thereto:</p> <p>Section No: _____ Submittal No: _____</p> <p>DATE: _____ BY: _____</p>
--

- G. Submittal Log:
1. Maintain an accurate submittal log for duration of the Work showing current status of all submissions.
 2. Show submittal number, section number, section title, submittal description dates and disposition of submittal.
 3. Make submittal log available to Engineer for Engineer's review upon request.
- H. Unless specified otherwise, make submissions in groups to facilitate efficient review and approval:
1. Include all associated items from individual specification sections to assure that all information is available for checking each item when it is received.
 2. Submit a complete initial submittal including all components when an item consists of components from several sources.
 3. Partial submittals may be rejected as not complying with provisions of the Contract.
 4. Engineer will not be held liable for delays due to poorly organized or incomplete submissions.
 5. Do not include items from more than one specification section for any one submittal number.

1.6 DISPOSITION OF SHOP DRAWINGS AND PRODUCT DATA

- A. "Approved": Approved with No Exceptions Noted:
1. No corrections or comments noted on submittal or in transmittal letter.
 2. Issues or miscellaneous comments pertaining to other related items of the Work may be included in transmittal letter.
 3. Resubmission not required.

- B. "Approved as Noted": Approved with Corrections Noted:
 - 1. Comply with corrections or comments as noted on submittal and in transmittal letter.
 - 2. Resubmission not required.
- C. "Revise And Resubmit": Incorrect or Specific Information Still Required:
 - 1. Submittal is either: incorrectly annotated; specific comments need to be addressed and incorporated in resubmittal; and/or additional information may be required as noted in transmittal letter.
 - 2. Submitted information may not include or address specific item required per the specification as identified in transmittal letter.
 - 3. Specific information related to identified item may be required for final approval of submittal.
 - 4. Resubmission of entire submittal may be required or resubmission of specific item may be required as identified in transmittal letter.
- D. "Rejected": Returned for Correction:
 - 1. Contractor required to resubmit complete submittal package in accordance with Contract Documents.
 - 2. Submittal does not comply with provisions of Contract Documents as noted in transmittal letter.
 - 3. Resubmission required

1.7 DISPOSITION OF SAMPLES

- A. "Approved": Approved with No Exceptions Noted:
 - 1. One sample sent to Owner
 - 2. One sample sent to Resident Project Representative
 - 3. One sample retained in Engineer's file
 - 4. Acknowledgment: Copy of transmittal letter sent to Contractor
 - 5. Resubmission not required
- B. "Approved Noted": Approved with Corrections Noted:
 - 1. One sample sent to Owner
 - 2. One sample sent to Resident Project Representative
 - 3. One sample retained in Engineer's file
 - 4. Acknowledgment: Copy of transmittal letter sent to Contractor
 - 5. Work performed or products furnished to comply with exceptions noted in acknowledgment
 - 6. Resubmission not required
- C. "Rejected": Returned for Correction:
 - 1. One sample retained in Engineer's file
 - 2. Remaining samples sent to Contractor for resubmittal and compliance with the Contract Documents as noted in transmittal letter.
 - 3. Copy of transmittal letter sent to Owner

4. Resubmission required

1.8 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in submittals required by Engineer and resubmit until approved.
- B. Transmit each resubmission under new letter of transmittal. Use number of original submittal followed directly by a capital letter corresponding to the number of times a submittal is resubmitted (i.e., 1, 1A, 1B, etc.).
- C. Shop Drawings and Product Data:
 - 1. Revise initial Drawings or data and resubmit as specified for the initial submittal.
 - 2. Indicate any changes which have been made other than those requested by Engineer.
- D. Samples: Submit new samples as required for initial submittal
- E. Reimbursement of Resubmission Review Costs:
 - 1. Review of first submittal and one resubmittal will be performed by Engineer at no cost to the Contractor.
 - 2. Costs for review of subsequent resubmissions will be directly paid by Contractor.
 - 3. Engineer will document work-hours required for review and costs for Engineer review will be deducted from payments due Contractor as Change Order deducts.
 - 4. Charges for review of resubmissions will include Engineer at maximum rate of \$95 per hour and Submittal Clerk at maximum rate of \$45 per hour.

1.9 ENGINEER'S DUTIES

- A. Review submittals with reasonable promptness and in accord with approved submission schedule provided that each submittal has been called for by the Contract Documents and is stamped by Contractor as indicated above:
 - 1. In the event that Engineer will require more than 7 calendar days to perform an expedited submittal review as requested by Contractor, Engineer shall so notify Contractor or indicate so on the submission schedule.
 - 2. No extensions of time are allowed due to Engineer's delay in reviewing submittals unless all the following criteria are met:
 - a. Contractor has notified Engineer in writing that an expedited review of particular submittal in question is critical to the progress of the Work and Contractor has identified the requested submittal return date.
 - b. Engineer has failed to return submittal within 21 days of receipt of the submittal or receipt of said notice, whichever is later
 - c. Contractor demonstrates that delay in progress of the Work was directly attributable to Engineer's failure to return submittal within 21 days
 - 3. No extensions of time are allowed due to delays in progress of the Work caused by rejection and subsequent resubmission of data, including multiple resubmissions or the lack of the complete or proper submission of shop drawing.

- B. Review drawings and data submitted only for general conformity with Contract Documents:
1. Engineer's review of drawings and data returned marked "Approved" or "Approved as Noted" does not indicate a thorough review of all dimensions, quantities, and details of material, equipment device or items shown.
 2. Engineer's review does not relieve Contractor of responsibility for errors, omissions or deviations nor responsibility for compliance with the Contract Documents.
 3. Engineer's review shall not extend to means, methods, techniques, sequences, operations of construction, and safety precautions and programs incidental thereto. No information regarding these items will be reviewed whether or not included in submittals.
- C. Assume that no shop Drawing or related submittal comprises a deviation to the Contract Documents unless Contractor advises Engineer otherwise in writing which is acknowledged by Engineer in writing:
1. Consider and review only those deviations from the Contract Documents clearly identified as such in submittal and tabulated in the Letter of Transmittal.
 2. At the discretion of the Engineer, notify Contractor that review of specific deviations will be reviewed under provisions of Section 01630, Product Options and Substitutions of these Specifications.
- D. Return submittals to Contractor for distribution or for resubmission.
- E. Transmit, unreviewed, to Contractor all copies of submittals not called for by the Contract Documents or which have not been approved by Contractor.
- F. Engineer will not review uncalled-for shop drawings or product data except by special arrangement.

- G. Affix stamp and indicate approval for submittal or resubmission requirements with the following stamp:

<input type="checkbox"/> APPROVED	<input type="checkbox"/> APPROVED AS NOTED
<input type="checkbox"/> REJECTED	<input type="checkbox"/> REVISE AND RESUBMIT

Approval is only for general conformance with the design concept of the Project and the information given in the Contract Documents. Contractor is responsible for dimensions to be confirmed and correlated at the job site; information that pertains solely to the fabrication process or to the means and methods of construction; coordination of the work of all trades; and performing work in a safe and satisfactory manner. This approval does not modify Contractor's duty to comply with the Contract Documents.

ZIMMERMAN, EVANS AND LEOPOLD, INC.

Date _____ By _____

1.10 SUBMITTAL SCHEDULE

- A. Unless indicated otherwise, provide all submittals required by individual sections of the Contract Documents to establish compliance with the specified requirements.
- B. Contractor may provide "Certificate of Compliance" in lieu of product data submittal as required above for the following sections:

Section Number	Section Title	Product Data or Item
02050	Demolition	
02936	Grassing	
03600	Grout	

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Schedule of Values
- B. Subschedule of Unit Material Values
- C. Cash Flow Projection

1.2 SUBMITTALS

- A. Submit to Engineer a Schedule of Values allocated to the various portions of the Work, within 10 days after Effective Date of Agreement.
- B. Upon request of Engineer, support the values with data which will substantiate their correctness.
- C. An unbalanced Schedule of Values providing over payment of Contractor on items of the Work which will be performed early will not be accepted.
- D. Revise and resubmit the Schedule of Values until acceptable to Engineer. No Applications for Payment shall be submitted until Schedule of Values is accepted.
- E. The Schedule of Values, when accepted by Engineer, shall be used only as the basis for the Contractor's Applications for Payment.

1.3 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Type schedule on 8-1/2 inch by 11 inch white paper; Contractor's standard forms and automated printout will be considered for approval by Engineer upon Contractor's request. Identify schedule with:
 - 1. Title of project and location
 - 2. Engineer and project number
 - 3. Name and address of Contractor
 - 4. Contract designation
 - 5. Date of submission
- B. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.
- C. Follow the Table of Contents of this Project Manual as the format for listing component items:
 - 1. Identify each line item with the number and title of the respective major section of the specifications.
- D. For each major line item list sub-values of major products or operations under the item.

- E. List such items as bond and insurance premiums, temporary construction facilities, monthly field overhead, mobilization and demobilization separately.
 - F. For the Various Portions of the Work:
 - 1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
 - 2. For items on which progress payments will be requested for stored materials, break down the value into:
 - a. The cost of the materials, delivered and unloaded, with taxes paid.
 - b. The total installed value, including Contractor's overhead and profit.
 - G. The sum of all values listed in the schedule shall equal the total Contract Sum.
- 1.4 SUBSCHEDULE OF UNIT MATERIAL VALUES
- A. Submit a Subschedule of Unit Costs and Quantities for:
 - 1. Products on which progress payments will be requested for stored products.
 - B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.
 - C. The unit quantity for bulk materials shall include an allowance for normal waste.
 - D. The Unit Values for the Materials Shall be Broken Down Into:
 - 1. Cost of the material, delivered and unloaded at the site, with taxes paid.
 - 2. Installation costs, including Contractor's overhead and profit.
 - E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

1.5 CASH FLOW PROJECTION

- A. Submit estimated cash flow projection for the project:
 - 1. Estimate monthly pay applications
 - 2. Coordinate with Schedule of Values and Construction Schedule.
- B. Resubmit a revised cash flow projection with any pay application which brings the aggregate of all pay applications to date to value which differs from the projected value by more than ±20 percent.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance and control of installation
- B. Field samples and mock-up
- C. Inspection and testing laboratory services and qualifications
- D. Laboratory duties and limitations of authority of testing laboratory
- E. Contractor's responsibilities
- F. Manufacturer's field services and reports
- G. Shop testing
- H. Field testing
- I. Testing and services schedule

1.2 REFERENCES

- A. Conform to reference standard by date of issue current on date of Contract Documents.
- B. Obtain copies of standards when required by Contract Documents.
- C. Where specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Provide copies of written reports for materials, equipment or systems as scheduled at the end of this section. Reference each report by respective section number.
- C. Laboratory qualifications - Provide statement of qualifications from testing firm and testing firm personnel for review and acceptance by Engineer.
- D. Field personnel qualifications—Provide statement of qualifications for review and acceptance by Engineer for the following:
 - 1. ACI certification

2. Independent special inspector and testing as specified.
- E. Laboratory test reports - Provide written reports of each test and inspection to Engineer. Each report shall include:
1. Date issued
 2. Project title and number
 3. Testing laboratory name, address and telephone number
 4. Name and signature of laboratory inspector
 5. Date and time of sampling or inspection
 6. Record of temperature and weather conditions
 7. Date of test
 8. Identification of product and specification section
 9. Location of sample or test in the Project
 10. Type of inspection or test
 11. Results of tests and compliance with Contract Documents
 12. Interpretation of test results when requested by Engineer
- F. Shop test reports: Provide reports detailing results of tests and certification from manufacturer to verify compliance with specifications.
- G. Field test reports: Provide reports detailing results of the tests. Indicate compliance or non-compliance with Contract Documents. Identify corrective action for materials and equipment which fails to pass field tests.
- H. Manufacturer's field services:
1. Provide qualifications of observer to Engineer 30 days in advance of required observations. Observer subject to acceptance of Engineer/Owner
 2. Provide reports to Engineer through Contractor certifying that:
 - a. Equipment is properly installed and lubricated.
 - b. Equipment is in accurate alignment.
 - c. Equipment is free from any undue stress imposed by connecting piping and anchor bolts.
 - d. Equipment has operated satisfactorily under full load conditions.
- 1.4 QUALITY ASSURANCE/CONTROL OF INSTALLATION
- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
 - B. Comply fully with manufacturer's instructions, including each step in sequence.
 - C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
 - D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

- E. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
 - F. Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities: Conditions of the Contract.
 - G. Certification of products: Respective sections of specifications.
 - H. Testing, adjusting and balancing of equipment: Respective sections of specifications.
 - I. Laboratory tests required and standards for testing: Respective sections of specifications.
- 1.5 FIELD SAMPLES
- A. Install field samples at the site as required by individual specifications sections for review.
 - B. Acceptable samples represent a quality level for the Work.
 - C. Where field samples are specified in individual sections, remove, and clear area after field sample has been accepted by Engineer.
- 1.6 MOCK-UP
- A. Tests will be performed under provisions identified in this section.
 - B. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes.
- 1.7 INSPECTION AND TESTING LABORATORY SERVICES
- A. Contractor shall employ and pay for the services of an independent testing laboratory to perform all specified services and testing related to the design of mixes, products and equipment, to Engineer's review of proposed materials and equipment before, during and after incorporation in the Work and to retest materials and equipment which fail original tests:
 - 1. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the Work of the Contract.
 - B. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Engineer.
- 1.8 QUALIFICATION OF LABORATORY
- A. Perform all tests to determine compliance with Contract Documents by an independent commercial testing firm acceptable to Engineer.
 - B. Testing firm's laboratory: Staffed with experienced technicians, properly equipped and fully qualified to perform tests in accordance with specified standards.

- C. Meet basic requirements of ASTM E329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction" as applicable.
- D. Authorized to operate in the State in which the Project is located.
- E. Testing equipment:
 - 1. Calibrated at reasonable intervals by devices of accuracy traceable to either:
 - a. National Bureau of Standards
 - b. Accepted values of natural physical constants

1.9 LABORATORY DUTIES

- A. Cooperate with Engineer and Contractor; provide qualified personnel after due notice.
- B. Perform specified inspections, sampling, and testing of materials and methods of construction:
 - 1. Comply with specified standards.
 - 2. Ascertain compliance of materials with requirements of Contract Documents.
- C. Promptly notify Engineer and Contractor of observed irregularities or deficiencies of work or products.

1.10 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of the Work.
 - 3. Owner employed laboratory shall not perform any duties of the Contractor.

1.11 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel and provide access to Work.
- B. Secure and deliver to the laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.
- C. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other material mixes which require control by the testing laboratory.
- D. Furnish copies of product test reports as required.
- E. Furnish incidental labor and facilities:
 - 1. To provide access to Work to be tested.
 - 2. To obtain and handle samples at the project site or at the source of the product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For storage and curing of test samples.

1.12 MANUFACTURER'S FIELD SERVICES

- A. Comply with provisions under Section 01650, Starting of Systems of these specifications.
- B. Contractor shall coordinate and pay for the services of manufacturers' representatives to perform the specified services.
- C. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting and balancing of equipment and, as applicable, to initiate instructions when necessary.
- D. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.
- E. Qualification of Manufacturer's Representative: Authorized representative of the manufacturer; experienced in the application and installation of the subject equipment.
- F. Inspect, check and adjust equipment as required and approve installation.
- G. Be present when equipment is placed in operation.
- H. Revisit the site as often as required to correct all problems and until equipment installation and operation are acceptable to Engineer.
- I. Instruct Owner's personnel in operation and maintenance of the equipment in accordance with Section 01730, Operation and Maintenance Data of these specifications and respective sections of these specifications.

1.13 SHOP TESTS

- A. Contractor shall coordinate and pay all costs associated with specified shop tests of equipment, including retesting of items which fail original tests specifically identified in the technical specifications.
- B. Where the specifications call for a shop test to be witnessed by a representative of the Engineer, notify Engineer not less than 14 days prior to the scheduled test date:
 - 1. Owner is to pay for all costs of Engineer's first visit.
 - 2. When subsequent visits by Engineer are required because of incomplete tests, retesting or subsequent tests, Contractor shall reimburse Owner for all costs of the subsequent visits.

1.14 FIELD TESTING

- A. Contractor shall pay all costs associated with field testing of materials and equipment as required in respective sections of the specifications.

- B. Provide all required materials, labor, equipment, water, and power required for testing.
- C. Perform all tests in presence of Engineer or Owner and provide one copy of field test results to Engineer same day of tests.
- D. Repair with no additional compensation all materials and equipment which fail during testing.

1.15 TESTING AND SERVICES SCHEDULE

- A. Testing laboratory services shall be provided for, but shall not be limited to, the following:

<u>Specification Section</u>	<u>Type of Material, Equipment or System</u>
02200	Excavation, Filling and Backfilling
03000	Concrete
04200	Masonry

1.16 FIELD TESTING

- A. Field testing shall be provided for, but shall not be limited to, the following:

<u>Specification Section</u>	<u>Type of Material, Equipment or System</u>
Section 02200	Excavation, Filling and Backfilling
Section 03000	Concrete
Section 04200	Masonry

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, heating, ventilating, telephone service, water, and sanitary facilities.
- B. Temporary Controls: Barriers, enclosures and fencing and protection of the Work.
- C. Construction Facilities: Access roads, parking, progress cleaning, storage, and temporary buildings.

1.2 GENERAL REQUIREMENTS

- A. Furnish, install and maintain all temporary utilities to assure continuous service required for the Work, except as allowed herein, and remove on completion of Work. Modify and extend systems as work progress requires.
- B. Furnish, install and maintain all construction aids required for the Work, except as allowed herein, and remove on completion of the Work.
- C. Furnish, install and maintain fences and barriers as required for protection of the public, property and the Work.
- D. Contractor may use existing roadways for access and parking to the extent practical. Provide any additional access and parking required for Contractor's personnel or operations.
- E. Provide a field office for the use of the Contractor's Superintendent, Owner's Representatives, and Engineer.
- F. Provide storage sheds as required by the Contractor.
- G. Products may be new or used, but must be serviceable, adequate for the intended purpose, and must not violate the requirements of any applicable codes or standards.
- H. Clean and repair damage caused by temporary installations or use of temporary facilities.
- I. Provide a project identification sign.

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Comply with applicable Federal and State rules and regulations, local codes and ordinances.
 - 2. Comply with utility company requirements.

1.4 TEMPORARY ELECTRICITY

- A. Contractor shall arrange for and pay all costs associated with power service to the field office and to Contractor's storage sheds and pay all costs for energy used.
- B. Construction equipment larger than 15 amps, 120 V, single phase, arrange for and pay all costs associated with temporary power service either from the local utility or a portable engine-generator.
- C. Provide power outlets for construction operations, with branch wiring and distribution boxes located at the site. Provide flexible power cords as required.
- D. Provide main service disconnect and overcurrent protection at convenient location.
- E. Permanent convenience receptacles may not be utilized during construction.
- F. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting:
 - 1. Provide 20 ampere duplex outlets, single phase circuits for power tools.
 - 2. Provide 20 ampere, single phase branch circuits for lighting.
- G. Pay all costs for installation and removal of temporary electrical service.

1.5 TEMPORARY LIGHTING

- A. Provide and maintain incandescent lighting for construction operations.
- B. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes as required.
- C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- D. Maintain lighting and provide routine repairs.

1.6 TEMPORARY HEATING

- A. Provide and pay for all temporary heat as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions of the installation of materials and to protect materials and finishes from damage due to temperature or humidity.
- B. Portable heaters shall be standard approved units complete with controls.
- C. Pay all costs of installation, maintenance, operation and removal and for fuel consumed.
- D. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

- E. Provide temporary heating for all subcontractors as required.

1.7 TEMPORARY VENTILATING

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Provide and pay for temporary ventilation equipment as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials and to protect materials and finishes from damage due to temp or humidity.
- C. Provide adequate forced ventilation of enclosed areas for curing of installed materials, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors or gases.
- D. Portable ventilators shall be standard approved units complete with controls.
- E. Pay all costs of installation, maintenance, operation and removal and for power consumed.
- F. Pay all costs for removal of telephones.
- G. Toll charges shall be paid by the party placing the call.

1.8 TEMPORARY WATER SERVICE

- A. Provide all water required for construction purposes.
- B. Provide all drinking water required by construction personnel. Pay all costs.

1.9 TEMPORARY SANITARY FACILITIES

- A. Provide sanitary facilities:
 - 1. As required by laws and regulations
 - 2. Not less than 1 facility
- B. Service, clean, and maintain facilities and enclosures.

1.10 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required by personnel and to facilitate the execution of the Work: Scaffolds staging, ladders, stairs, ramps, runways, platforms, railways, hoists, cranes, chutes, and other such facilities and equipment.
- B. Contractor may, at his own risk, use existing hoists and cranes at the site and hoists and cranes installed hereunder:
 - 1. Coordinate with Engineer and Owner.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

2. Do not exceed rated capacity of hoists and cranes.
 3. Replace or repair any damaged units.
 4. Owner makes no representation as to the suitability, serviceability, or safety of new or existing hoists and cranes and assumes no responsibility for their safe use by construction personnel.
- C. Relocate construction aids as required by progress of construction, by storage or work requirements, and to accommodate legitimate requirements by Owner.
- D. Completely remove temporary materials, equipment, and services at completion of the Project.
- E. Clean, repair damage caused by installation or by use of temporary facilities:
1. Remove foundations and underground installations for construction aids.
 2. Grade the areas for the site affected by temporary installations to required elevations and slopes and clean the area.

1.11 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Protect non-owned vehicular traffic, stored materials, site and structures from damage.
- C. Install facilities of a neat and reasonable uniform appearance, structurally adequate for the required purposes.
- D. Relocate barriers as required by progress of construction.
- E. Completely remove barriers, including foundations, when construction has progressed to the point that they are no longer needed.
- F. Clean and repair damage caused by installation, fill and grade the areas of the site to required elevations and slopes and clean the area.

1.12 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.13 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather-tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary

heating and maintenance of required ambient temperatures identified in individual specification Sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

- B. Provide temporary roofing as required to protect work and equipment.

1.14 PROTECTION OF INSTALLED WORK

- 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 minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished driving surfaces, floors, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit storage upon waterproofed or roofed surfaces. If activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.15 SECURITY

- A. Provide security and facilities to protect Work from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.

1.16 ACCESS ROADS

- A. Construct and maintain temporary roads accessing public thoroughfares to service construction area.
- B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering street or clean streets as required by owner.
- E. Existing on-site roads may be used for construction traffic.

1.17 PARKING

- A. Temporary dirt surface parking areas adjacent to the site can accommodate construction personnel.
- B. When site space is not adequate, provide additional off-site parking.
- C. Do not allow vehicle parking on existing pavement.

1.18 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from remote spaces prior to enclosing the space.
- C. Remove waste materials, debris, and rubbish from site periodically and dispose off-site in accordance with local and state regulations.
- D. Broom and vacuum clean interior areas prior to start of surface finishing.

1.19 FIELD OFFICES AND SHEDS

- A. Construction:
 - 1. Structurally sound, weathertight, with floors raised above ground.
 - 2. Temperature transmission resistance: Compatible with occupancy and storage requirements.
 - 3. At Contractor's option, portable or mobile buildings modified for office use may be used.
 - 4. Fill and grade sites for temporary structures to provide surface drainage.
 - 5. Construct temporary field offices and storage sheds on proper foundations, provide connections for utility services:
 - a. Secure portable or mobile buildings when used
 - b. Provide steps and landings at entrance door
 - 6. Mount thermometer at convenient outside location, not in direct sunlight.
 - 7. Provide periodic maintenance and cleaning for temporary structures, furnishings, equipment and services.
 - 8. Remove temporary field offices, contents, and service at a time they are no longer needed.
 - 9. Remove storage sheds when they are no longer needed.
 - 10. Remove foundations and debris; grade the site to required elevations and clean the areas.
- B. Office for Engineer and Resident Project Representative (RPR):
 - 1. A separate office for the sole use of designated occupants with secure entrance doors and one key per occupant with following items listed.
 - 2. Area: 160 sq ft minimum, with minimum dimension 8 feet
 - 3. Windows:

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

- a. Minimum: Three, with a minimum total area of 10 percent of floor area
 - b. Operable sash and insect screens
 - c. Locate to provide views of construction areas
4. Furnishings:
- a. One standard size desk with 3 drawers
 - b. One drafting table: 29 inch by 72 inch by 28 inch high front, 34 inch high at back, with one equipment drawer and drafting chair on rollers or as directed by Engineer
 - c. One plan rack to hold a minimum of 6 racks of project drawings
 - d. Twelve lineal feet of bookshelves
 - e. Three straight chairs
 - f. Two waste basket
 - g. One metal, double-door storage cabinet under table
 - h. Standard 4-drawer, legal-size, metal filing cabinet with locks and keys; 1 per occupant
 - i. One swivel arm chair
 - j. One swivel light on drafting table
 - k. One tackboard, 36 inch by 30 inch
5. Services:
- a. Lighting: 50 foot candles at desk top height
 - b. Exterior lighting at entrance door
 - c. Minimum of four 110 volt duplex electric convenience outlets, at least one on each wall
 - d. Electric distribution panel: Two circuits minimum, 110 volt, 60 hertz service
 - e. Convenient access to toilet facilities
 - f. Telephone: One direct line instrument (separate phone number from contractor)
 - g. Internet service
 - h. Bottled drinking water with dispenser (cold and hot)
 - i. Automatic heating and mechanical cooling equipment to maintain comfort conditions.
 - j. High-low outdoor type thermometer, mount as directed by Engineer
 - k. Clean office once per week
 - l. Grade level pad area to accommodate trailer and parking for no less than four vehicles.
- C. Contractor's Office and Facilities:
- 1. Size: As required for general use and to provide space for project progress meetings
 - 2. Lighting and temperature control: As specified for Engineer's office
 - 3. Telephone: One direct line instrument
 - 4. Furnishings in meeting area:
 - a. Conference table and chairs for at least 8 persons
 - b. Racks and files for project record documents in, or adjacent to, the meeting area
 - c. Meeting area: 200 square feet minimum, minimum dimension 8 feet

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

5. Other furnishings: Contractor's option
 6. One 10-inch outdoor-type thermometer
- D. Storage Shed:
1. To requirements of the various trades, as required.
 2. Dimensions: Adequate for storage and handling of products.
 3. Ventilation: Comply with specified and code requirements for the products stored.
 4. Heating: Adequate to maintain temperatures specified in the respective sections for the products stored.
- E. Existing facilities at the site shall not be used for field offices or storage.
- F. New permanent facilities shall not be used for field offices or for storage.
- 1.20 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS
- A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Final Application for Payment.
 - B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
 - C. Clean and repair damage caused by installation or use of temporary work.
 - D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General requirements for materials and equipment
- B. Definitions
- C. Quality assurance and qualifications
- D. Delivery, storage and handling
- E. Product Qualifications
- F. Product Certification
- G. Warranty
- H. Material and fabrication requirements
- I. Preparation, installation and field quality control requirements

1.2 GENERAL REQUIREMENTS

- A. The section applies to all equipment provided under this contract.
- B. The requirements of detailed specifications take precedence over this section in the event of an apparent conflict.
- C. Provide all new materials and equipment, except as specified or required by testing.
- D. Except as specifically indicated or specified, materials and equipment removed from the existing structure shall not be used in the completed Work.
- E. Contractor to coordinate equipment with other parts of the Work, including verification or compatibility of structures, piping, wiring and equipment components.
- F. Contractor is responsible for all alterations in the Work to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or specifications.
- G. Do not use any material or equipment for any purpose other than that for which is designed or specified.
- H. Provide materials, equipment and/or systems suitable for its intended purpose and/or function as confirmed and supported by the supplier and/or manufacturer where only routine maintenance and care is required for its operation. Do not use material, equipment or a system that will become damaged, require excessive maintenance, fail to

perform and not function as required. Materials, equipment and systems provided are expected to function and operate when exposed to the wide range of environmental conditions encountered for this type of facility. Damaged, unsuitable or defective materials, equipment and/or systems identified by the Engineer shall be replaced at no cost to the Owner.

- I. Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer unless herein specified to the contrary.

1.3 DEFINITIONS

- A. Special tools, instruments, devices, or accessories: Any tools, instruments, devices or accessories required for repair, adjustment or maintenance of equipment which are designed especially for the equipment in question or which are not normally kept in stock by local tool suppliers.

1.4 QUALIFICATIONS

- A. Installers Qualifications: Equipment and material shall be installed and placed in service by or under the guidance of qualified personnel having the knowledge and experience necessary for proper results. Where Contractor's or subcontractor's employees are not properly qualified, such personnel shall be field representative of the equipment supplier.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Arrange deliveries of products in accord with construction schedules, coordinate to avoid conflict with work and conditions at the site.
- B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible, all in accordance with manufacturer's instructions.
- C. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and accepted submittals and that products are properly protected, undamaged and correct quantities.
- D. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.
- E. Box, crate, or otherwise completely enclose and protect all equipment.
- F. Protect painted surfaces against impact, abrasion, discoloration or other damage.
- G. Include complete packing lists and bills of material with each shipment.
- H. Deliver anchor bolts together with templates sufficiently early to permit setting when structural concrete is placed.

- I. Package materials and equipment to facilitate handling and protect against damage during transit handling or storage.
- J. Protect equipment from exposure to the elements and keep thoroughly dry and dust free at all times.
- K. Grease or oil all bearings and similar items.
- L. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
- M. For exterior storage of fabricated products, place on sloped supports, above ground on blocking or skids to prevent soiling, staining or other damage.
- N. Provide off-site storage and protection when site does not permit on-site storage or protection.
- O. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
- P. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- Q. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- R. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.
- S. Store immediately upon delivery.
- T. Store electrical equipment and equipment with bearings in weathertight structures maintained above 60° F.
- U. Protect electrical equipment, controls, and insulation against moisture, water, and dust damage.
- V. Connect and operate continuously all space heaters furnished in electrical equipment.
- W. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.
- X. Provide permanent, labeled, packings for spare parts.

1.6 PRODUCT CERTIFICATION

- A. All materials or products which come into contact with drinking water must be certified as meeting the specifications of the American National Institute/National Sanitation Foundation Standard 61, Drinking Water System Components - Health Effects. Certifications shall be provided with product submittals.
- B. All chemicals and products added to a public water supply as part of the treatment process shall be certified as meeting the specifications of the American National Standards Institute/National Sanitation Foundation Standard 60, Drinking Water Treatment Chemicals - Health Effects. The certifying party shall be accredited by the American National Standards Institute.

1.7 WARRANTY

- A. Warranty all materials and equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, leakage, breakage or other failure.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Suitable for the service conditions.
- B. Structural and miscellaneous fabricated steel in equipment shall conform to AISC standards, except as otherwise specified.

2.2 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must be registered for the purpose specified with USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.

2.3 SOURCE QUALITY CONTROL AND TESTS

- A. Observation of performance tests:
 - 1. Where specifications require the presence of Engineer for testing of equipment, Owner is to pay for all costs of Engineer's first visit.
 - 2. If subsequent visits by Engineer are required because of incomplete tests, retesting or subsequent tests, Contractor shall reimburse Owner for all costs.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspect equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install any equipment showing such effects. Replace damaged equipment with identical new equipment.

3.2 PREPARATION

- A. Install equipment anchor bolts during placement of structural concrete.

3.3 INSTALLATION

- A. Install all equipment on bases 4 inch minimum height.
- B. Anchor baseplates to the concrete base and fill space beneath with grout.
- C. Provide lubricants as recommended by the equipment manufacturer in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup and operation prior to acceptance of equipment by Owner.
- D. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products, which require off-site storage, restoration, or renovation. Pay all costs for such Work.
- E. Handle, install, connect, clean, condition, and adjust products in strict accord with manufacturer's instructions and in conformity with specified requirements:
 - 1. Obtain and distribute copies of such instructions to parties involved in the installation in the manner detailed in the submittal section.
 - 2. Maintain one set of complete instructions at the job site during installation and until completion.
 - 3. Perform Work in accord with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.
 - 4. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.
 - 5. Do not proceed with Work without clear instructions.
- F. No shimming between machined surfaces is allowed.

3.4 FIELD QUALITY CONTROL

- A. Provide a qualified manufacturer's field representative when specified in Section 01650, Starting of Systems or in the detailed specifications to provide the services specified.

- B. Where installation assistance is specified, manufacturer's representative is to observe, guide, instruct and direct Contractor's erection or installation procedure.
- C. Where an installation check is specified, manufacturer's representative is to verify equipment is properly installed as detailed in the Section 01650, Starting of Systems.
- D. Field representatives are to revisit the site as often as necessary to attain installation satisfactory to Engineer.
- E. Acceptance of Work in connection with the installation of equipment furnished by others is subject to acceptance by the field representative. Such acceptance by the field representative or Engineer does not relieve Contractor of responsibility for planning, supervising, and executing the installation of Work or of responsibility for defective Work.

3.5 ADJUSTING

- A. Perform under provisions of Section 01650, Starting of Systems of these specifications.
- B. Perform all required adjustment tests, operation checks, and other startup activities required.

3.6 CLEANING

- A. Perform under provisions of Section 01710, Cleaning of these specifications.
- B. Repaint all painted surfaces which are damaged prior to equipment acceptance to Engineer's satisfaction.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping designations, materials, locations, and test conditions.

1.2 RELATED SECTIONS

- A. Section 15060 - Pipe and Pipe Fittings
- B. Section 15062 - Ductile Iron Pipe
- C. Section 15067 - Stainless Steel Pipe
- D. Division 15 plumbing and HVAC specifications

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 SCHEDULES

- A. Pipeline Schedules

PIPELINE SCHEDULE

MEDIA	DESCRIPTION	MATERIAL	SPEC SECTION	INSTALLATION	TEMP DEG F	TEST PRESSURE psig	TEST TYPE (H OR P)	REMARKS
AL								
	Alum, Interior	Sch 80 PVC	15060	Exposed, Submerged	40 - 160	40	P	
	Alum, Yard	Sch 80 PVC	15060	Buried	40 - 160	40	P	
BW	Filter Backwash	CML, DIP	15062	Buried, Exdposed	40 - 160	50	H	PC 200 Minimum
CA	Compressed Air	Sch 40 STL, Copper	15060	Exposed, Buried	40 - 160	200	P	
CC	Caustic Chemical	Sch 40 STL, Copper	15060	Exposed, Buried	40 - 160	30	H	
CD	Chemical Drain	Sch 80 PVC	15060	Exposed, Buried	0 - 5			
CV	Chemical Vent	Sch 80 PVC	15060	Exposed	0 - 5			
D								
PD	Process Drain, Interior	CML DIP	15060	Exposed	40 - 100	5	H	PC 200 Minimum
	Perforated Drains	Sch 40 PVC	15060	Buried	40 - 100	N/A	N.A	
YD	Yard Drain	CML DIP	15060	Buried	40 - 100	5	H	PC 200 Minimum

SECTION 01601
PIPING SCHEDULE

MEDIA	DESCRIPTION	MATERIAL	SPEC SECTION	INSTALLATION	TEMP DEG F	TEST PRESSURE psig	TEST TYPE (H OR P)	REMARKS
F								
FW	Filtered Water, Interior	CML DIP PC 250	15062	Exposed	40 - 100	100	H	
	Filtered Water, Yard	CML DIP PC 250	15062	Buried	40 - 100	100	H	
FM	Lift Station Force Main	HDPE-DR 13.5	02665	Buried		50	H	
H								
HSW	High Service Water, Interior Less than 4 inch diameter	Copper, Sch 80 PVC	15060	Exposed	40 - 100	200	H	
	High Service Water, Interior 4 inch and greater	CML DIP PC 350	15062	Exposed	40 - 100	200	H	
	High Service Water, Yard	CML DIP PC 350	15062	Buried	40 - 100	200	H	
HOCL	Sodium Hypochlorite solution	Sch 80 PVC	15060	Buried, Submerged, Exposed	40 - 100	30	H	
H ₂ O ₂	Peroxide	Sch 80 PVC Copper	15060	Buried, Exposed	40 - 100	30	H	

SECTION 01601
PIPING SCHEDULE

L								
	Lime	Sch 80 PVC	15060					
N								
NANM	Sodium Permanganate	Sch 80 PVC	15060	Buried, Submerged, Exposed	40 - 100	50	H	
NAOH	Sodium Hydroxide	Sch 80 PVC	15060	Buried, Submerged, Exposed	40 - 100	50	H	
P								
POL	Polymer	Sch 80 PVC	15060	Buried, Exposed	40 - 120	50	H	
PPH	PolyPhosphate	Sch 80 PVC	15060	Buried, Submerged, Exposed	40 - 100	50	H	
PPW								
	Plant Potable Water, Interior	Copper, Sch 80 PVC, CML DIP	15060 15062	Exposed	40 - 100	125	H	PC 200 Minimum
	Plant Potable Water, Yard	CML DIP	15062	Buried	40 - 100	200	H	PC 200 Minimum

SECTION 01601
PIPING SCHEDULE

R								
RAIN	Down Spout Drain	SCH 40 PVC		Buried	40 - 100	N/A	N/A	
RE	Rewash Water, Interior	CML DIP PC 350	15062	Exposed	40 - 100	50	H	PC 200 Minimum
	Rewash Water, Yard	CML DIP PC 350	15062	Buried	40 - 100	50	H	PC 200 Minimum
RW	Raw Water, Interior	CML DIP	15062	Exposed	40 - 100	200	H	CL 53 Minimum
	Raw Water, Yard	CML DIP	15062	Buried	40 - 100	200	H	PC 200 Minimum
	Raw Water Main	CML DIP	15062	Buried	40 - 100	125	H	PC 200 Minimum
S								
SAN	Sanitary Sewer	CML DIP	15062	Buried, Exposed	40 - 100	50	H	PC 350
SAM	Miscellaneous Sampling Copper	Sch 80 PVC	15060	Buried, Exposed	40 - 100	30		
STM	Storm Sewer	RCP	02720	Buried	40 - 100	5	H	Class III

- B. Abbreviations: Abbreviations used in the Pipeline Schedule are defined as follows:
1. Test type:
 - a. H – Hydraulic (water) pressure testing procedures
 - b. P – Pneumatic (air) pressure testing procedures
 2. Piping:
 - a. CML – Cement Mortar Lined
 - b. DIP – Ductile Iron Pipe
 - c. STL – Steel pipe
 - d. RCP – Reinforced Concrete Pipe

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Product options available to Contractor
- B. Procedures for securing acceptance of proposed Substitutions for a product which is specified in Contract Documents by reference to one or more of the following:
 - 1. Name of manufacturer
 - 2. Name of supplier
 - 3. Trade name
 - 4. Catalog model number

1.2 GENERAL REQUIREMENTS

- A. The Contract is based on standards of quality established in Contract Documents:
 - 1. In agreeing to terms and conditions of Contract, Contractor has accepted a responsibility to verify that specified products will be available and to place orders for all required materials in such a timely manner as is needed to meet construction schedule.
 - 2. Neither Owner nor Engineer has agreed to substitution of materials or products called for in Contract Documents, except as they may specifically be stated otherwise in writing.

1.3 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only—Any Product meeting those standards or description:
 - 1. Products specified by reference to standard specifications such as ASTM and similar standards.
 - 2. Products specified by manufacturer's name and catalog model number.
- B. Products Specified by Naming One or More Manufacturers—Products of manufacturers named and meeting specifications, no options or substitutions allowed:
 - 1. Where materials and/or products are specified by naming one single manufacturer and/or model number, without stating that Substitutions will be considered, only the material and/or products named are approved for incorporation into the Work.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions - Submit a request for substitution for any manufacturer not named in accordance with this section:
 - 1. Where materials and/or products are specified by name and/or model number, followed by words "Or accepted substitution":
 - a. The material and/or product specified by name establishes required standard of quality.

- b. Materials and/or product proposed by Contractor to be used in lieu of materials and/or products so specified by name shall in all ways equal or exceed the qualities of named materials and/or products.
- D. Where phrase “or accepted substitution” occurs in contract documents, do not assume that materials, equipment or products will be accepted as substitution unless item has been specifically so reviewed for this Work by Engineer.

1.4 SUBSTITUTIONS

- A. Engineer will consider requests for Substitutions only within 30 days after date of Owner-Contractor Agreement.
- B. Written requests for substitution considered:
 - 1. After award of Contract
 - 2. Only when submitted through Contractor
- C. Substitutions will not be considered when they are indicated or implied on shop Drawing or product data submissions, without separate written request.
- D. Substitutions may be considered when a Product becomes unavailable through no fault of Contractor:
 - 1. Should the Contractor demonstrate to satisfaction of Engineer that specified material or product was ordered in a timely manner and will not be available in time for incorporation into this Work, Contractor shall submit to Engineer such data on proposed substitute materials and/or product as are needed to help Engineer determine suitability of proposed Substitution.
- E. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- F. A request constitutes a representation that Contractor:
 - 1. Investigated proposed product and determined that it meets or exceeds quality level of specified product and that it will perform function for which it is intended.
 - 2. Will provide same warranty for Substitution as for specified Product.
 - 3. Will coordinate installation and make changes to other Work which may be required for Work to be complete with no additional cost to Owner.
 - 4. Will provide a complete operating installation including any and all changes and additions in structure, piping, building, mechanical and electrical work, controls and accessories necessary to accommodate proposed Substitution.
 - 5. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 6. Will reimburse Owner for review or redesign services associated with review by Engineer and re-approval by authorities.

1.5 PROCEDURE FOR REQUESTING SUBSTITUTION

- A. Submit three copies of request for substitution for consideration in a manner similar to provisions for submission requirements under Section 01340, Shop Drawings, Product Data and Samples:
 - 1. Substitutions will be considered as "deviations" to the Contract Documents.
 - 2. Submit with transmittal letter describing the deviation and justifications for accepting Substitution.
 - 3. Submit shop drawings, product data, and certified test results attesting to proposed substitution equivalence.
 - 4. Burden of proof is on the proposer.

- B. Limit each request to one proposed Substitution

- C. Transmittal Contents:
 - 1. Identification of proposed Substitution:
 - a. Manufacturer's name
 - b. Telephone number and representative contact name
 - c. Specification section or drawing reference of originally specified product including discrete name or tag number
 - 2. Manufacturer's literature clearly marked to show compliance of proposed Substitution with Contract Documents.
 - 3. Itemized comparison of original product and proposed Substitution addressing characteristics including but not necessarily limited to:
 - a. Size
 - b. Composition
 - c. Weight
 - d. Electrical or mechanical requirements
 - e. Installation and maintenance requirements
 - 4. Product experience:
 - a. Location of previous projects utilizing product in similar situation per Contract Documents
 - b. Name and telephone number of persons knowledgeable of proposed product associated with referenced projects
 - c. Available field data and test reports associated with proposed product
 - 5. Identify any changes to construction schedule or cost required to implement proposed substitution.
 - 6. Samples:
 - a. Provide in similar manner under provisions of Section 01340, Shop Drawings, Product Data and Samples as requested by Engineer
 - b. Provide full size sample if requested by Engineer
 - c. Samples will be retained by Engineer until substantial completion
 - d. Engineer is not responsible for loss or damage to samples

1.6 ACCEPTANCE OR REJECTION

- A. Engineer will notify Contractor in writing of decision to accept or reject request for Substitution.
- B. Engineer reserves the right to require proposed Substitution to comply with all aspects of specified product to secure design intent.
- C. If request for Substitution results in change of Contract Amount or Contract Time, adjustments will be applied under provisions in General Conditions.
- D. Substitutions will be rejected if:
 - 1. Submission is not through Contractor with Contractor stamp of approval.
 - 2. Requests for Substitution are not made in accordance submission procedures outlined herein.
 - 3. Acceptance will require substantial revision of the original design as determined by Engineer.
 - 4. Substitution is not equal to original product specified or will not adequately perform intended function as determined by Engineer.

1.7 REIMBURSEMENT OF SUBSTITUTION REVIEW COSTS

- A. In the event Substitutions are proposed to Engineer after award of Contract, Engineer will record all time used by Engineer and Engineer's consultants in evaluating each proposed Substitution.
- B. Contractor shall reimburse Owner for all charges of Engineer and Engineer's consultants for time spent in evaluating proposed Substitution, whether or not the Engineer approves a proposed Substitution:
 - 1. Costs for Substitution review will be deducted from payments due Contractor as change order deducts.
 - 2. Charges for review of proposed Substitution will include Engineer at maximum rate of \$175 per hour plus costs of Engineer's consultants.

1.8 DELAYS

- A. Delays in construction arising by virtue of the nonavailability of a specified material and/or product will not be considered by the Engineer as justifying an extension of the agreed time of Substantial and/or Final Completion.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01631
REQUEST FOR SUBSTITUTION

PROJECT: _____

OWNER: _____

TO: **Zimmerman, Evans & Leopold, Inc.**

SPECIFIED ITEM:

Section	Page	Paragraph/Article	Description
---------	------	-------------------	-------------

The Contractor hereby requests consideration of the following:

PROPOSED SUBSTITUTION: _____

Attached data includes product description, specifications, drawings, photographs, performance, and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Contractor certifies that the following paragraphs, unless modified by attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings.
2. The Contractor will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.

The Contractor further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item

Submitted by:

Signature: _____

Firm _____

Address _____

Date _____

Telephone _____

For use by the Engineer

Accepted

Accepted as noted

Rejected

Received too late

By _____

Date _____

Remarks _____

Attachments

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Start-up, pre-demonstration and demonstration of facility, systems or equipment
- B. Personnel training
- C. Testing, adjusting, and balancing
- D. Related systems start-up and demonstration period requirements

1.2 DEFINITIONS

- A. Project System: Specific system, consisting of an independent arrangement of equipment, structures, components, piping, wiring, materials or incidentals that performs an identifiable function which is both operational and safe.
- B. Pre-Demonstration Period: Period of time, of unspecified duration after initial construction and installation during which Contractor, with assistance from manufacturer's representative, performs the following activities in sequence:
 - 1. Initial equipment start-up
 - 2. Correction of all discrepancies or functions prior to Demonstration Period
- C. Demonstration Period: Period of time, of specified duration, following Pre-Demonstration Period, during which Contractor completes personnel training including review of approved O&M Manuals with Owner and initiates process flow or product through facility or Project System, starts up and operates facility or project system without exceeding specified downtime limitations, to prove functional integrity of mechanical and electrical equipment and components and control interfaces to satisfaction of Engineer as evidence of Substantial Completion.
- D. Related System: Equipment or subsystem whose function is necessary for the start-up, testing and operation of the project system as a whole.
- E. Substantial Completion: Reference General Conditions.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Submit in chronological order listed below prior to completion of Pre-Demonstration Period:
 - 1. Master operation and maintenance training schedule:
 - a. Submit 30 days (minimum) prior to first training session for Owner's personnel

- b. Schedule to include:
 - 1) Target date and time for Owner witnessing initial start-up of each system
 - 2) Target date and time for Operation and Maintenance training for each system, both field and classroom
 - 3) Target date for initiation of Demonstration Period
 - c. Submit for review and approval by Owner
 - d. Include holidays observed by Owner
 - e. Owner reserves the right to insist on a minimum 7 days' notice of rescheduled training session not conducted on master schedule target date for any reason.
 - f. Resubmit schedule until approved
2. Substantial Completion Submittal:
- a. File Contractor's Notice of Substantial Completion, Request for Inspection and documentation under provisions of Section 01700, Contract Closeout.
 - b. Approved Operation and Maintenance manuals received by Engineer minimum 1 week prior to scheduled training.
 - c. Written request for Owner to witness each system pre-demonstration start-up. Request to be received by Owner minimum 1 week before scheduled training of Owner's personnel on that system.
 - d. Equipment installation and pre-demonstration start-up certifications.
 - e. Letter verifying successful completion of all pre-demonstration start-up activities including receipt of all specified items from manufacturers or suppliers as final item prior to initiation of Demonstration Period.
 - f. Letter verifying successful completion of Demonstration Period start-up activities.

1.4 COST OF START-UP

- A. Contractor to pay all costs associated with facility, systems or equipment start-up.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 START-UP - GENERAL

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Engineer 7 days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

- D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of responsible manufacturer's representative in accordance with manufacturers' instructions.
- G. 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.
- H. Submit a written report in accordance with Section 01400, Quality Control of these specifications that equipment or system has been properly installed and is functioning correctly.
- I. Start-up divided into two periods:
 - 1. Pre-Demonstration Period including:
 - a. Completion of Work to prepare facility, systems or equipment for Demonstration Period
 - b. Start-up of equipment
 - c. Complete filing of all required submittals
 - 2. Demonstration Period including:
 - a. Demonstration of functional integrity of facility or system
 - b. Training of personnel
 - c. Review of approved preliminary O&M Manuals with Owner
 - d. Filing of Contractor's Notice of Substantial Completion and Request for Inspection
- J. Operation and Maintenance Manuals for equipment or system scheduled for start-up and training:
 - 1. Prepare and submit manuals in accordance with Section 01730, Operation and Maintenance Data, of these specifications prior to delivery of equipment or system.
 - 2. Confirm approved preliminary operation and maintenance manuals are available prior to commencing any equipment or system training activities.
 - 3. Start-up and demonstration period of equipment or system will not be complete, nor will start-up and demonstration period payments be made, until manufacturer's authorized representative includes a complete and thorough review of the approved preliminary O&M Manual with Owner during the equipment training session.

3.2 PRE-DEMONSTRATION PERIOD

A. Equipment Start-up:

1. Requirements for individual items of equipment are included in Divisions 2 through 16 of these Specifications.
2. Prepare equipment to operate properly and safely and be ready to demonstrate functional integrity during Demonstration Period.
3. Perform equipment start-up to extent possible without introducing product flow.
4. Test tanks, pumping, filters, and similar equipment requiring a fluid, using clean water supplied at Contractor's expense.
5. Dispose of water used for equipment start-up.
6. Procedures include, but are not necessarily limited to the following:
 - a. Test or check and correct deficiencies of:
 - 1) Power, control, and monitoring circuits for continuity prior to connection to power source
 - 2) Voltage of all circuits
 - 3) Phase sequence
 - 4) Cleanliness of connecting piping systems
 - 5) Alignment of connected machinery
 - 6) Vacuum and pressure of all closed systems
 - 7) Lubrication
 - 8) Valve orientation and position status for manual operating mode
 - 9) Tankage for integrity using {clean water} {process water}
 - 10) Pumping equipment using {clean water} {process water}
 - 11) Instrumentation and control signal generation, transmission, reception, and response under provisions of Section 13400, Instrumentation of these specifications
 - 12) Tagging and identification systems
 - 13) All equipment: Proper connections, alignment, calibration and adjustment
 - b. Calibrate all safety equipment
 - c. Manually rotate movable parts to assure freedom of movement
 - d. "Bump" start electric motors to verify proper rotation
 - e. Perform other tests, checks, and activities required to make equipment ready for Demonstration Period.
 - f. Documentation:
 - 1) Prepare log showing each equipment item subject to this paragraph and listing what is to be accomplished during equipment start-up.
 - 2) Provide place for Contractor to record date and person accomplishing required work. Submit completed document before requesting inspection for Substantial Completion certification.
7. Obtain certifications, without restrictions or qualifications, and deliver to Engineer:
 - a. Manufacturer's equipment installation check letters
 - b. Instrumentation supplier's instrumentation installation certificate

3.3 PERSONNEL TRAINING

- A. Reference individual equipment specification sections.
- B. Conduct all personnel training after completion of equipment start-up for the equipment for which training is being conducted:
 - 1. Personnel training on individual equipment or systems will not be considered completed unless:
 - a. All pre-training deliverables are received and approved before commencement of training on the individual equipment or system.
 - b. No system malfunctions occur during training.
 - c. All provisions of field and classroom training specifications are met.
 - 2. Training not in compliance with the above will be performed again in its entirety by the manufacturer at no additional cost to Owner.
 - 3. Videotape each training session.
- C. Field and classroom training requirements:
 - 1. Hold classroom training on-site
 - 2. Notify each manufacturer specified for on-site training that Owner reserves the right to video record any or all training sessions. Organize each training session in a format compatible with video recording.
 - 3. Training instructor: Factory trained and familiar with giving both classroom and “hands-on” instructions.
 - 4. Training instructors: Be at classes on time. Session beginning and ending times to be coordinated with the Owner and indicated on the master schedule. Normal time lengths for class periods can vary, but brief rest breaks should be scheduled and taken.
 - 5. Organize training sessions into maintenance verses operation topics and identify on schedule.
 - 6. Plan for minimum class attendance of 15 people at each session and provide sufficient classroom materials, samples, and handouts for those in attendance.
 - 7. Instructors to have a typed agenda and well prepared instructional material. The use of visual aids, e.g., films, pictures, and slides is recommended for use during the classroom training programs. Deliver agendas to the Engineer a minimum of 7 days prior to the classroom training. Provide equipment required for presentation of films, slides, and other visual aids.
 - 8. Cover information as required in Section 01340, Operation and Maintenance manuals submitted according to Section 01340, Shop Drawings, Product Data and Samples of these specifications and following areas as applicable to project systems:
 - a. Operation of equipment
 - b. Lubrication of equipment
 - c. Maintenance and repair of equipment
 - d. Troubleshooting of equipment
 - e. Preventive maintenance procedures
 - f. Adjustments to equipment

- g. Inventory of spare parts
 - h. Optimizing equipment performance
 - i. Capabilities
 - j. Operational safety
 - k. Emergency situation response
 - l. Takedown procedures (disassembly and assembly)
 - 9. Address above paragraphs a), b), h), I), j) and k) in the operation sessions
 - 10. Address above paragraphs c), d), e), f), g), and l) in the maintenance sessions
 - 11. Maintain a log of classroom training provided including: Instructors, topics, dates, time, and attendance
- D. Complete filing of all required submittals:
- 1. Shop Drawings
 - 2. Operation and Maintenance Manuals
 - 3. Training material
- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction
- F. Amount of time required for instruction on each item of equipment and system is that specified in individual sections.

3.4 DEMONSTRATION PERIOD

- A. Demonstrate operation and maintenance of Products to Owner's personnel within 14 days prior to date of Substantial Completion unless specified otherwise by requirements of construction staging per Section 01010, Summary of Work of these specifications.
- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' 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 times, at equipment location.
- D. Demonstrate the functional integrity of the mechanical, electrical, and control interfaces of the respective equipment and components comprising the facility or system as evidence of Substantial Completion.
- E. If, during the Demonstration Period, the aggregate amount of time used for repair, alteration, or unscheduled adjustments to any equipment or systems that renders the affected equipment or system inoperative exceed 10 percent of the Demonstration Period, the demonstration of functional integrity will be deemed to have failed. In the event of failure, a new Demonstration Period will recommence after correction of the cause of failure. The new Demonstration Period shall have the same requirements and duration as the Demonstration Period previously conducted.

- F. Conduct the demonstration of functional integrity under full operational conditions.
- G. Owner will provide operational personnel to provide process decisions affecting plant performance. Owner's assistance will be available only for process decisions. Contractor will perform all other functions including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period.
- H. Owner reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, etc., to verify the functional integrity of automatic and manual backup systems and alternate operating modes.
- I. Duration of Demonstration Period: Minimum of 5 consecutive days:
 - 1. Time of beginning and ending of any Demonstration Period will be agreed upon by Contractor, Owner, and Engineer in advance of initiating Demonstration Period.
 - 2. Length of Demonstration Period other than specified will be agreed upon by Contractor, Owner and Engineer in advance of initiating Demonstration Period.
- J. Provide knowledgeable personnel to answer Owner's questions throughout the Demonstration Period.
- K. Provide final field instruction on select systems and respond to any system problems or failures which may occur.
- L. Provide all labor, supervision, utilities, chemicals, maintenance, equipment, vehicles or any other item necessary to operate and demonstrate all systems being demonstrated.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures
- B. Final cleaning
- C. Adjusting
- D. Contractor's closeout submittals
- E. Project record documents
- F. Warranties
- G. Spare parts and maintenance materials
- H. Delivery to Owner
- I. Substantial completion
- J. Final inspection
- K. Reinspection fees
- L. Final adjustments of accounts
- M. Final application for payment

1.2 CLOSEOUT PROCEDURES

- A. Comply with requirements stated in conditions of the Contract and in specifications for administrative procedures in closing out the Work.
- B. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.
- C. Provide submittals to Engineer/Owner that are required by governing or other authorities.
- D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.3 FINAL CLEANING

- A. Provide final cleaning under provisions of Section 01710, Cleaning of these specifications.

- B. Execute final cleaning prior to final inspection.
- C. Clean equipment to a sanitary condition
- D. Clean debris from roofs, gutters, downspouts, and drainage systems.
- E. Clean site; sweep paved areas, rake clean landscaped surfaces.
- F. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.4 ADJUSTING

- A. Provide under provisions of Section 01650, Starting of Systems of these specifications.
- B. Adjusting operating Products and equipment to ensure smooth and unhindered operation.

1.5 CONTRACTOR'S CLOSEOUT SUBMITTALS

- A. Project record documents
- B. Operating and maintenance data, instructions to Owner's personnel: As specified in Section 01730, Operation and Maintenance Data of these specifications.
- C. Spare parts and maintenance materials: As specified in individual sections and as specified herein.
- D. Evidence of payment and waiver of claims: As specified in General and Supplementary Conditions.
- E. Two copies of each specified special bond, warranty, and service contract.
- F. Final inspection reports by all regulatory agencies demonstrating the agencies' final approval.
- G. At Contract close-out, deliver Record Documents to Engineer for the Owner.
- H. 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 his authorized representative

1.6 PROJECT RECORD DOCUMENTS

- A. Provide project record documents under provisions of Section 01720, Project Record Documents of these specifications.

- B. Maintain on site, one set of the following record documents; record actual revisions to the Work:
 - 1. Contract Drawings
 - 2. Specifications
 - 3. Addenda
 - 4. Change Orders and other Modifications to the Contract
 - 5. Reviewed shop drawings, product data, and samples
 - 6. Field test reports
 - 7. Construction photographs

- C. Store record documents and samples separate from documents used for construction:
 - 1. Provide files and racks for storage of documents
 - 2. Provide locked cabinet or secure storage space for samples

- D. Record information concurrent with construction progress:
 - 1. Do not conceal any work until required information is recorded
 - 2. Legibly mark to record actual construction

- E. Specifications and addenda—Legibly mark and record at each Product section description of actual Products installed, including the following:
 - 1. Manufacturer's name, product model, number, trade name and supplies
 - 2. Product substitutions or alternates utilized
 - 3. Changes made by Addenda, field order or change order

- F. Record documents and shop drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish floor datum
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail
 - 5. Details not on original Contract Drawings
 - 6. Changes made by Field Order or by Change Order

- G. Submit documents to Engineer with claim for final Application for Payment.

- H. File documents and samples in accordance with Data Filing Format of the Uniform Construction Index.

- I. Maintain documents in clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

- J. Make documents and samples available at all times for inspection by Engineer.

- K. Provide felt tip marking pens for recording information in the color code designated by Engineer.

- L. Label each document "Project Record" in neat, large printed letters.

1.7 WARRANTIES

- A. Provide duplicate notarized copies.
- B. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.
- C. Provide Table of Contents and assemble in three "D" side ring binder with durable plastic cover.
- D. Submit prior to final Application for Payment.
- E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.8 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.
- C. Store the items in a clean, dry, heated, storage shed, or bonded warehouse.
- D. Protect all items from damage during storage. Store in sturdy wooden boxes or crates with lid.

1.9 DELIVERY TO OWNER

- A. At or prior to time of inspection for Substantial Completion deliver all required items to Owner at place on site designated by Owner:
 - 1. Contractor and representatives of Owner and Engineer shall inspect and inventory all items delivered.
- B. Submit to Engineer detailed itemized summary of all items delivered:
 - 1. Organize summary by specification sections.
 - 2. Indicate on summary any items delivered which were damaged or defective.
 - 3. Contractor and Owner's and Engineer's representatives shall sign summary certifying that all items listed were delivered and that, unless otherwise noted on summary, all items were in good condition at time of delivery to Owner.
- C. Engineer will review summary for completeness and inform Contractor promptly of any deficiencies therein.

- D. Contractor shall deliver all additional items identified by Engineer and replace all damaged and defective items noted on original summary before requesting final inspection.
- E. Summary for additional and replacement items, signed by Contractor and Owner's and Engineer's representatives, shall be submitted.

1.10 SUBSTANTIAL COMPLETION

- A. When Contractor considers the Work is substantially complete, he shall submit to Engineer:
 - 1. A written notice that the Work or designated portion thereof is substantially complete.
 - 2. A list of items to be completed or corrected.
- B. Within reasonable time after receipt of such notice, Engineer will make an inspection to determine status of completion.
- C. Should Engineer determine that the Work is not substantially complete:
 - 1. Engineer will promptly notify Contractor in writing, giving reasons therefore
 - 2. Contractor shall remedy deficiencies in the Work and send second written notice of Substantial Completion to Engineer.
 - 3. Engineer will reinspect the Work
- D. When Engineer finds that the Work is substantially complete, he will:
 - 1. Prepare and deliver to Owner tentative Certificate of Substantial Completion with tentative list of items to be completed or corrected before final payment.
 - 2. After consideration of any objections made by Owner as provided in Conditions of the Contract and when Engineer considers the Work substantially complete, he will execute and deliver to Owner and Contractor definite Certificate of Substantial Completion with revised tentative list of items to be completed or corrected.
- E. No Certificate of Substantial Completion will be issued by Engineer until detailed itemized summary is submitted for review.
- F. Final payment will not be made until all specified spare parts, maintenance materials, and special tools have been delivered to Owner in acceptable condition.

1.11 FINAL INSPECTION

- A. When Contractor considers the Work is complete, Contractor shall submit written certification that:
 - 1. Contract Documents have been reviewed.
 - 2. Work has been inspected for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.

4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
 5. Work is completed and ready for final inspection.
- B. Engineer and Consultant will make an inspection to verify status of completion with reasonable promptness after receipt of such certification.
- C. Should Engineer consider that the Work is incomplete or defective:
1. Engineer will promptly notify Contractor in writing listing incomplete or defective work.
 2. Contractor shall take immediate steps to remedy stated deficiencies and send second written certification to Engineer that the Work is complete.
 3. Engineer will reinspect Work.
- D. When Engineer finds that the Work is acceptable under Contract Documents, Engineer shall request Contractor to make closeout submittals.

1.12 REINSPECTION FEES

- A. Should Engineer and Consultant perform reinspections due to failure of the Work to comply with claims of status of completion made by Contractor:
1. Owner will compensate Engineer for such additional services of Consultant.
 2. Owner will deduct amount of such compensation from final payment to Contractor.

1.13 FINAL ADJUSTMENTS OF ACCOUNTS

- A. Submit final statement of accounting to Engineer
- B. Statement shall reflect all adjustments to contract sum:
1. Original Contract Sum
 2. Additions and deductions resulting from:
 - a. Previous Change Orders
 - b. Deductions for uncorrected Work
 - c. Deductions for liquidated damages
 - d. Deductions for reinspection payments
 - e. Other adjustments
 3. Total Contract Sum, as adjusted
 4. Previous payments
 5. Sum remaining due

1.14 FINAL APPLICATION FOR PAYMENT

- A. Submit final Application for Payment in accordance with procedures and requirements stated in conditions of the Contract.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hazards and governing control
- B. Cleaning materials
- C. General work area conditions during construction
- D. Interior and exterior (site) cleaning
- E. Cleaning of certain parts of the work described in various sections of the specifications

1.2 STORAGE AND HANDLING

- A. Store cleaning products and cleaning wastes in containers specifically designed for those materials.

1.3 SCHEDULING

- A. Schedule cleaning operations so that dust and other contaminants disturbed by cleaning process will not fall on newly painted surfaces.

1.4 HAZARDS AND GOVERNING CONTROL

- A. Hazards Control:
 - 1. Store volatile wastes in covered metal containers and remove from premises daily.
 - 2. Prevent accumulation of wastes which create hazardous conditions.
 - 3. Provide adequate ventilation during use of volatile or noxious substances.
- B. Conduct cleaning and disposal operations to comply with laws and safety orders of governing authorities including anti-pollution laws:
 - 1. Do not burn or bury rubbish and waste materials on project site.
 - 2. Do not dispose of volatile wastes such as mineral spirits, oil or paint thinner in storm or sanitary drains.

PART 2 PRODUCTS

2.1 CLEANING MATERIALS

- A. Cleaning Agents:
 - 1. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.
 - 2. New and uncontaminated
- B. Use only cleaning materials recommended by manufacturer of surface to be cleaned

PART 3 EXECUTION

3.1 GENERAL WORK AREAS DURING CONSTRUCTION

- A. Maintain premises and public properties free from accumulations of waste and debris caused by work on this project.
- B. Prevent dust nuisance attributable to this work.
- C. Do not drop or throw materials from heights greater than 4 foot or less than 4 foot if conditions warrant greater care.
- D. Handle materials in a controlled manner with as few handlings as possible.
- E. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on newly painted surfaces.
- F. Dispose of degradable debris at an approved solid waste disposal site.
- G. Dispose of nondegradable debris at an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.
- H. Repair, patch, and touch-up marred surfaces to specified finish to match adjacent surfaces.
- I. On completion of work, leave area in a clean, natural looking condition. Remove all signs of temporary construction and activities incidental to construction of required permanent Work.

3.2 EXTERIOR (SITE) CLEANING

- A. Cleaning During Construction:
 - 1. Construction debris:
 - a. Confine in strategically located container(s) covered to prevent blowing by wind.
 - b. Remove from work area to container daily.
 - c. Haul from site once a week (minimum).
 - 2. Vegetation: Keep weeds and other vegetation trimmed to 3 inch maximum height.
 - 3. Remove soils, sand, and gravel deposited on paved areas and walks as required to prevent muddy or dusty conditions:
 - a. Do not flush into storm sewer system.
 - 4. Comply with stormwater general permit requirements, and monitor and employ best management practices (BMP).

- B. Final Cleaning:
 - 1. Remove trash and debris containers from site:
 - a. Re-seed areas disturbed by location of trash and debris containers
 - 2. Broom clean paved surfaces
 - 3. Rake clean other surfaces of grounds

3.3 FIELD QUALITY CONTROL

- A. During substantial completion walk thru or prior to start-up, conduct an inspection with Engineer to verify acceptable condition of all work areas.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Maintenance of record documents. Throughout progress of Work, maintain an accurate record of changes in the Contract Documents, and, upon completion of Work, transfer recorded changes to set of Record Documents.

1.2 RELATED SECTIONS

- A. Include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
- B. Individual sections of Technical Specifications.

1.3 SUBMITTALS

- A. Comply with pertinent provisions under Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Engineer's acceptance of the current status of Project Record Documents will be a prerequisite to Engineer's recommendation for payment of progress payments and final payment under the Contract.
- C. Prior to submitting each request for progress payment, secure Engineer's acceptance of the current status of the Project Record Documents.
- D. Prior to submitting request for final payment, submit the final Project Record Documents to Engineer for acceptance.

1.4 QUALITY ASSURANCE

- A. Delegate the responsibility for maintenance of Record Documents to one person on Contractor's staff acceptable to Engineer.
- B. Accuracy of records:
 - 1. Thoroughly coordinate changes within Record Documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other Documents where such entry is required to show the change properly.
 - 2. Accuracy of records shall be such that future searches for items shown in the Contract Documents may rely reasonably on information obtained from accepted Project Record Documents.
- C. Make entries within 24 hours after receipt of information that the change has occurred.

- D. Record the exact final location of pipe lines by offset distances to surface improvements such as edge of existing pavement or to property markers, etc. at a maximum interval of 200 feet. Make sufficient measurements to definitely locate all pipe lines to permanent points. The drawings shall show references to all valves, fittings, pipe material changes, etc.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Maintain job set of Record Documents completely protected from deterioration and from loss and damage until completion of the Work and transfer of all recorded data to the final Project Record Documents.
- B. In the event of loss of recorded data, use means necessary to again secure the data for Engineer's acceptance:
 - 1. Such means shall include, if necessary, in the opinion of Engineer, removal and replacement of concealing materials.
 - 2. In such case, provide replacement to the standards originally required by the Contract Documents.

PART 2 PRODUCTS

2.1 RECORD DOCUMENTS

- A. Job set: Promptly following receipt of Owner's Notice to Proceed, secure from Engineer at no charge to Contractor one complete set of all Documents comprising the Contract.
- B. Final Record Documents: At a time nearing the completion of the Work, secure from Engineer at no charge to Contractor one complete set of blue-line copies of all Drawings in the Contract.

PART 3 EXECUTION

3.1 MAINTENANCE OF JOB SET

- A. Immediately upon receipt of job set, identify each of the Documents with the title, "RECORD DOCUMENTS - JOB SET".
- B. Preservation:
 - 1. Devise a suitable method acceptable to Engineer for protecting job set, considering the Contract completion time, the probable number of occasions upon which the job set must be taken out for new entries and for examination, and the conditions under which these activities will be performed.
 - 2. Do not use job set for any purpose except entry of new data and for review by Engineer, until start of transfer of data to final Project Record Documents.
 - 3. Maintain job set at the site of Work as that site is designated by Engineer.
 - 4. The Engineer may request that project "redlines" be submitted with monthly pay requests.

- C. Making entries on Drawings:
 - 1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by graphic line and note as required.
 - 2. Date all entries
 - 3. Call attention to the entry by a "cloud" drawn around the area or areas affected.
 - 4. In the event of overlapping changes, use different colors for the overlapping changes.

- D. Make entries in pertinent other Documents accepted by Engineer.

- E. Conversion of schematic layouts:
 - 1. In some cases on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items, is shown schematically and is not intended to portray precise physical layout:
 - a. Final physical arrangement is determined by Contractor, subject to Engineer's acceptance.
 - b. However, design of future modifications of the facility may require accurate information as to the final physical layout of items which are shown only schematically on the Drawings.
 - 2. Show on the job set of Record Drawings, by dimension accurate to within one inch, the centerline of each run of items described above:
 - a. Clearly identify the item by accurate note such as "ductile iron drain," "galv. water," and the like.
 - b. Show, by symbol or note, the vertical location of the item ("under slab," "in ceiling plenum," "exposed," and the like).
 - c. Make all identification so descriptive that it may be related reliably to the Specifications.
 - 3. Engineer may waive the requirements for conversion of schematic layouts where, in Engineer's judgment, conversion serves no useful purpose. However, do not rely upon waivers being issued except as specifically issued in writing by Engineer.

3.2 FINAL PROJECT RECORD DOCUMENTS

- A. The purpose of final Project Record Documents is to provide factual information regarding all aspects of Work, both concealed and visible, to enable future modification of Work to proceed without lengthy and expensive site measurement, investigation, and examination.

- B. Acceptance of recorded data prior to transfer:
 - 1. Following receipt of blue-line copies for Final Record Documents, and prior to start of transfer of recorded data thereto, secure Engineer's acceptance of all recorded data.
 - 2. Make required revisions

- C. Transfer of data to Drawings:
1. Carefully transfer change data shown on job set of Record Drawings to the corresponding bluelines, coordinating the changes as required.
 2. Clearly indicate at each affected detail and other Drawing, a full description of changes made during construction, and the actual location of items to be located.
 3. Call attention to each entry by drawing a "cloud" around the area or areas affected.
 4. Make changes neatly, consistently, and with the proper media to assure longevity and legibility.
- D. Transfer of data to other Documents:
1. If Documents other than Drawings have been kept clean during progress of Work, and if entries thereon have been orderly and acceptable to Engineer, the job set of those Documents other than Drawings will be accepted as final Record Documents.
 2. If any such Document is not acceptable to Engineer, secure a new copy of that Document from the Engineer at Engineer's usual charge for reproduction and handling, and carefully transfer the changed data to the new copy for acceptance by Engineer.
- E. Review and submittal:
1. Submit completed set of Project Record Documents to Engineer as described above and under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
 2. Participate in review meetings as required.
 3. Make required changes and promptly deliver final Project Record Documents to Engineer.

3.3 CHANGES SUBSEQUENT TO ACCEPTANCE

- A. Contractor has no responsibility for recording changes in Work subsequent to Final Completion, except for changes resulting from Warranty work.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittals
- B. Format and content of manuals
- C. Manual for equipment and systems
- D. Instruction of Owner's personnel
- E. Schedule of submittals

1.2 QUALITY ASSURANCE

- A. Preparation of data shall be done by personnel:
 - 1. Trained and experienced in maintenance and operation of the described products.
 - 2. Completely familiar with requirements of this section.
 - 3. Skilled as a technical writer to the extent required to communicate essential data.
 - 4. Skilled as a draftsman competent to prepare required drawings.
- B. Manuals for equipment systems shall be prepared by the equipment manufacturer or system supplier.
- C. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under the Contract.
- D. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Manuals for equipment and systems:
 - 1. Submit 3 preliminary copies prior to the date of shipment of the equipment or system:
 - a. Engineer will review
 - b. If approved, "Approved " 1 copy will be returned to Contractor, 1 copy sent to Resident Project Representative and 1 copy retained in Engineer's file
 - c. If approved, "Furnish as Corrected," 1 copy will be returned to Contractor, 1 copy sent to Resident Project Representative, and 1 copy retained in Engineer's file

- d. If not approved, "Revise and Resubmit" or "Rejected," 2 copies will be returned to Contractor with Engineer's comments for revision and 1 copy retained in Engineer's file. Resubmit 3 revised preliminary copies for Engineer's review.
 - e. Partial payment of 50 percent for equipment and systems on hand or installed will be made for preliminary manuals returned "Exceptions Noted".
 - f. No partial payments will be made for equipment and systems on hand or installed until preliminary manuals are submitted and approved.
2. Submit 3 final copies no less than 30 days prior to putting the equipment or system in service. If final manuals differ from approved preliminary manuals, submit 2 copies of any necessary supplemental material with instructions for insertion for conforming Engineer's and Resident Project Representative's copies of preliminary manuals to final manuals:
- a. Engineer will compare with approved preliminary manual.
 - b. If identical or otherwise approved, "Approved ", Contractor will be so notified. Approved final copies will be transmitted to Owner.
 - c. If not approved, "Revise and Resubmit," or "Rejected" all copies will be returned to Contractor for revision or retained by Engineer and the necessary revision data requested from Contractor at Engineer's option.
 - d. No portion of the Work is substantially complete until final equipment and system manuals relating to that portion of the Work are approved by Engineer.
 - e. Submit 4 copies of any revisions found desirable during instruction of Owner's personnel with instructions for insertion for revising Owner's, Engineer's and Resident Project Representative's copies of manual.
 - f. Submit 2 final CD copies of approved final manuals.
 - g. 2 copies of revisions and one CD copy will be transmitted to Owner and one CD copy retained by Engineer.
- C. Additional requirements for specialized instruction of Owner's personnel are given in the detailed equipment specifications.
- 1.4 FORMAT
- A. Prepare data in the form of an instructional manual for use by Owner's personnel.
- B. Presentation of Information:
1. Size: 8-1/2 inch by 11 inch
 2. Paper: 20 lb weight minimum, white, for typed pages
 3. Text: Manufacturer's printed data or neatly typewritten
 4. Drawings:
 - a. Provide reinforced punched binder tab, bind in with text
 - b. Reduced to 8-1/2 inch by 11 inch by 17 inch and folded to 8-1/2 inch by 11 inch
 - c. Where reduction is impractical, folded and placed in 8-1/2 inch by 11 inch envelopes bound in text

- d. Suitably identified on drawings and envelopes
 5. Provide flysheets for each separate product or each piece of operating equipment:
 - a. Provide typed description of product and major component parts of equipment
 - b. Provide indexed tabs, may be in color
 6. Spine and cover: Identify each volume with typed or printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" preceded by the word. "PRELIMINARY" or "FINAL" as applicable. Final manuals to list information on the cover and the spine. List the following:
 - a. Title of project, reference Owner and project location as applicable
 - b. Identity of separate structure as applicable
 - c. Identity of general subject matter covered in manual and specification section number
 7. As much as possible, assemble and bind material in the same order as specified
- C. Binders:
1. Preliminary manuals: Commercial quality permanent 3-ring or 3 post binders with durable, cleanable, hard plastic covers. GBC bound manual may be accepted upon review by Engineer.
 2. Final manuals: Commercial quality permanent 3-ring or 3 post binders with durable, cleanable, hard plastic covers with clear plastic cover and spine pockets suitable for title and cover inserts. Manufacturer's pre-printed binder may be accepted upon review by Engineer. "Deluxe Round Ring View Binder" as manufactured by Wilson Jones or accepted substitution.
- D. Arrange content by systems under section numbers and sequence of table of contents of this Project Manual.
- E. Provide tabbed flyleaf for each separate product and system, with typed description of product and major component parts of equipment.
- F. CD and/or DVD:
1. Label each CD and/or start-up DVD provided
 2. Provide with project name, section and equipment/system label on CD and for CD case
 3. When multiple CDs or DVDs are required, provide CD/DVD 3-ring plastic binder sheet(s) for insertion into final O&M manual
- ### 1.5 CONTENTS OF EACH VOLUME
- A. Neatly typewritten table of contents for each volume, arranged in a systematic order:
1. Contractor, name of responsible principal, address and telephone number
 2. A list of each product required to be included, indexed to the content of the volume.
 3. List, with each product, the name, address and telephone number of:
 - a. Subcontractor or installer
 - b. Maintenance contractor, as appropriate

- c. Identify the area of responsibility of each
 - d. Local source of supply for parts and replacement
 4. Identify each product by product name and other identifying symbols as set forth in Contract Documents
 - B. Product data:
 1. Include only those sheets which are pertinent to the specific product
 2. Annotate each sheet to:
 - a. Clearly identify the specific product or installed
 - b. Clearly identify the data applicable to the installation
 - c. Delete references to inapplicable information
 - C. Drawings:
 1. Supplement product data with drawings as necessary to clearly illustrate:
 - a. Relations of component parts of equipment and systems
 - b. Control and flow diagrams
 2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation:
 3. Do not use Project Record Documents as maintenance drawings
 - D. Written text, as required to supplement product data for the particular installation:
 1. Organize in a consistent format under separate headings for different procedures
 2. Provide a logical sequence of instructions for each procedures
 - E. Copy of each warranty, bond and service contract issued:
 1. Provide information sheet for Owner's personnel, give:
 - a. Proper procedures in the event of fracture
 - b. Instances which might affect the validity of warranties or bonds
- ## 1.6 MANUALS FOR EQUIPMENT AND SYSTEMS
- A. Provide an operation and maintenance manual for each item of equipment or system listed in the schedule of manuals in the quantity listed in the submittal schedule.
 - B. Content for each of equipment and system as appropriate:
 1. Description of unit and component parts:
 - a. Function, normal operating characteristics and limiting conditions
 - b. Performance curves, engineering data and tests
 - c. Complete nomenclature and commercial number of all replaceable parts
 2. Operating procedures:
 - a. Startup, break-in, routine and normal operating instructions
 - b. Regulation, control, stopping, shutdown and emergency instructions
 - c. Summer and winter operating instructions, as applicable
 - d. Special operating instructions
 3. Maintenance procedures:
 - a. Routine operations
 - b. Guide to "trouble-shooting"

- c. Disassembly, repair and reassembly
 - d. Alignment, adjusting and checking
 4. Servicing and lubrication schedule:
 - a. List of lubricants required
 5. Manufacturer's printed operating and maintenance instructions
 6. Description of sequence of operation by control manufacturer
 7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance:
 - a. Predicted life of parts subject to wear
 - b. Items recommended to be stocked as spare parts
 8. As-installed control diagrams by controls manufacturer
 9. Each contractor's coordination drawings:
 - a. As-installed color coded piping diagrams
 10. Charts of valve tag numbers with the location and function of each valve
 11. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage
 12. Other data as required under pertinent sections of specifications
- C. Content for each electric and electronic item or system, as appropriate:
 1. Description of system and component parts:
 - a. Function, normal operating characteristics and limiting conditions
 - b. Performance curves, engineering data and tests
 - c. Complete nomenclature and commercial number of replaceable parts
 2. Circuit directories of panelboards:
 - a. Electrical service
 - b. Controls
 - c. Communications
 3. As-installed color coded wiring diagrams
 4. Operating procedures:
 - a. Routine and normal operating instructions
 - b. Sequences required
 - c. Special operating instructions
 5. Maintenance procedures:
 - a. Routine operations
 - b. Guide to "trouble-shooting"
 - c. Adjustment and checking
 6. Manufacturer's printed operating and maintenance instructions.
 7. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.
 8. Other data as required under pertinent sections of specifications.
- D. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
- E. Additional requirements for Operation and Maintenance Data: The respective sections of specifications.

1.7 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide under provisions of Section 01650, Starting of Systems of these specifications.
- B. Prior to final inspection or acceptance, fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and system.
- C. Operation and maintenance manual constitutes the basis of instruction:
 - 1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.
- D. Additional requirements for specialized instruction of Owner's personnel are given in the detailed equipment specification.

1.8 SCHEDULE OF SUBMITTALS

- A. Equipment and systems operation and maintenance manuals shall be prepared for each of the following:

Specification Section	Type Of Equipment Or System
08711	Door Hardware
11245	Liquid Chemical Feed Systems
13400	Instrumentation and Controls
14300	Single Girder Crane Systems
15100	Valves, Cocks and Hydrants

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Demolition, removal, salvage and disposal of existing materials, structures and equipment where indicated on the Drawings and as specified in this Section.
- B. Disconnecting and capping miscellaneous water and chemical feed piping and electric utilities.

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work
- B. Section 02200 - Excavation, Filling and Grading
- C. Section 02936 - Grassing
- D. Section 09900 - Painting

1.3 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data, and Samples of these specifications.
- B. Shop Drawings: Indicate demolition, removal sequence, and location of salvageable items. Indicate location and type of construction for barricades and fences.
- C. Permits and Certificates:
 - 1. Permits and notices authorizing building demolition
 - 2. Certificates of severance of utility service
 - 3. Permit for transport and disposal of debris

1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01720, Project Record Documents of these specifications.
- B. Accurately record actual locations of capped utilities and subsurface obstructions.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, and disposal.
- B. Obtain required permits from authorities.

- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Do not close or obstruct roadways, sidewalks, or hydrants without written permission from Owner.
- E. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.

1.6 SEQUENCING

- A. Sequence work under the provisions of Section 01010, Summary of Work of these specifications.

1.7 SCHEDULING

- A. Schedule work under the provisions of Sections 01010, Summary of Work and 01310, Construction Schedules of these specifications.
- B. Schedule work to avoid disruption of water treatment plant operations during demolition of existing building, systems and equipment scheduled for demolition.
- C. Provide detailed descriptions for demolition and removal procedures.

1.8 CUTTING AND PATCHING

- A. Contractor shall be responsible for all cutting, fitting, and patching, including attendant excavation and backfill, required to complete the Work or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the Work to provide for installation of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.
 - 5. Remove samples of installed work as specified for testing.
- B. Provide products as specified or as required to complete cutting and patching operations.
- C. Inspection:
 - 1. Inspect existing conditions of the Project, including elements subject to damage or to movement during cutting and patching.
 - 2. After uncovering work, inspect the conditions affecting the installation of products, or performance of the work.
 - 3. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with the work until the Engineer has provided further instructions.

D. Preparation:

1. Provide adequate temporary support as necessary to assure the structural value of integrity of the affected portion of the Work.
2. Provide devices and methods to protect other portions of the Project from damage.
3. Provide protection from the elements for that portion of the Project which may be exposed by cutting and patching work and maintain excavations free from water.
4. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
5. Restore work which has been cut or removed; install new products to provide completed Work in accord with requirements of Contract Documents.
6. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Fill Material: Use on site fill material under provisions of Section 02200, Excavation, Filling and Backfilling of these specifications.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify areas to be demolished are unoccupied and discontinued in use.
- B. Do not commence work until conditions are acceptable to Engineer.

3.2 PREPARATION

- A. Provide, erect, and maintain temporary barriers, enclosures, security fences and shoring at demolition locations in accordance with Section 01500, Construction Facilities and Temporary Controls of these specifications to protect personnel.
- B. Protect existing structures and electrical service which are not to be demolished.
- C. Provide temporary wiring and connections to maintain existing telephone, electrical, instrumentation and control systems in service during construction.
- D. Protect designated trees and plants from damage.
- E. Mark location of existing utilities.
- F. Arrange for and verify termination of utility services to include removing meters.

- G. Remove items scheduled to be salvaged for Owner, and place in designated storage area.

3.3 GENERAL REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent structures.
- B. Conduct operations with minimum interference to Owner access. Maintain protected egress and access at all times.
- C. Sprinkle Work with water to minimize dust where applicable. Provide hoses and water connections for this purpose.
- D. Do not use water to extent causing flooding, contaminated runoff, or icing.
- E. Break concrete and masonry into sections less than 3 feet in any dimension.
- F. Repair damage to adjacent structures.
- G. Parge walls or adjacent structures exposed by demolition work.
- H. Make neat saw cuts, 1 inch in depth, around areas of concrete to be removed, where remaining concrete is to be incorporated into new work.
- I. Remove existing exposed piping and electrical wiring and conduit to be abandoned to structural surface, cut flush, and finish to match existing surfaces.
- J. Remove buried piping, wiring, and conduit to be abandoned as required for the Work. Plug or cap shall be watertight. Wiring to be abandoned shall be removed from the conduit. Conduit designated for reuse shall remain, other it shall be removed.

3.4 DISPOSAL

- A. Remove demolition debris daily.
- B. Do not store or burn materials on-site.
- C. Transport demolition debris to disposal area.

3.5 SALVAGE

- A. Carefully remove items to be salvaged and or reused in Work or to be delivered to Owner's storage:
 - 1. Store and protect items indicated on drawings or specified to be reused in Work.
 - 2. Replace in kind with new items any item damaged through carelessness in removal, storage, or handling.
 - 3. Do not reuse materials or equipment not specifically indicated or specified to be reused.

- B. Preparation of Equipment for Storage:
1. Identify each component with markings or tags to show its position in the assembly and the assembly of which it belongs.
 2. Bundle pump column and shaft sections for convenient storage and handling and provide with platforms, lifting devices and supports to prevent damage and deformation.
 3. Place small parts in wooden boxes and clearly mark contents on the outside.
 4. Thoroughly clean and dry equipment.
 5. Remove oil from oil-lubricated bearings and gear boxes and replace with storage oil.
 6. Grease grease-lubricated bearings.
 7. Coat unpainted surfaces with 2 coats of rust-preventive compound.
 8. Replace any breather plug with solid plug.
 9. Megger test motor windings, attach report of the test results to the unit and furnish one to the Engineer.
 10. Attach unit to suitable crate bottom.
 11. Enclose unit in polyethylene film and seal all seams and the film to the base of the unit with tape.
 12. Construct crate of wooden slats around top and sides of unit.
 13. Attach permanent instruction tag to outside of crate stating "This unit has been prepared for storage - replace oil, vent plugs and lubricant in accordance with manufacturer's instructions before startup".

3.6 SITE DEMOLITION

- A. Disconnect, remove, cap and identify designated utilities within demolition area.
- B. Remove foundation walls and footings to a minimum of two feet below finished grade.
- C. Remove asphalt paving, curb, gutter, sidewalk and other concrete slabs to facilitate construction.
- D. Remove fencing fabric to be reinstalled in manner to prevent damage. Store and protect under provisions of Section 01600, Materials and Equipment of these specifications.
- E. Backfill areas excavated caused as a result of demolition, in accordance with Section 02200, Excavating Filling and Backfilling of these specifications.
- F. Rough grade and compact areas affected by demolition to maintain site grades and contours as shown on Drawings.
- G. Remove demolished materials from site.
- H. Do not burn or bury materials on site. Leave site in clean condition.

- I. Seed disturbed areas not to be Xeriscaped by Owner under provisions of Section 02936, Grassing of these specifications.

3.7 ELECTRICAL DEMOLITION

A. General:

- 1. Remove, relocate and extend existing installation to accommodate new construction.
- 2. Remove abandoned wiring back to nearest outlet or device that is to remain or back to source of supply.

3.8 PROCESS EQUIPMENT AND SYSTEMS DEMOLITION

- A. Valves and Actuators: In general, salvage all butterfly valves and actuators removed and deliver to Owner's storage on site. Remove and salvage existing backwash flow control valve and actuator. Deliver to Owner's storage on site.
- B. Control Equipment: In general, salvage all control and instrumentation equipment removed or abandoned. Deliver to Owner's storage on site.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this specification consists of furnishing all labor, equipment, appliances, materials and supervision, and in performing all operations in connection with clearing, grubbing, and topsoil stripping in strict accordance with this section of the specifications, the applicable drawings and terms and conditions of the Contract. The Contractor is required to contact the ONE CALL CENTER in the State of Georgia. Call 1-800-282-7411.

1.2 GENERAL

- A. Operations shall be conducted in a manner that will provide for the safety of employees and others.
- B. Existing utility lines, paving or structures to remain shall be safeguarded and protected from damage, and supported if necessary.
- C. Prior to any work, the Contractor shall obtain necessary permits for work in the area or shall ascertain that the permits have otherwise been obtained.
- D. Classification of Excavation: All excavation in connection with site work will be considered unclassified common excavation.

1.3 SITE CONDITIONS

- A. The area to be cleared and grubbed is shown schematically on the Drawings or specified below.

1.4 REFERENCES

- A. Latest edition of the “Manual for Erosion and Sediment Control in Georgia”

1.5 QUALITY ASSURANCE

- A. Comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state or federal authorities having jurisdiction.
- B. Layout work shall be done under supervision of a Civil Engineer or Registered Land Surveyor, registered in Georgia.
- C. Transit and measuring devices shall be calibrated to layout site and construction work.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. The Contractor shall furnish equipment of the type normally used in clearing and grubbing operations including, but not limited to, tractors, dozers, chippers, trucks, loaders, and root rakes.

PART 3 EXECUTION

3.1 PREPARATION

- A. Install erosion and sedimentation control structures as shown on the Drawings.
- B. Protect all trees, vegetation, structures, utilities, and buildings not designated for removal for demolition.

3.2 TOPSOIL STRIPPING AND STOCKPILING

- A. Topsoil (top 6" – 8" of material) is to be removed from all cleared and grubbed areas and placed in designated stockpile areas as shown on the plans. The Contractor shall then grade the entire work site to conform, in general, to the finish elevations shown on the Plans.
- B. Shape topsoil stockpiles to drain without ponding water.
- C. Where trees are indicated to remain, stop topsoil stripping at drip line.

3.3 CLEARING AND GRUBBING

- A. Clear and grub each area before excavating. All trees, herbaceous growth and stumps are to be chipped for mulch. Mulch will be stockpiled in the areas designated on the Plans or used for erosion control as required. All other debris is to be removed to an approved landfill.
- B. Materials to be removed from the project site include, but are not limited to trash, organic matter, construction waste materials (i.e. paving, concrete miscellaneous structures, houses), debris and abandoned utilities.
- C. Grubbing shall consist of the removal and disposal of all stumps, roots larger than 1 1/2 inches in diameter to the depth specified, and matted roots from the areas to be grubbed.
 - 1. In the clear well and settling basin areas, stumps, roots, logs or other timber 1 1/2 inches and over in diameter, matted roots and other debris not suitable for foundation purposes, shall be excavated and removed to a depth not less than 24 inches below any structure or slab, 18" below any subgrade, shoulder or slope; and to a depth of 12 inches below finish grade in areas to be grassed.

2. All depressions excavated below the original ground surface for or by the removal of stumps and roots, shall be refilled with suitable material and compacted to make the surface conform to the surrounding ground surface.
 3. Grubbing will not be required in areas other than those occupied by current, and proposed construction and graded and grassed areas.
- D. All foundations and planking embedded in the ground shall be removed and disposed. Butts of utility poles shall be removed.
- E. Landscaping features shall include, but not limited to, fences, cultivated trees and shrubbery, property corners, man made improvements and signs. The Contractor shall take extreme care in moving landscape features and promptly re-establishing these features.
- F. Surface rocks and boulders shall be grubbed from the soil and removed from the site if not suitable as rip rap.
- G. The entire construction area shall be grubbed by heavy tractors with root rakes. Raking shall generally proceed along the contour rather than up and down slopes so as to inhibit soil erosion.
- F. Where the tree limbs interfere with utility wires, or where the trees to be felled are in close proximity to utility wires, the tree shall be taken down in sections to eliminate the possibility of damage to the utility.
- G. Any work pertaining to utility poles shall comply with the requirements of the appropriate utility.
- H. All fences adjoining any excavation or embankment that, in the Contractor's opinion, may be damaged or buried, shall be carefully removed, stored and replaced. Any fencing that, in the Engineer's opinion, is significantly damaged shall be replaced with new fence material.
- I. Stumps and roots shall be grubbed and removed to a depth not less than two feet below grade. All holes or cavities which extend below the subgrade elevation of the proposed work shall be filled with crushed rock or other suitable material, compacted to the same density as the surrounding material.
- J. The Contractor shall exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, etc. situated within the limits of the construction area but not directly within excavation and/or fill limits. The Contractor shall be held liable for any damage the Contractor's operations have inflicted on such property.
- K. The Contractor shall be responsible for all damages to existing improvements resulting from Contractor's operations.

3.4 DISPOSAL OF DEBRIS

- A. The debris resulting from the clearing and grubbing operation shall be removed from the site and disposed of in accordance with all requirements of federal, state, county and municipal regulations. No debris of any kind shall be deposited in any stream or body of water, or in any street or alley. No debris shall be deposited upon any private property. In no case shall any material or debris be left on the Project, shoved onto abutting private properties or buried on the Project.

- B. When approved in writing by the Engineer and when authorized by the proper authorities, the Contractor may dispose of such debris by burning on the Project site provided all requirements set forth by the governing authorities are met. The authorization to burn shall not relieve the Contractor in any way from damages which result from the Contractor's operations.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, appliances, materials, layout staking and grade staking and supervision, and in performing all operations in connection with the excavation, filling and backfilling and grading the site for structures and piping in strict accordance with this section of the specifications, the applicable drawings and terms and conditions of the Contract.

1.2 RELATED SECTIONS

- A. Section 02100 - Site Preparation
- B. Section 02205 - Trench Excavation and Backfill
- C. Section 02210 - Erosion Control
- D. Section 02936 - Grassing

1.3 REFERENCES

- A. ASTM C33 - Concrete Aggregates
- B. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates
- C. ASTM D1241 - Material for Soil Aggregate Subbase, Base, and Surface Courses
- D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
- E. ASTM D1557 - Modified Method Standard Test Methods for Linear Density of Textile Fibers
- F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- G. ASTM D2922 - Nuclear Methods for in Place "Density"
- H. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile
- I. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- J. AASHTO M288 - Geotextile Specifications for Highway Applications

- K. AASHTO T180 - Moisture-Density Relations Of Soils

1.4 CLASSIFICATION OF EXCAVATION

All excavation shall be unclassified.

PART 2 PRODUCTS

2.1 PIPE BEDDING MATERIAL

- A. The bedding material shall be well-graded crushed stone or crushed gravel meeting the requirements of ASTM C-33, Gradation 67 (3/4 inches to No. 4).

2.2 FILL AND BACKFILL MATERIAL

- A. General: Material for fill and backfilling shall be selected from the excavated material, and shall be free of trash, lumber, or other debris, roots and other organic, perishable or deleterious matter.
- B. Borrow Material shall be selected from excavated on-site materials to meet the requirements and conditions of the particular application for which it is to be used. The material shall consist of sandy soils or sand-clay soils capable of being readily shaped and compacted to the required densities and shall be free of roots, trash and any other deleterious material. The material shall be obtained from on-site excavation as approved by the Engineer. Borrow material shall be stored as necessary, and shall be graded and maintained so that adequate and proper drainage and a neat appearance shall exist at all times.
- C. Topsoil shall consist of a natural material that occurs in surface deposits of limited depth, and for elevated areas, it shall be composed of natural mixtures of clay and soil binder with sand. Topsoil shall contain no more than 25 percent of clay and shall be free of stones larger than 2 inches in diameter, roots, excessive vegetation, rubbish or other deleterious matter. The Engineer shall approve topsoil before being used on the work. Topsoil as described, shall be excavated from all areas to be disturbed, whether for structures, piping, site grading, or paving, and it shall be stored for later use. Stockpiled topsoil shall be placed to provide good drainage.

2.3 SEPARATION GEOTEXTILE

- A. Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test method:
 1. Survivability: Class 2; AASHTO M 288.
 2. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751.
 3. Permittivity: 0.02 per second, minimum; ASTM D4491.
 4. UV Stability: 50 percent after 500 hours exposure; ASTM D4355.

2.4 RIP RAP

- A. The stone material for riprap shall be in the size range of 4" diameter to 60 lbs. stone.

PART 3 EXECUTION

3.1 EXCAVATION

- A. General: The excavation shall conform to dimensions and elevations appropriate for the roadway or structure. Excavation shall be continued to the elevation necessary for firm support. The excavated surface beneath the structures and pavement shall be proofrolled in four passes using a minimum of 10 yards of material loaded on a pan excavator or equivalent. Any soft spots shall be filled and compacted to 98% ASTM D1557 (Modified Proctor). The resulting surface shall be brought back to appropriate grade with suitable fill from the excavated material and recompacted to 98% of the density measured by ASTM D1557.
- B. Excavation for Walls and Footings shall extend a sufficient distance to allow for the placing and removal of forms, installation of services and for inspection, except where the concrete wall or footing may be authorized to be deposited directly against excavated surfaces.
- C. Trench Excavation: Trenches shall be excavated true to line and grade. Trenches to receive pipe having a nominal diameter of 24 inches or less shall not be less than 12 inches wider nor more than 16 inches wider than the outside diameter of the pipe to be laid therein, so that a clear space of not less than 6 inches nor more than 8 inches in width is provided on each side of the pipe.
 - 1. The maximum width specified applies to the width at or below the level of the top of the pipe. The width of the trench above the pipe may be as wide as necessary to provide room for proper installation of the work. The Contractor shall comply with the safety requirements of OSHA.
 - 2. Trenches for gravity lines shall be excavated below the pipe invert to provide space for the pipe bedding. Where good soil or rock is encountered in the trench bottom, the excavation shall be carried below the bottom of the pipe a distance of 4 inches or one-eighth the outside diameter of the pipe, whichever is greater.
 - 3. Where rock is encountered in the trench bottom, the excavation shall be carried below the bottom of the pipe a distance of 6 inches or one-eighth the outside diameter of the pipe, whichever is greater. Where, in the opinion of the Engineer, the natural trench bottom is soil which is incapable of satisfactorily supporting the pipe, such unsuitable soil shall be removed to the depth required as determined at the site. The trench bottom shall then be refilled with crushed stone, placed in 8 inch layers and compacted at optimum moisture content. Each layer shall be thoroughly tamped. The refill shall be brought to the proper elevation for the pipe.

- D. Dewatering and Drainage of Excavated Areas: Grading in the vicinity of structures shall be controlled to prevent surface water from running into excavated areas. Dewatering by pumping or wellpointing from excavated areas shall be performed by the Contractor to provide a stable excavation and a firm pit or trench bottom. Dewatering shall incur no extra cost to the Owner.
1. All dewatering methods shall be subject to the approval of the Engineer as to capacity and effectiveness. Water removed from the excavated areas shall be conveyed in a proper manner to a suitable point of discharge where it will neither cause injury to public health, public or private property, the surface or use of streets by the public, or work completed or in progress.
- E. Protection against Flotation: To guard against the danger of flotation of empty or partially empty structures due to a high water table, all dewatering operations shall be continued without interruption until such time as sufficient backfill has been placed or construction has been completed sufficiently to overcome the buoyancy effect of a completely empty structure that is entirely submerged.
- F. Shoring and Protection of Excavations: Shoring shall be provided by the Contractor as necessary to protect life or property. All existing structures, streets, pipes, and foundations which are not to be removed or relocated shall be adequately protected or replaced by the Contractor without cost to the Owner. The Contractor shall adequately protect the work under construction and the safety of his workmen in excavations by the use of suitable sheeting, shoring, bracing, or by sloping the banks in accordance with the angle of repose of the soil.
- G. The Contractor alone is responsible for any damage or injury resulting from his failure to either provide adequate protection from the excavation or to comply with OSHA requirements and guidelines.
- H. Excess Material: Excess material to be used for backfill or stored for later use shall be stockpiled. Excavated material shall be deposited a sufficient distance from the side of excavation walls to prevent excessive surcharge on the wall. Excess excavated material OR material not suitable for backfill or filling shall be disposed of by the Contractor off site, graded and grassed as required by Section 02210, Erosion Control. Disposal of the excess material is the responsibility of the Contractor.

3.2 FILL

- A. Earth fill shall be placed in layers/lifts not to exceed 8 inches in thickness. Each layer shall be compacted at optimum moisture content in a manner approved by the Engineer. After compaction, the dry weight per cubic foot for each layer shall be as specified for backfilling.
- B. Roadways: Roadways shall consist of a compacted subgrade. The top 8" of the subgrade shall be compacted to 98% density as measured by Modified Proctor, ASTM D1557.

3.3 BACKFILLING

- A. The Engineer shall be notified before backfilling in order that the work may be inspected before it is covered. After completion of the foundation footings, walls, or pipe work, and prior to backfilling, all forms shall be removed and the excavation shall be cleared of all trash and debris. Symmetrical backfill loading shall be maintained. Special care shall be taken to prevent any wedging action or eccentric loading upon or against a structure or pipe. Backfill shall be placed in horizontal layers not in excess of 8 inch thickness, and shall have optimum moisture content when compacted. After compaction, the dry weight per cubic foot for each layer shall be at least 95% of the maximum Laboratory Dry Weight per cubic foot, as determined by ASTM D1557, except that backfill under slabs, walls, footings, sidewalks and pavement shall be at least 98% of ASTM D1557.

3.4 GRADING

- A. General: Site grading shall consist of excavating and placing all necessary materials outside the limits of the structure. Site grading shall be completed when all surfaces are in conformity with the contours as shown on the drawings, smooth, firm, containing the specified materials. Site grading shall also include all excavation, filling and compacting required for construction of temporary roads.
- B. Topsoil work shall not be performed when the soil is so wet that the tilth (physical condition) of the soil will be destroyed, such as moisture content, degree of aeration and rate of water infiltration.

3.5 RIP RAP

- A. Designated areas shall be rip rapped for a minimum of 5 square yards each. Areas to receive riprap shall be covered with a geotextile separation fabric beneath the riprap stone. The area to be covered shall be prepared to a relatively smooth condition free of obstructions, depressions and debris. The fabric shall be placed with the long dimension running up the slope, and overlapped a minimum of 1 foot at joints. Fabric shall be anchored in place with pins of a type recommended by the fabric manufacturer, which are placed not more than 3 inches from the centerline of the overlap. Fabric shall be placed loosely so as to give and avoid stretching or tearing during placement of riprap. Fabric shall be protected from clogging due to clay, silt or other contaminants and shall be cushioned with sand of sufficient depth to protect the fabric during placement of riprap. Stones shall be dropped not more than 3 feet during construction. Riprap shall be placed to form a uniform surface not less than 8 inches thick, with a tolerance of plus 4 inches.
- B. Embankment: This item consists of placing in fills and embankments for roadways, and other site grading work; materials removed from the various excavations and borrow pits; all as specified herein and in accordance with the appropriate lines, grades, sections, contours and dimensions.

3.6 CONSTRUCTION METHODS

- A. **General:** During construction, embankments, fills and excavations shall be kept shaped and drained. Ditches and drains along the subgrade shall be maintained in such manner as to drain effectively at all times. Grading shall be done so that the surface of the ground will be properly sloped to prevent water from running into the excavations for structures or pipe lines; any water which accumulates in excavations shall be removed promptly. Excavated materials shall not be stockpiled within a distance from the edge of any excavation less than 1-1/2 times the depth of the excavation. Suitable material removed from excavation shall be used, where feasible, in the formation of embankments, fills, subgrades, shoulders, backfills, and site grading; excess material from excavation not required for such uses, or materials not suitable for such uses, shall be stockpiled. Any wetting, hauling, scarifying, mixing, shaping, rolling, tamping or other operation incidental to the following requirements, which, in the judgment of the Engineer, are necessary to obtain the specified results, shall be performed by the Contractor at no additional expense to the Owner.
- B. **Site Grading:** Except as otherwise specified herein, all disturbed areas on the site shall be finished off to a uniformly smooth surface, free from abrupt, irregular surface changes. The degree of smoothness shall be that ordinarily obtainable from power grader operations. The finished surface shall not be more than 0.20' above or below the established grade. There shall be no roots, wasted building materials, trash or other unsightly matter projecting through or visible at the surface.
- C. **Ditches** shall be cut accurately to line, grade, and cross section. Any excessive ditch excavation shall be backfilled to grade with material approved by the Engineer, consisting of suitable excavated soil, borrow or stones. The requirements of paragraph "Site Grading" above, shall apply to ditches except as follows: The degree of smoothness shall be that usually obtainable with string line or hand raking methods; the finished surface of ditch slopes shall not be more than 0.10' above or below the appropriate elevations.
- D. **Embankment:** Sloping ground surface, steeper than one vertical to four horizontal, on which embankment or fill is to be placed, shall be plowed, stepped, or broken up in such manner that the embankment material will bond with the existing surface. Approved material, consisting of earth, sandy clay, sand and gravel, clay gravel, soft shale, or other granular material (not containing muck, trees, stumps, brush, matted roots or other clods of earth or stones) shall be placed in horizontal layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly and tamped and compacted to 90 percent of the density measured by Modified Proctor ASTM D1557. Tamping shall be accomplished by sheepsfoot rollers or mechanical hand tampers. Final compaction may be by an approved power roller weighing not less than 10 tons, except where insufficient cover may cause damage to pipe.

3.7 INSPECTION AND TESTS

- A. The Contractor shall be responsible for the soil moisture density tests and for the in-place tests of filled and backfilled areas. Tests shall be performed by an independent laboratory approved by the Engineer and shall be performed in accordance with the following: (1) Laboratory Density Tests on soils shall conform to ASTM D1557 or AASHTO T180, METHOD A, and (2) Field Density Tests on soils shall accurately reflect the in place density. Two Laboratory certified copies each of the moisture density tests and the in-place tests shall be forwarded promptly by the Laboratory to the Engineer.
- B. Tests for in-place density shall consist of 4 laboratory tests and 20 field density tests. The Owner will pay directly to the testing laboratory only for tests in excess of this number, except that where there are retests on materials that failed to meet the specifications, the retesting of rejected materials and reinstalled work shall be done at the Contractor's expense.
- C. The Engineer, at his discretion, may order tests and inspections to be performed during the progress of the work, or at the completion of any individual unit of the work, or at the time of final inspection of the entire project. Random spot checks of elevation and slopes shall be conducted by ordinary surveying methods utilizing an established benchmark. Random spot-checks of topsoil thickness shall be conducted by cutting through the surface with a spade or mattock and measuring the thickness of topsoil exposed.

3.8 GRASSING

- A. Areas disturbed by construction operations shall be grassed in accordance with Section 02936, Grassing of these specifications. Areas to be grassed shall be planted, maintained, and shall utilize lime, fertilizer, proper and approved grass and mulch sufficient to produce a cover suitable to eliminate significant erosion.

3.9 MAINTENANCE

- A. Inspection of each area of the site work as it is completed shall not constitute final acceptance of the item or area. The Contractor shall maintain all items in such condition as to be ready for final inspection from the time of completion until the final acceptance of the entire project.

3.10 RESTORATION OF PRIVATE PROPERTY

- A. The Contractor shall carefully restore all property defaced by operations or actions of any of his agents or employees. Such restoration shall include seeding, sodding, and transplanting of lawns, hedges or ornamental plantings, and the repair or replacement of other private facilities in such manner as to meet the approval of the Engineer and at no additional cost to the Owner. No structures or trees shall be removed without the consent of the property owner or until condemnation procedure, if necessary, has been completed.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Excavation, trenching, complete and continual dewatering of excavation, sheeting, bracing and shoring of sides of trench excavation, backfilling around site utilities including all pipelines, electrical conduits and duct banks, and disposal of excess excavated material.

1.2 REFERENCES

- A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))
- B. ASTM D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) - Modified Proctor Test.
- C. ASTM D2487 - Classification of Soils for Engineering Purposes.
- D. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) (Withdrawn 2007)
- E. ASTM D2937 - Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method

1.3 CLASSIFICATION OF EXCAVATION

- A. All excavation shall be unclassified, except rock excavation.
- B. Rock Excavation: Rock excavation shall be defined as the removal of material that cannot be excavated without systematic drilling and blasting or jack hammering. Any boulder larger than ½ c.y. generally is also classified as rock. All excavated rock shall be removed from the site.

1.4 SUBMITTALS

- A. Test and Inspection Reports: Written reports shall be submitted to ENGINEER, with copy to CONTRACTOR, documenting testing and/or inspection results. Tests shall include:
 - 1. Test reports on borrow material.
 - 2. Gradation analysis for granular backfill and subbase materials.
 - 3. Field reports; in-place soil density tests will be performed by a representative of OWNER

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
- B. Testing and Inspection Service: CONTRACTOR will employ and pay for a qualified independent geotechnical testing and inspection laboratory to perform soil testing and inspection service during earthwork operations.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
- B. CONTRACTOR shall notify One Call Center in the State of Georgia 1-800-282-7411, three working days prior to starting any excavation with power equipment.
 - 1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility Owner immediately for directions. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.
 - 2. Do not interrupt existing utilities serving facilities occupied by OWNER or others during occupied hours except when permitted in writing by ENGINEER, and then only after acceptable temporary utility services have been provided.
 - 3. Provide minimum of 2 working days notice to ENGINEER and receive written notice to proceed before interrupting any utility.
 - 4. Demolish and completely remove from Site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.
- C. Property Corners, Right of Way Markers: All property corners, right of way markers and easement markers shall be flagged and protected from all construction activity or shall be reset by a qualified registered land surveyor in the State of Georgia at no additional expense to the Owner if disturbed or damaged as a result of construction.
- D. Use of Explosives: Permission from authorities having jurisdiction where blasting is necessary, it shall be done in accordance with local ordinances by skilled operators and precautions shall be taken to avoid damage. Suitable mats shall be provided to confine, within the limits of the excavations, all materials lifted by blasting. A log shall be recorded to define horizontally and vertically where rock is encountered. The recorded log shall be made available to the Engineer at all times. Contractor shall provide written notice to the Engineer at least 48 hours prior to blasting.

- E. Protection of Persons and Property: Barricade open excavations occurring as part of this Work and post with warning lights.
1. Operate warning lights as recommended by authorities having jurisdiction.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 3. Perform excavation by hand within drip line of large trees to remain. Protect root systems from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.

PART 2 PRODUCTS

2.1 FILL AND BACKFILL MATERIAL

- A. Material for fill and backfilling shall consist of the native excavated material, if suitable, and shall be free of trash, lumber, or other debris, roots and other organic, perishable or deleterious matter.

2.2 SELECTED REFILL MATERIAL FOR TRENCH BACKFILL

- A. Selected refill material shall be used to refill the trench bottom to a minimum depth of 6" where rock excavation is required in the trench. Such material shall be crushed stone or gravel of suitable gradation free from sod, sticks, roots and other organic, perishable or deleterious matter. Selected refill material shall be #57 stone or smaller.

2.3 BEDDING AND HAUNCHING MATERIALS FOR FLEXIBLE PIPE

- A. Unless specified otherwise, bedding and haunching materials shall be crushed stone sized between No. 57, No. 89 and No. 4, inclusive.

2.4 FILTER FABRIC WOVEN TYPE

- A. Filter fabric associated with bedding shall be a polypropylene woven fabric. The fabric shall be a high modulus type with good separation capabilities. The fabric shall be inert to biological degradation and naturally occurring chemicals, alkalies and acids.
- B. The fabric shall have an equivalent opening size EOS of 20 to 45.
- C. Filter fabric shall be Mirafi 500X, Amoco 2002, Exxon GTF-200 or approved equal.

PART 3 EXECUTION

3.1 EXCAVATION

- A. General: The excavation shall conform to dimensions and elevations appropriate for the pipeline or structure. Excavation shall not be carried below the elevation necessary for

construction.

B. Trench Excavation

1. Trenches shall be excavated true to line and grade. Trenches to receive pipe having nominal diameter of less than 24" shall not be less than 8" wider and pipes greater than 24" shall not be less than 12" wider or more than 16" wider than the outside diameter of the pipe to be laid therein.
2. The maximum width specified applies to the width at or below the level of the top of the pipe. The width of the trench above the pipe may be as wide as necessary to provide room for proper installation of the work. If the site has width constraints or easement limitations, the proper shoring of the trench wall shall be necessary. The Contractor shall comply with the safety requirements of OSHA.
3. The bottoms of trenches for water lines shall be 4" to 6" of loose native material to accept the utility main. Bell holes and excavations for joints shall be dug by hand. These holes shall be so spaced and sized as to permit first class workmanship on the joint and to insure that the maximum length of pipe possible will rest on the bottom of the trench.
4. If the trench bottom is determined to be unsuitable to receive the pipe, a minimum of 6" of unsuitable material shall be removed (in 6" lifts, maximum of 2') and replaced with either borrow material or selected refill material as directed by the Engineer.

C. Dewatering and Drainage of Excavated Areas

1. Grading in the vicinity of the work shall be controlled to prevent surface water from running into excavated areas. Dewatering by pumping or wellpointing from excavated areas shall be performed by the Contractor to provide a stable excavation and a firm pit or trench bottom. Dewatering shall incur no extra cost to the Owner.
2. All dewatering methods shall be subject to the approval of the Engineer as to capacity and effectiveness. Water removed from the excavated areas shall be conveyed in a proper manner to a suitable point of discharge where it will neither cause injury to public health, public or private property, the surface or use of streets by the public or work completed or in progress.

D. Protection Against Flotation: To guard against the danger of flotation of empty or partially empty pipe or structure due to a high water table, all dewatering operations shall be continued without interruption until such time as sufficient backfill has been placed over the top of the pipe or around structures to overcome the buoyancy effect of a completely empty pipe or structure which is entirely submerged.

E. Shoring and Protection of Excavations: Shoring shall be provided by the Contractor as necessary to protect life or property. All existing structures, streets, pipes, hydrants, valves and foundations which are not to be removed or relocated shall be adequately protected or replaced by the Contractor without cost to the Owner. The Contractor shall

adequately protect the work under construction and the safety of his workmen in excavations by the use of suitable sheeting, shoring and bracing, or by sloping the banks in accordance with the angle of repose of the soil if site conditions permit. The Contractor alone is responsible for any damage or injury resulting from his failure either to provide adequate protection from the excavation or to comply with OSHA requirements.

3.2 ROCK EXCAVATION

- A. Replacement Depth: Where rock is encountered in the trench bottom, replacement depth excavation shall be carried below the bottom of the pipe a minimum distance of 6" for pipe less than 24" and 9" for pipe larger than 24".
- B. Over Excavation: The over excavation of rock within the trench beyond what is necessary for the correct grade of the pipe shall be refilled with selected refill material at no extra cost to the owner.

3.3 LENGTH OF TRENCH OPENING

- A. In excavating for pipelines, the excavation shall at all times be finished to the required grade for an adequate distance in advance of the completed pipeline. Unless otherwise permitted by ENGINEER, not more than 50 feet of trench shall be open at one time in advance of the pipe. The length of the street which may be occupied by the construction work at any one time will be based on the requirements of use of the street by the public. No more than 600 consecutive feet of length of the street shall be occupied at one time, and vehicle traffic through the street shall not be entirely stopped without the permission of ENGINEER.

3.4 METHOD OF EXCAVATION IN EARTH

- A. All excavation shall be by open cut from the surface, except in special cases where tunneling under pavement or structures may be required or where tunneling under the root system shall be required for tree root protection. All excavation shall be made in such a manner and to such depth, length, and width as shall give ample room for building the structures, for bracing, sheeting, and supporting the sides of the excavation, for pumping and drainage of groundwater and sewage which may be encountered, and for the removal of all materials excavated. Special care shall be taken so that the soil below the bottom of structures to be built shall be left undisturbed to provide a firm bed for construction.

3.5 STORAGE OF EXCAVATED MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill where directed. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
2. Dispose of excess excavated soil material and materials not acceptable for use as backfill or fill.

3.6 BEDDING

- A. Place specified bedding materials under the pipe, in the haunches along the sides of the pipe, and over the pipe to a level 1 foot above the pipe. The material directly below the pipe shall be compacted. The material in the haunch area shall be placed in layers not to exceed 6 inches in depth and shall be compacted to 95 percent of its maximum unit weight.

3.7 BACKFILLING TRENCHES

- A. **BACKFILLING (Above the Top of the Pipe):** The Engineer shall be notified before backfilling in order that the work may be inspected before it is covered. After completion of the pipe work, and prior to backfilling, the excavation shall be cleared of all trash and debris. Symmetrical backfill shall be placed in horizontal layers not in excess of 6" thickness after compaction and shall have an optimum moisture content when compacted. All backfilling of the trench, including the width of the sloped banks, shall be compacted as directed. After compaction, the dry weight per cubic foot for each layer shall be at least 95% of the maximum Laboratory Dry Weight per cubic foot, as determined by ASTM D 698.
- B. When directed by the Engineer, selected refill material shall be used to refill the trench bottom where unsuitable soil is encountered. Refill material shall be a minimum of 6". Where unsuitable material is greater than 6" below the bottom of the pipe, material shall be removed and refilled in 6" layers to a maximum of 2' as directed by the Engineer.
- C. **Flowable fill backfill:** Flowable fill shall be used where large trenches exist under structures ensure stab of th trunk. See also Section 03000, Concrete of these specifications.

3.8 FIELD QUALITY CONTROL

- A. **Quality Control Testing during Construction:** Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.
- B. Tests for compaction and density shall be conducted by an independent testing laboratory approved by the Engineer.
 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 in accordance with ASTM D698.
 - b. Determination of in-place backfill density shall be done in accordance with ASTM D1557, ASTM D2937, or ASTM D2922.
 - c. Test frequency for trenches and confined areas of 1 test per two foot vertical lift for every 100 linear feet.
 - d. Inspecting and testing stripped site, subgrades 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.

END OF SECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions, and Division-1 Specification Sections apply to work of this section.

1.2 SECTION INCLUDES

- A. Under this section shall be included all measures both temporary and permanent to control erosion and sedimentation, and protect all surface waters and property both on and off site. This shall include all labor, materials and equipment necessary to meet the requirements of this Section.

1.3 EROSION AND SEDIMENTATION ACT – DEFINED

- A. It is the intent of this Specification that the Project and the Contractor comply with all applicable requirements of the Latest edition of the “Manual for Erosion and Sediment Control in Georgia”.
- B. The Handbook for Erosion and Sediment Control in Georgia further defines practices and requirements. The Contractor is responsible for maintaining all sediment and erosion control measures on the project site during construction. The Contractor is responsible for any damage caused due to failure to implement these requirements. A Soil Erosion and Sedimentation Control Permit have been obtained by the Owner so that periodic inspections may be made by the County. The Contractor is to cooperate with the person performing these inspections.

1.4 COORDINATION WITH CONTRACT PLANS

- A. A Soil Erosion and Sedimentation Control Plan is included in the Contract Documents and is to be implemented as a part of the procedures necessary to implement requirements of the Act and Ordinance.

PART 2 PRODUCTS

2.1 EROSION AND SEDIMENT CONTROL PRODUCTS

- A. Filter Fabrics Materials shall be strong rot-proof synthetic fibers formed into a fabric of either the woven or non-woven type. Either type of fabric shall be free of any treatment or coating which might significantly alter its physical properties after installation. The fabric shall contain stabilizers and/or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat. The fabric shall be a pervious sheet of synthetic fibers oriented into a stable network so that the fibers retain their relative position with respect to each other under normal handling, installation, and service conditions. Edges of the fabric shall be finished to prevent the outer yard from pulling away from the fabric.

1. During all periods of shipment and storage, the fabric shall be wrapped in a heavy-duty protective covering which will protect the cloth from sunlight, mud, dust, dirt, and debris. The fabric shall not be exposed to temperatures greater than 140 degrees F.
 2. The fabric shall meet the physical requirements called out in GDOT Specification 171
- B. The Wire Support Fence shall be at least 24" high and shall have at least 6 horizontal wires 4x4 W1.5xW1.4 or equal
- C. Posts for Type Sdl-Ns silt fence shall be a minimum of 4 feet long with a 6 foot maximum spacing and may be soft wood, oak or steel. Soft wood posts shall be at least 2" in dia. or 2" x 2". Nominal oak posts shall be at least 1" thick and steel shall be at least 0.75 lb./ft.
- D. Posts for Type Sdl-S silt fence shall be a minimum of 4 feet long with a 4 foot maximum spacing and be made of steel at least 1.3 lb./ft.
- E. Wire Staples/Fasteners shall be #17 gauge minimum and shall have a crown at least $\frac{3}{4}$ inch wide and legs at least $\frac{1}{2}$ inch long. Nails for fasteners shall be #14 gauge minimum, 1 inch long with $\frac{3}{4}$ inch button heads. Fasteners shall be evenly spaced with at least 4 per post.

PART 3 EXECUTION

3.1 GENERAL

- A. Implementation of the requirements of the Act is based on the following principles:
1. The disturbed area and the duration of exposure to erosion elements should be minimized.
 2. Protect off-site and downstream locating draining systems and natural waterways from the impacts of erosion and sedimentation.
 3. Limit the exit velocities of the flow leaving the site to non-erosive or pre-developed conditions.
 4. Design and implement an ongoing inspection and maintenance plan.

3.2 SYMBOLS

- A. The Soil Erosion and Sedimentation Control Plan contains standard symbols for the different types of measures for implementing the Act. These symbols are defined for conditions, design criteria and construction specifications in Sections II and III of the Handbook.

3.3 SPECIFIC REQUIREMENTS

- A. Grading operations shall be conducted in a manner that will minimize the exposure of disturbed soil to wind and rain. The contractor shall make every effort to temporarily stabilize disturbed areas as soon as the desired grade is achieved, and shall sequence operations logically such that exposed areas are utilized for structures or permanently stabilized in a timely manner. All work shall be done in accordance with the latest edition of the “Manual for Erosion and Sediment Control in Georgia”.
- B. All disturbed areas shall be grassed by sodding or seeding, fertilizing, mulching and watering to obtain a ground cover which prevents soil erosion.
- C. Temporary grassing shall be cut by the Contractor based on the following conditions:
 - 1. Temporary grass reaches a height of 6 inches or greater.
 - 2. Within forty five (45) days after first cutting if temporary grassing has reached a height sufficient to shade out the growth of the permanent grassing.
 - 3. Cutting of the grass by the Contractor shall be a minimum of one time during the course of the contract.
- D. A temporary construction egress pad shall be installed and maintained at any point where construction vehicles enter a public right-of-way, street or parking area. The pad shall be used to eliminate mud from the construction area onto public rights-of-way. The pad shall be constructed as shown in the Manual for Erosion and Sediment Control.
- E. Disturbed ditches shall be protected and stabilized with slope matting and seeding or sod rolls of grass as determined by the Owner or his representative. This will include all slopes and bottom of ditch.
- F. All measures installed for sediment control shall be checked at the beginning and end of each day when construction is occurring to ascertain that the measures are in place and functioning properly.
- G. Removal of Temporary Soil Erosion and Sediment Control Measures: After permanent erosion control features of the work site are complete and ample grass is established, the temporary fences, ditch checks, etc. shall be removed. Silt that has collected shall be removed, or when appropriate, regarded, stabilized, and planted.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- A. The work covered by this section of the specifications consists of furnishing all plant, labor, supervision, equipment, materials and performing all operations in connection with the pavement of the driveway and parking area of this project, in accordance with this section of the specifications, and subject to the terms and conditions of the Contract

1.2 REFERENCES

- A. ASTM C33 - Concrete Aggregates
- B. ASTM D1557 - Test methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb Rammer and 18 inch drop
- C. ASTM D1559 - Test Method for Resistance of Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

1.3 RELATED SECTIONS

- A. Section 02100 - Site Preparation
- B. Section 02200 - Excavation, Filling & Backfilling

1.4 SUBMITTALS

- A. Test and Inspection Reports: Written reports shall be submitted to Engineer, with copy to Contractor, documenting testing and/or inspection results. Test shall include:
 - 1. Certificates of Compliance on all Materials
 - 2. Field Reports; in place base course, binder and surface course density tests.

1.5 GENERAL

- A. Asphalt Pavement: Asphalt pavement shall consist of the excavation, filling, preparation and further compaction when necessary of the proof-rolled and recompacted subgrade, placing of the graded aggregate base course, application of bituminous prime coat, application of the binder course, tack coat, and an asphaltic concrete surface course and performing other items of construction as indicated or necessary to complete the pavement.
- B. Seasonal Limitations: No bituminous materials shall be applied for surface treatment between November 10 and April 10, except with written approval of the Engineer.
- C. Weather Limitations: Bituminous mixtures shall not be produced or placed during rainy weather, when the subgrade or base course is frozen or shows any evidence of excess

moisture or when the moisture on the surface to be paved would prevent proper bond, nor when the air temperature is less than 45° F. in the shade away from artificial heat.

1.6 APPLICABLE SPECIFICATIONS

- A. All work and materials required under this section of the specifications shall conform to the applicable sections of the "Standard Specifications for Construction of Roads and Bridges" of the Department of Transportation, State of Georgia.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Asphalt Cement: GDOT Section 400, ASTM D 946.
- B. Aggregate for Base Course: GDOT Standards, Section 815.
- C. Aggregate for Binder Course: In accordance with GDOT Standards, Section 802.
- D. Aggregate for Wearing Course: In accordance with GDOT Standards, Section 802.
- E. Fine Aggregate: In accordance with GDOT Standards, Section 802.
- F. Mineral Filler: In accordance with GDOT Standards, Section 883.
- G. Primer: In accordance with GDOT Standards, Section 412.
- H. Tack Coat: Conforming to Section 413 of the Georgia Department of Transportation Standard Specification.
- I. Herbicide Treatment: Commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid, or wettable powder form. Conforming to Section 725 of the Georgia Department of Transportation Standard Specification.

2.2 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Base Course: Graded Aggregate Base (GAB).
- C. Binder Course: 2" 220 lb/sy Superpave or as directed by the Engineer.
- D. Wearing Course: 1-1/2" 165 lb/sy Superpave or as directed by the Engineer.

PART 3 EXECUTION

3.1 SUBGRADE

- A. Excavation: The Contractor shall excavate the existing material as needed to provide for the base course. All unsuitable excavated materials that cannot be used in fill areas shall be wasted in spoil areas. Excavation shall be performed in a manner and sequence that will provide drainage at all times. All excavation shall be unclassified and considered common excavation for this project
- B. Grading, Filling and Backfilling: The grading shall conform to the applicable requirements described in detail Section 02100, Site Preparation of these specifications. Filling and backfilling shall conform to Section 02200, Excavation, Filling and Backfilling of the specifications.
- C. Protection of Subgrade: The Contractor shall protect the subgrade from damage and shall keep it adequately drained. It shall be kept free from ruts and other depressions and in a smooth and compacted condition until the asphaltic binder course has been placed.

3.2 GRADED AGGREGATE BASE COURSE

- A. A 6" thick graded aggregate base course shall be applied in accordance with the applicable requirements of Section 310 of the Georgia DOT Standard Specifications. Material shall be compacted to at least 100% of maximum density at optimum moisture content based upon the Modified Proctor Method, ASTM D-1557. The base shall be drained by installing weeps at low points and intervals not to exceed 50 ft.

3.3 BITUMINOUS PRIME

- A. Bituminous prime shall be applied to the finished base course and to existing surface treatment at a rate of not less than 0.18 and not more than 0.23 gallons per square yard. Application of the bituminous prime shall be in accordance with Section 412 of those specifications.

3.4 ASPHALTIC CONCRETE BINDER AND SURFACE COURSES

- A. General: Areas required to be paved shall receive a 2-1/2" Intermediate Course and a 1-1/2" inch compacted thickness surface course. The surface course shall be Asphaltic Concrete, Type F; the intermediate course, Type B.
- B. Mix: The job mix will be determined in accordance with the provisions of Article 828 of the Georgia DOT Specifications and shall require the approval of the Engineer.
- C. Application: Apply the asphaltic concrete surface course in accordance with the applicable requirements of Section 400.05, Georgia DOT Specifications.

- D. Compaction: Compact to at least 98% of the density of a laboratory specimen of the same mixture subjected to 50 blows of a standard Marshall Hammer on each side of the specimen, based on the Marshall Test Procedure, ASTM D1559.

3.5 ASPHALT DRIVEWAY REPLACEMENT OVER TRENCH

- A. Driveway cuts over trench excavations shall be saw-cut parallel over pipeline. Asphalt driveway replacement shall include 6" compacted crushed stone base over 95% standard proctor compacted backfill with a 2-1/2" compacted course of asphalt, equal to existing after applying tack coat to stone.
- B. Limits for driveway replacement shall be 4'-0" plus pipe O.D. wide. Disturbance or damage to the driveway outside of the trench limits shall be repaired at no extra cost to the Owner.

3.6 TESTS

- A. Materials: The Contractor shall be responsible for having the materials he proposes to furnish tested to demonstrate this conformance to these specifications. Certified copies of Test Reports shall be approved by the Engineer prior to construction.
- B. Compaction and Thickness: Compaction and thickness tests will be made at the discretion of, and at locations specified by the Engineer, at no cost to the Owner.

3.7 RESTORATION OF PROPERTY

- A. The Contractor shall carefully restore all property defaced by operation or acts by his agents or employees. Such restoration shall include, but not be limited to seeding, sodding, ornamental planting, repair or replacement of structures, or other facilities and shall be at least equal in quality to the original undisturbed condition. No such cost shall be incurred by the Owner.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Portland cement concrete curbs, gutters and walkways

1.2 RELATED SECTIONS

- A. Section 02200 - Excavation, Filling and Backfilling
- B. Section 02500 - Asphalt Pavement
- C. Section 03000 - Concrete
- D. Section 07900 - Joint Sealants

1.3 RESOURCES

- A. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- B. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- C. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- D. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
- E. AASHTO M233 - Standard Specification for Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with local governing regulations if more stringent than herein specified.

1.5 SUBMITTALS

- A. Furnish samples, manufacturer's product data, test reports, and materials' certifications as required in referenced sections for concrete and joint sealants.

1.6 JOB CONDITIONS

A. Traffic Control:

1. Maintain access for vehicular and pedestrian traffic as required for other construction activities.
2. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conformance: All materials shall conform to the applicable section of the Department of Transportation Standard Specification in the State where the Project is located.

B. Forms:

1. Use steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
2. Use flexible spring steel forms or laminated boards to form radius bends as required.
3. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.

C. Welded Wire Mesh:

1. Welded plain cold-drawn steel wire fabric, ASTM A1064
2. Furnish in flat sheets, not rolls, unless otherwise acceptable to the Engineer.

D. Reinforcing Bars: Deformed steel bars, ASTM A615, Grade 60

E. Concrete Materials: Comply with requirements of applicable Division 3 sections for concrete materials, admixtures, bonding materials, curing materials, and others as required

F. Expansion Joint Materials: Comply with requirements of Section 07900, Joint Sealants for performed expansion joint fillers and sealers

G. Anti-Spalling Compound: Fifty percent (by volume) boiled linseed oil and 50% (by volume) mineral spirits, complying with AASHTO M233

H. LiquidMembrane-Forming Curing Compound:

1. Complying with ASTM C309, Type I, Class A unless other type acceptable to the Engineer.
2. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
 - a. "Masterseal"; Master Builders
 - b. "A-H 3 Way Sealer"; Anti-Hydro Waterproofing Company

- c. "Ecocure"; Euclid Chemical Company
- d. "Clear Seal"; A. C. Horn
- e. "J-20 Acrylic Cure"; Dayton Superior
- f. "Sure Cure"; Kaufman Products Incorporated
- g. "Spartan-Cote"; The Burke Company
- h. "Sealkure"; Toch Div. - Carboline
- i. "Kure-N-Seal"; Sonneborn-Contech
- j. "Polyclear"; Upco Chemical/USM Corporation
- k. "L&M Cure"; L & M Construction Chemicals
- l. "Klearseal"; Setcon Industries
- m. "LR-152"; Protex Industries
- n. "Hardtop"; Gifford - Hill

- I. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.
 - 1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
 - a. "J-40 Bonding Agent"; Dayton Superior Corporation
 - b. "Weldcrete"; Larsen Products
 - c. "Everbond"; L & M Construction Chemicals
 - d. "EucoWeld"; Euclid Chemical Company
 - e. "Hornweld"; A. C. Horn
 - f. "Sonocrete"; Sonneborn-Contech
 - g. "Acrylic Bondcrete"; The Burke Company
- J. Epoxy Adhesive
 - 1. ASTM C 881, two component material suitable for use on dry or damp surfaces
 - 2. Provide material "Type", "Grade", and "Class" to suit project requirements
 - 3. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
 - a. "Epoxitite"; A. C. Horn
 - b. "Edoco 2118 Epoxy Adhesive"; Edoco Technical Products
 - c. "Sikadur Hi-Mod"; Sika Chemical Corporation
 - d. "Euco Epoxy 463 or 615"; Euclid Chemical Company
 - e. "Patch and Bond Epoxy"; The Burke Company
 - f. "Sure-Poxy"; Kaufman Products Incorporated

2.2 CONCRETE MIX, DESIGN AND TESTING

- A. Comply with requirements of applicable Division 3 sections for concrete mix design, sampling and testing, and quality control, and as herein specified.
- B. Design mix to product normal-weight concrete consisting of portland cement, aggregate, water-reducing or high-range water-reducing admixture (super-plasticizer), air-entraining admixture and water to produce the following properties:
 - 1. Compressive Strength: 3000 psi, minimum at 28 days

2. Flexural Strength: 600 psi minimum at 28 days
3. Slump Range: 2.5" to 4"
4. Air Content: 4.0 to 5.5%
5. W/C Ratio: 0.53

PART 3 EXECUTION

3.1 SURFACE PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete

3.2 FORM CONSTRUCTION

- A. Set forms to required grades and lines, rigidly braced and secured.
- B. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
- C. Check completed formwork for grade and alignment to the following tolerances:
 1. Top of forms not more than 1/8" in 10'
 2. Vertical face on longitudinal axis not more than 1/4" in 10'
- D. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

3.3 REINFORCEMENT

- A. Locate, place and support reinforcement as specified in Division 3 sections, unless otherwise indicated.

3.4 CONCRETE PLACEMENT

- A. General:
 1. Comply with requirements of Section 03000, Concrete of these specifications, for mixing and placing concrete, and as specified herein.
 2. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
 3. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

4. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 5. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2-hour, place a construction joint.
- B. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

3.5 JOINTS

- A. General:
1. Construct expansion and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.
 2. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Tooled Joints: Form weakened plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
- C. Sawed Joints: Form weakened plane joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
- D. Construction Joints:
1. Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2-hour, except where such placements terminate at expansion joints.
 2. Construct joints as shown or, if not shown, use standard metal keyway section forms.
- E. Expansion Joints:
1. Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.
 2. Locate expansion joints at a maximum spacing of 50' o.c. Extend joint fillers full width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. If no joint sealer is specified, place top of joint filler flush with finished concrete surface.

3. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together.
4. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

F. Fillers and Sealants:

1. Comply with requirements of applicable Division 7 sections for preparation of joints, materials, installation, and performance.
2. Control joints in sidewalks shall be spaced at intervals equal to the width of the sidewalk and in curb and gutter at 10' intervals.

3.6 CONCRETE FINISHING

- A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
- B. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities and refloat repaired areas to provide a continuous smooth finish.
- C. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2" radius, unless otherwise indicated. Eliminate tool marks on concrete surface.
- D. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
 1. Broom finish: By drawing a fine-hair broom across concrete surface, perpendicular to line of traffic. Repeat operation if required to provide a fine line texture acceptable to the Engineer.
 2. On inclined slab surfaces: Provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic.
- E. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and repoint any minor honeycombed areas. Remove and replace areas or sections with defects.

3.7 CURING

- A. Protect and Cure: Protect and cure finished concrete, complying with applicable requirements of Division 3 sections. Use membrane-forming curing and sealing compound or approved moist-curing methods.

3.8 REPAIRS AND PROTECTIONS

- A. Repair or replace broken or defective concrete.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Sweep concrete pavement, driveways or access ramps and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and fittings for water supply

1.2 RELATED SECTIONS

- A. Section 02200 – Excavation, Filling and Backfilling
- B. Section 02670 - Valves and Hydrants
- C. Section 02675 - Disinfection of Water Distribution System
- D. Section 09900 – Painting and Finishing

1.3 REFERENCES

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- C. ANSI B31.9 - Building Service Piping
- D. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- E. AWS A5.8 - Brazing Filler Metal
- F. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
- G. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other liquids
- H. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 Inch through 48 Inch, for Water and Other Liquids
- I. AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings
- J. AWWA C150 - Thickness Design of Ductile-Iron Pipe
- K. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
- L. AWWA C153 - Ductile-Iron Compact Fittings, 3 Inch through 12 Inch, for Water and Other Liquids
- M. AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances

- N. AWWA C800 - Underground Service Line Valves and Fittings
- O. AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water
- P. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 1/2 inch through 3 inch, for Water
- Q. ASTM B88 - Seamless Copper Water Tube
- R. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- S. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
- T. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
- U. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals
- V. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter
- W. NSF 61 - Drinking Water System Components - Health Effects

1.4 SYSTEM DESCRIPTION

- A. Provide piping complete with all fittings, jointing materials, supports, anchors, and necessary appurtenances.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Shop Drawings: Provide piping layout fabrication and assembly drawings with fitting dimensions. Provide sufficient information to verify compliance with specifications.
- C. Product Data: Provide data on pipe materials, pipe fittings, and accessories. Provide manufacturer's catalog information with dimensions, material, and assembled weight. Indicate pressure ratings for pipe and fittings.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Test Reports: Submit reports of field pressure tests under provisions of Section 01400, Quality Control.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01720, Project Record Documents of these specifications.
- B. Accurately record actual locations of piping mains, valves, connections, and top of pipe elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01730, Operation and Maintenance Data of these specifications.
- B. Maintenance Data: Include installation and maintenance instructions.

1.8 QUALITY ASSURANCE

- A. Perform Work in accordance with Columbia County Water Utility requirements.
- B. Manufacturer's name and pressure rating marked on piping.

1.9 GENERAL REQUIREMENTS

- A. All piping and accessories furnished by the Contractor for incorporation in the work shall be new, unused, and of the type specified herein, and listed in the Bid. All material and construction must be in accordance with the AWWA Standards and any PVC material or plastic service line used must bear the National Sanitation Foundation (NSF) seal of approval for potable water use. All pipe, solder and flux used during installation of the water lines must be "lead-free" with not more than 8% lead in pipes and fittings, and not more than 0.2% lead in solder and flux.
- B. All water lines \leq 24 inches will have 4'-0" minimum cover and $>$ 24 inches will have a minimum of 6'-0" cover unless otherwise noted. Contractor MUST install water line 4'-0" minimum below roadway grade within the Right-of-Way.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600, Materials and Equipment of these specifications.
- B. All pipe, fittings, valves and hydrants shall be stored on site such that they are elevated off the ground at least 6" to prevent any water or form of debris to enter the pipe or pipe openings. All materials shall be properly supported to prevent excess stress while stored. All water systems materials that come into contact with any foreign material shall be thoroughly cleaned before installation in strict accordance with AWWA C651.

- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. During loading, transporting and unloading, exercise care to prevent damage to material:
 - 1. Use slings, hooks, pipe tongs, or skids
 - 2. Do not drop pipe or fittings
 - 3. Do not roll or skid against pipe already on ground
 - 4. Repair any damage done to coating or lining
 - 5. Handle per manufacturer's recommendations
 - 6. Store rubber gaskets in cool dark location
 - 7. Store all material on wood pallets or timbers
- E. Adequately tag or otherwise mark all piping and fittings as to size.

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE:

- A. Underground pipe shall be ductile iron. Pipe sizes 4" to 12" shall be Pressure Class 350, 14" to 36" shall be Pressure Class 250, and in accordance with ANSI Specification A21.50 and A21.51, using 60/42/10 grade of iron. Pipe shall be coated on the outside with a bituminous coating and lined with cement lining in accordance with ANSI A21.4. Approved Ductile Iron Pipe Manufacturers shall be American Cast Iron Pipe Company, U.S. Pipe Company, Griffin Pipe Products Company or McWane Incorporated only.
- B. Fittings shall be manufactured from ductile iron grade 70/50/05 in accordance with ANSI A21.10 / AWWA C110 or ANSI A21.53 / AWWA C153. All fittings shall be interior lined in accordance with ANSI A21.4 / AWWA C104 and have an asphaltic exterior coating the same as DIP. All fittings for underground use shall be mechanical joint. All retainer glands shall be manufactured of ductile iron in accordance with ANSI A21.1 / AWWA C111. Cast iron fittings or accessories are not permitted. Payment for fittings shall be made on the basis of published weights less accessories (MegaLug®, etc.). Fittings shall be as manufactured by American Cast Iron Pipe Company, Union Tyler Foundry Company, Clow, Star Pipe, U.S. Pipe Company or Sigma.
- C. Joints and Jointing Materials:
 - 1. Joints in underground ductile iron pipe shall be mechanical joint, push-on joint or restrained joint where indicated. All joints and jointing materials shall conform to the requirements of ANSI A21.11.
 - 2. Push-on Joints for underground pipe shall have gaskets made of vulcanized natural or synthetic rubber compound conforming to ANSI A21.11 and smooth and free from all imperfections and porosity. Lubricant for push-on joints shall be non-toxic, shall not support bacteria growth and shall have no deteriorating effect on the gasket material.
 - 3. Mechanical Joints shall conform to ANSI A21.10 and A21.11, and shall have gaskets smooth and free from any porosity or imperfections; gaskets shall be made of vulcanized natural or vulcanized synthetic rubber. Bolts for mechanical

joints shall be standard, high-strength, heat-treated cast iron tee-head bolts with hexagon nuts meeting the requirements of ANSI A21.11.

4. Restrained Joints: All joint restraint for underground ductile iron pipe and fittings shall be rated for a minimum of 250 psi. Restraining gaskets shall be clearly marked 6" thru 24" pipe and shall utilize "Fast Grip" restraining gaskets for ACIPCO (American) Pipe only or "Field Lok" restraining gaskets for U.S. Pipe, Griffin Pipe and McWane Pipe only. Restrained Joints for pipe 24" to 36" shall be ACIPCO "Flex Ring", U. S. Pipe "TR Flex" or comparable product which utilizes a positive restraining joint. Accessories including Megalug® series 1100 and 1700 and Sigma ONE-LOK™ (up to 24") may also be used as restraint for ductile iron pipe 6" to 36". All horizontal bend fittings and connecting pipe shall be restrained.

2.2 COPPER TUBING

- A. Water tubing: Buried, ASTM B88, Type K annealed
- B. Water tubing: Exposed or above grade, ASTM B88; Type L, hard drawn
- C. Fittings:
 1. Flared Joints: ANSI B16.26, cast bronze
 2. Solder Joints: ANSI B16.18, cast bronze or B16.22, wrought copper and bronze
 3. Compression Joints: Ford "Grip Joint", Mueller "110 Compression" or equal.
 4. Unions: All three part unions for longer services and reconnections shall be Ford Brass C44-33G for ¾" and C44-446 for 1"
 5. Dielectric Connections: Union with galvanized or plated steel threaded-end, copper solder end, water imperious isolation barrier:
 - a. Threaded: PSI "Delrin Insulating Couplings," Vallet "V-Line Insulating Couplings," or equal
 - b. Flanged: Epco "Dielectric Flange Unions," PSI Type E Flange Insulation," or equal
- D. Solder: Solid wire, ASTM B32, Grade 95TA
- E. Soldering flux: Paste Type, FS O-F-506, Type I, Form A
- F. Brazing filler metal: ASTM C260, BCuP-5; Engelhard "Silvaloy 15," Goldsmith "gb-15," Handy and Hardman "Sil- Foss," or equal
- G. Brazing flux: Paste Type, FS O-F-499, Type B
- H. Flanges: Cast bronze, 150 psig, brazed joints, ANSI B16.24:
 1. Flange bolts and nuts: As specified for steel pipe
 2. Flange gaskets: As specified for steel pipe, except full face
 3. 1/16 inch thick preformed neoprene gaskets
- I. Expansion joints: Flexonics "Model HB Expansion Compensators," Mercer, or equal

2.3 PVC PIPE

- A. PVC pressure pipe 4" to 10" shall be DR 18, PR 200 unless otherwise shown on the plans and shall conform to AWWA C900, latest designation, made from compounds meeting standard code designation PVC 1120. Couplings, bells, gaskets and lubricants to be used with PVC pipe shall also conform to AWWA C900 requirements. Pipe shall have ductile iron pipe equivalent outside diameters. Each joint of pipe shall be marked with the nominal size and OD Base, material code designation, dimension ratio number, AWWA pressure class, AWWA designation number, manufacturer's name or trademark and production record code, and seal of the National Sanitation Foundation verifying the suitability of the pipe material for potable water service. Gaskets and lubricants shall be of proper size and shape and suitable for potable water and shall be furnished as required by the pipe manufacturer.
- B. The contractor shall furnish manufacturer's affidavit certifying that the pipe meets AWWA C900 latest designation standards. Size and class shall be as called for in the Bid Form or plans.

2.4 ACCESSORIES

- A. Concrete for Thrust Blocks: Concrete type specified in Section 03000, Concrete of these specifications.
- B. Manhole Ring and Cover: Refer to Section 02607, Manholes and Covers of these specifications.
- C. Water line markers shall be 60" Phino Tri-View – PST with 6D-5194C Decals installed at locations on plans.
- D. Tapping Sleeves shall be full circle style constructed completely of stainless steel. The tapping sleeve flange shall also be stainless steel. All bolts, nuts, and washers shall be stainless steel. The tapping sleeve shall be Ford style FTSS rated for a minimum working pressure of 250 psi.
 - 1. 4" – 12" Smith-Blair #663, Ford Meter Box Style FTSS or Mueller H-304SS
 - 2. 14" – 24" Smith-Blair #662 or Mueller H-304SS
- E. Corporation and Curb Stops: All corporation and curb stops for water services and sample tap connections shall be as manufactured by Ford Meter Box Corporation or Mueller Company.
 - 1. Corporation Stops: 3/4" – FB1000-3G B-25008, 1" – FB1000-4G B-25008
 - 2. Curb Stops: 3/4" – BA43-232WG B-24258, 1" – BA43-344WG B-24258(1R)
- F. Meter boxes shall be Rome type cast iron 10" X 19" X 12". Top shall have cast ribs on bottom side with four (4) legs to prevent sliding. A 1½" dia. Hole shall be drilled (or pre-drilled) in the top of the vault slab to receive the touch read conduit.

2.5 CORROSION CONTROL

- A. Comply with provisions under Section 09900, Painting and Finishing of these specifications.
- B. Shop paint all ferrous metal surfaces of valves and accessories, both interior and exterior, for corrosion protection
- C. Manufacturer's standard paint will be acceptable if it is functionally equivalent and compatible with specified field coatings
- D. Bituminous coating or asphalt varnish: Manufacturer's Standard for all buried piping.
- E. Shop lining: Cement, AWWA C104/C205 or Epoxy coating for potable water, AWWA C210.
- F. Rust inhibitive primer: Themec "Series 77 Chem-Prime," Sherwin Williams "Ken Kromick Universal Metal Primer," or equal.
- G. Rust preventative compound: Houghton "Rust Veto 344," Rust-Oleum "R-9," or equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions under provisions of Section 01010, Summary of Work of these specifications.
- B. Verify that building service connection and municipal utility water main size, location and invert are as indicated.
- C. Carefully examine pipe and fittings for cracks, damage to linings, and other defects prior to installation. All pipe and fittings may be inspected at the place of manufacture by representatives of the Owner and/or by a testing laboratory of the Owner's selection. Such inspection shall not in any way relieve the Contractor from the responsibility for the compliance of all materials installed as specified, nor shall such inspection in any way relieve the manufacturer from his responsibility for materials he furnished to be as specified.
- D. Remove all defective pipe from site and replace.
- E. Examine areas for weak or structural defects or deviations beyond allowable tolerances for piping clearances that adversely affect excavation and quality of Work.
- F. Start installation only when conditions are satisfactory.

3.2 PREPARATION

- A. No pipe fittings, valves or hydrants shall be transported with a loader fork inserted into the pipe or water way as means of transportation. Free dropped pipe, fittings, valves or hydrants may constitute removal and replacement.
- B. Ream pipe and tube ends and remove burrs.
- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Prepare pipe connections to equipment with flanges or unions.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 02200, Excavation, Filling and Backfilling of these specifications for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8 inches compacted depth, compact to 95 percent.
- C. Backfill around sides and to top of pipe with fill, tamped in place and compacted to 95 percent.

3.4 INSTALLATION - PIPE

- A. Install as specified or in accordance with the manufacturer's recommendations.
- B. In installation, no blocking of pipe barrel above the trench bottom will be permitted. Any pipe which has its alignment, grade, or joints disturbed after laying shall be taken up and re-laid. The interior of the pipe shall be thoroughly cleaned of all foreign matter before laying in the trench and shall be kept clean during laying operations by means of plugs or other approved methods. The pipe shall not be laid in water or when trench or weather conditions are unsuitable for work, and water shall be kept out of trenches until the pipe joints have been completed. When work is not in progress, open ends of pipe and fittings shall be securely plugged so that trench water, earth or other foreign substance cannot enter the line. Plug shall be on site before trench excavation begins. Multiple plugs shall be on site if trenching is starting in more than one area.
- C. Handling: Pipe and accessories shall be handled in such a manner as to insure delivery on the site and installation in the trench in a sound, undamaged condition. Particular care should be taken not to injure the coating.
- D. Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe or its coating. Cutting shall be done by means of an approved type of mechanical cutter. After cutting, all burrs and other roughness shall be removed and the exterior of the spigot end suitably beveled to facilitate assembly. If cutting is not possible, short lengths of pipe shall be furnished as necessary.

- E. Placing and Laying: Pipe and accessories shall be examined for defects and tapped with a light hammer to detect cracks while suspended in the sling before installing. All damaged, defective or unsound items will be rejected and removed immediately from the site of the work. All water shall be removed from the trench before pipe is to be laid.
- F. **Temporary Plugging: All ends of pipelines shall be properly plugged and watertight to eliminate any foreign material from entering the pipe at the end of each work session.**
 - 1. The RPR for the project shall verify that the Contractor has all plugs/caps necessary for the work. If Contractor does not have all that is needed, work suspend until proper and sufficient plugs/caps are on hand.
- G. Install ductile iron piping and fittings to AWWA C600
- H. Route pipe in straight line.
- I. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- J. Install access fittings to permit disinfection of water system performed under Section 02675, Disinfection of Water Distribution Systems of these specifications.
- K. Slope water pipe and position drain at low points.
- L. Protect from lateral displacement by placing embedment evenly on both sides of pipe.
- M. Do not lay pipe in water. Do not lay pipe under unsuitable weather or trench conditions.
- N. Lay pipe with bell ends facing the direction of laying except when Engineer authorizes reverse laying.
- O. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main.
- P. Establish elevations of buried piping to ensure not less than 3 ft of cover.
- Q. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- R. Backfill trench in accordance with Section 02200, Excavation, Filling and Backfilling of these specifications.
- S. Install trace wire continuous over top of pipe buried 6, above pipe line; coordinate with Section 02200, Excavation, Filling and Backfilling of these specifications.
- T. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.5 DEFLECTION

- A. Deflection of water lines (ductile or PVC) and fittings shall be made in strict accordance with manufacturer's requirements. If alignment requires deflections in excess of the manufacturer's limitations, the Contractor shall provide special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within the limits set forth by the manufacturer.

3.6 JOINTING

- A. Push-on Joints shall be assembled by pre-positioning a continuous, molded rubber ring gasket in an annular recess in the pipe socket and forcing the spigot end of the entering pipe into the socket, thereby compressing the gasket radially to the pipe to form a positive seal. The design and shape of the gasket and the annular recess shall be such that the gasket is locked in place against displacement as the joint is assembled. Details of the joint design shall be in accordance with the manufacturer's standard practice. The size and shape of the gasket shall be such as to provide adequate compressive force between the spigot and the socket after assembly to affect a positive seal under all combinations of the joints and gasket tolerances. Contractor shall furnish to Owner one copy of the pipe manufacturer's joint assembly instructions. The Contractor shall adhere strictly to the pipe manufacturer's joint assembly instructions.
- B. Mechanical Joints: The last 8 inches of the spigot and inside of the bell of mechanical joint pipe shall be thoroughly cleaned and then painted with a soap solution made by dissolving one-half cup of granulated soap in one gallon of water. The cast iron gland shall then be slipped on the spigot end of the pipe. The rubber gasket shall be painted with the soap solution and placed on the spigot end with the thick edge toward the gland. The entire section of the pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell, being careful to have the gasket evenly positioned around the entire joint. The cast-iron gland shall be moved into position for bolting, all bolts inserted, and the nuts screwed up tightly with the fingers. Nuts spaced 180 degrees apart shall be tightened alternately to produce an equal pressure on all parts of the gland. A suitable torque-limiting wrench shall be used with maximum torque as recommended by the manufacturer.

3.7 CLEANING

- A. A pipe swab shall be kept in the pipe at all times to prevent debris from entering the newly laid pipe. Whenever pipe laying operations are ceased, a watertight, inflatable plug shall be installed in the open end of the pipe to prevent ground water from entering the newly laid pipe.

3.8 CREEK CROSSINGS

- A. Creek crossings shall consist of restrained ductile iron carrier pipe, steel casing pipe, casing spacers, casing end seals and concrete encasement. The maximum spacing for spacers is 10'-0". The concrete encasement shall be poured continuous and have three

defined sides either of wood or clean trench wall and bottom. The minimum thickness of concrete around the casing shall be 8" thick.

3.9 SERVICE LINE CONNECTIONS, REPAIR OR REPLACEMENT

- A. House service lines for ¾" and 1" taps shall consist of a tapping saddle with ¾"/1" outlet, ¾"/1" ballcorp corporation stop, ¾"/1" service line, ¾"/1"-90 deg. curb stop and meter box.
- B. 1½" and 2" service lines shall consist of a 2" tapping saddle with 2" outlet, 2" iron body gate valve with valve box, 1½"/2" service line, 1½"/2"-90 deg. curb stop and meter box. Ballcorp corporation stop shall be CC threads with grip nut. The curb stop shall be an angle ball meter valve.

3.10 SERVICE LINE INSTALLATION

- A. The service line shall be laid in a straight line and be of a continuous piece from corporation stop or gate valve to curb stop.
- B. Direct taps for service line connections are permitted and will NOT be installed directly on top of water line. The contractor shall tap water in strict accordance with manufacturer's recommendations such that the integrity of the pipe is not compromised during construction or thereafter. Service lines shall maintain a minimum of 3'-6" cover at all times other than direct connections to meters.
- C. Service lines shall be at a minimum depth of 4 feet under pavement.

3.11 TAPPING SLEEVES

- A. The existing water line to receive the tapping sleeve shall be checked for "out-of-round" and thoroughly cleaned before installing the sleeve.
- B. Tapping sleeve placement shall be a minimum of 3'-0" from either end of the existing pipe to be tapped.
- C. Tapping of water lines whether PVC pipe, DIP pipe or CIP shall be in strict accordance with the manufacturer's recommendations and these specifications. All taps made shall retain a coupon of the pipe being tapped. All coupons shall be returned to the Columbia County Water Utility Inspector. Tapping equipment shall be sanitized and made safe for the potable water system application.
 - 1. Tapping Bits shall be a shell cutter head type utilizing a pilot bit. All shell cutter bits shall be adequately sized and of first class workmanship free of damage before being used to tap any water line.
- D. Pressure Testing the tapping sleeve and valve shall be completed before any tapping of existing water lines is permitted.

- E. Tapping sleeves for wet tap connections shall be full body style wrap around sleeves. The sleeves shall have a full wrap around gasket seal. Tapping sleeves shall be rated for a minimum working pressure of 200 psi.
- F. Sleeve Body shall be made entirely of 18-8 304 stainless steel including branch and joint connection. All nuts and bolts shall be 18-8 304 stainless steel and coated to prevent galling. Tapping sleeve branch joints shall be flange joints in accordance with these specifications.
- G. The sleeve shall be fitted with a test port for testing.
- H. Manufacturers
 1. 4"—12" Smith-Blair #663, Ford Meter Box style FTSS or Mueller H-304SS.
 2. 14" – 24" Smithy-Blair #662 or Mueller H-304SS.

3.12 CONNECTIONS TO EXISTING MAINS

- A. The Contractor shall verify existing conditions of tie-in and submit to Engineer for approval a sketch of the connection if conditions differ from Contract Documents. The Contractor shall contact the Columbia County Water Utility Engineering Office at 706-651-0433 and request approval 5 days prior to the intended connection date.
- B. The Contractor shall furnish and install all fittings and appurtenances necessary (unless otherwise noted) to make connections to the existing distribution system. All solid sleeves used to cut into existing pipes shall have a maximum gap of 3/4" between butted plain end pipes. Where this is unable to be achieved, a filler ring shall be installed to close the gap between the cut pipes. All sleeves shall be restrained joint. All restraint necessary, existing pipe and new piping, shall be the responsibility of the Contractor.
- C. Dewatering the existing pipe shall be done to prevent any cross contamination of trench water. The Contractor shall provide a pump sufficient for the rate of flow and/or appropriate drainage to ensure there is no backflow into the existing water line. The cut or break in the existing water line shall be at the highest point of the connection.
- D. All fittings, pipe, valves and appurtenances used to connect to the existing water system prior to standard disinfection shall be clean, free of foreign material and disinfected. Disinfection shall utilize a bleach solution of 1 1/2 parts water to 1 part bleach that shall be sprayed inside pipe, valves, fittings and appurtenances before the connection is to be put back on line with the existing water system.

3.13 CONCRETE BLOCKING FOR RESTRAINT

- A. Unless otherwise shown, fittings not connected to restrained joint pipe shall utilize concrete blocking for restraint. The blocking shall be poured as to provide access to all joints. No bolts, glands or restraint shall be in direct contact with concrete. The concrete blocking shall be formed against undisturbed trench wall. All temporary forms shall be removed before backfilling.

- B. Vertical changes in the pipe line shall utilize restrained joint pipe and fittings, or the combination of, with concrete restraining collar (see detail) only. Concrete blocking will not be acceptable for restraint in the vertical position.
- C. Before installation of concrete blocking for restraint, submittal for approval by Engineer is required

3.14 CONCRETE THRUST COLLARS

- A. Concrete thrust collars shall be poured continuous around pipes and bearing against undisturbed earth. All concrete and reinforcing shall comply with the concrete section of these specifications.
- B. Thrust collars shall be poured at least 7 days prior to the tie-in connection of the water lines. Restraining rods used shall be a minimum of A307 steel and completely field coated with bituminous coating. Where concrete collars utilize a mid-span retainer gland as restraint, polyethylene must be installed to protect the gripping rings from concrete intrusion. Mid-span retainer glands shall be MegaLug® series 1100SDB or approved equal for ductile iron pipe applications. Concrete forms that must remain in place, shall be treated lumber.
- C. All backfilling around thrust collars shall be compacted to 100% density (ASTM D698) and tested. Where unsuitable material is discovered around thrust collar, the unsuitable material shall be removed and replaced with borrow material as directed by the Engineer.

3.15 CONCRETE ENCASEMENT

- A. Provide as indicated on the drawings.
- B. Suitably support and block pipe and anchor against flotation.

3.16 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Flush and disinfect system in accordance with Section 02675, Disinfection of Water Distribution Systems of these specifications.

3.17 PROTECTIVE COATING

- A. Provide polyethylene tube encasement on all buried DIP pipe, fittings, valves and rodding:
 - 1. Comply with AWWA C105
- B. Metal Surfaces:
 - 1. Coat all steel clamp rods, bolts, and other metal accessories used in tapping saddles, anchorages, cut ends of pipe, follower rings and bolts or joint harnesses subject to submergence or contact with the earth and not concrete encased, but including pipe fittings and bolts in polyethylene tube protection
 - 2. Apply 2 coats of coal tar paint to clean, dry metal surfaces.

3.18 TESTING

- A. General: After completion of the piping, it shall be tested for leaks in accordance with AWWA C600 and proved tight at 200/50 psi (at low point) see pipe schedule for details. The Contractor shall provide, at his expense, all labor, supervision, pumps, measuring devices, power, miscellaneous equipment, temporary plugs or valves and water necessary for performance of all testing and disinfection on all piping in accordance with the requirements of these specifications.
- B. **The contractor shall strategically plan disinfection of all piping involved. New piping of all sizes shall be separated from the existing systems either by a valve or temporary fittings to safely flush, pressure test and disinfect the piping without jeopardizing or contaminating the existing plant piping. The contractor shall furnish and install all fittings necessary to ensure complete testing and disinfection. The existing high service water via a hydrant shall be used to fill, flush, test and disinfect piping. The Contractor is responsible for all fittings/adaptors necessary. For example, new piping laid unattached to the existing piping with temporary plugs (tapped for sampling) necessary along with the sleeves to reconnect to the existing piping. In addition, where highly chlorinated water that will be removed from the piping is to be deposited in a location that can affect down stream systems whether aquatic or not, the contractor must properly de-chlorinate the water before discharging. The contractor must prepare a complete plan with sketches and bullet point processes in advance of flushing, testing and disinfection in order to be approved to move forward with the processes. The contractor shall plan accordingly and submit to Engineer in advance for review and approval.**
- C. **Contractor MUST provide a plan to flush all lines to AWWA Standards, 2.5 fps. Contractor MUST also submit to Engineer on how the Contractor will diffuse the water to not cause any erosion during flushing.**
- D. The contractor is responsible for strategically planning all of the injection points, sample taps and flushing points required for the disinfection process in order to best manage the end result. The contractor is responsible for providing all taps as required including appropriate sizing for the disinfection process when injecting chlorine. In addition, the contractor must ensure there is proper flushing points along the pipe line where not already shown on the plans and in accordance with the flushing and disinfection plan to be submitted to Engineer. Hydrants shall be utilized for flushing but cannot be used to pull a TCB sample. The contractor shall coordinate all disinfection process through the Engineer and the Columbia County Water Utility Central Lab Manager. The minimum placement of taps shall be as follows:
1. Within 10' of the beginning and end of newly installed pipe line.
 2. Injection tap(s) shall be sized as required to facilitate proper flow and concentration rates. The minimum size of the tap shall be 1" diameter. Where necessary, the contractor is responsible for determining the appropriate size necessary per application.
 3. There shall be a tap(s) installed no more than 1200 feet along the pipe line.
 4. There shall be a tap(s) installed at all low points along the pipe line.

5. There shall be a tap(s) installed at all high points along the pipe line.
6. Taps(s) shall be installed on each side of in-line valves where areas can be sectioned off and disinfected as separate entities.

E. Hydrostatic Tests:

1. Pressure Test:

- a. All sample taps shall be installed before pressure testing. The contractor is required to thoroughly flush the newly laid water line prior to pressure testing. All newly installed pressure pipe or any valved section thereof shall be subjected to the appropriate hydrostatic pressure based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gage. The duration of each pressure test shall be two hours. Before applying the specified test pressure, all air must be expelled from the line. The Contractor will make the necessary taps and insert plugs to complete the test. All taps installed shall be marked in red on the Contract Drawings that will serve as the record drawings. Any exposed pipe, fittings, valves, and joints shall be carefully examined during the open trench test. All defective joints shall be repaired or replaced to the satisfaction of the Inspector. Any cracked or defective pipe, joints, fittings, valves or hydrants discovered in consequence of this pressure test shall be removed and replaced with sound material and the test shall be repeated until satisfactory to the Inspector.

2. Leakage Test:

- a. The duration of the leakage test shall be for a minimum of two hours, and during the test the main or section of the main under test shall be subjected to the above noted pressure based on the lowest point in the line or section under test and corrected to the elevation of the test gage. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the air has been expelled and the pipe has been filled with water at the test pressure. No pipe installation will be accepted until leakage is less than the number of gallons per hour as determined by the formula

$$L = \frac{D\sqrt{P}}{148}$$

L = Allowable leakage in gallons per hour per 1,000 ft. pipe.

D = The nominal diameter of the pipe in inches.

P = The average test pressure during the leakage test in pounds per square inch gauge.

- b. All visible leaks shall be repaired regardless of the allowance used for testing.

3.19 CLEAN-UP

Upon completion of the installation of the water lines and appurtenances, all equipment and debris remaining as a result of the Contractor's operations shall be removed from the site of the work.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Disinfection of potable water distribution system.
- B. Testing and reporting results.
- C. All piping complete with fittings and appurtenances shall be flushed until thoroughly clean and sterilized as specified in AWWA C651 and in accordance with these specifications. Disposal of heavily chlorinated water (following disinfection) must be accomplished in accordance with AWWA C651. Heavily chlorinated water shall not be deposited directly into a live creek or stream. The requirements of this paragraph apply equally to new pipe and fittings, and to existing pipelines into which connections have been made, or which may have been otherwise disturbed to the extent that contamination may have occurred.

1.2 RELATED SECTIONS

- A. Section 02667 - Site Water Lines

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Disinfection:
 - 1. Basis of Measurement: By the linear foot
 - 2. Basis of Payment: Includes preparation, disinfection, testing and reporting

1.4 REFERENCES

- A. ANSI/AWWA B300 - Standard for Hypochlorites
- B. ANSI/AWWA B301 - Standard for Liquid Chlorine
- C. ANSI/AWWA C651 - Standards for Disinfecting Water Mains
- D. NSF 60 - Drinking Water Treatment Chemicals - Health Effects

1.5 SUBMITTALS

- A. Test Reports: Indicate results comparative to specified requirements.
- B. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01720, Project Record Documents of these specifications.

- B. Disinfection report; record:
 - 1. Type and form of disinfectant used
 - 2. Date and time of disinfectant injection start and time of completion
 - 3. Test locations
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested
 - 5. Date and time of flushing start and completion
 - 6. Disinfectant residual after flushing in ppm for each outlet tested

- C. Bacteriological report; record:
 - 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. Certification that water conforms, or fails to conform, to bacterial standards of Columbia County Water Utility (CCWU)
 - 8. Bacteriologist's signature and authority

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with ANSI/AWWA C651 and C652.
- B. All disinfection methods and practices are thoroughly described in the AWWA manual "Disinfection of Pipelines and Storage Facilities Field Guide".

1.8 QUALIFICATIONS

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years documented experience.
- B. Testing Firm: Company specializing in testing potable water systems, approved by the State of Georgia.

1.9 REGULATORY REQUIREMENTS

- A. Conform to state regulations for performing the work of this Section.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

- A. All chlorine chemical concentrations shall be in accordance with ANSI/AWWA B300. All chemicals used to create chlorine solutions shall be new and have been properly stored before use in disinfection process. All chlorine solutions introduced into the pipeline shall not exceed 100 ppm. Chlorine liquid, calcium hypochlorite tablets, or

calcium hypochlorite for swimming pools are not acceptable chemicals for disinfection. The only chlorine chemicals permitted for disinfection shall be as follows:

- B. Sodium Hypochlorite in liquid solution containing 5-15% available chlorine. The chemical solution shall be mixed as required and injected into the water line.
- C. Calcium Hypochlorite in granular or powdered form containing approximately 65% available chlorine. Calcium hypochlorite chemical shall be solely used as a pre-mixed solution and introduced into the water line as a liquid. Granules or powder dumped or thrown into the inside the pipe line is not permitted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping system has been cleaned, inspected and pressure tested.
- B. Perform scheduling and disinfection activity with start-up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.
- C. Complete disinfection after passing pressure tests.

3.2 GENERAL REQUIREMENTS

- A. Chlorine Testing shall be the contractor's responsibility in order to produce the proper dosage (ppm) of chlorine during all phases of disinfection. The contractor shall be responsible for adequately flushing all air out of the system before chlorine testing.
- B. Water Feed Source shall be made through the temporary connection to the existing Columbia County Water System.
- C. Temporary Connection shall consist of a piping arrangement that contains a meter and backflow device between the existing water system and newly installed piping. The maximum distance between the existing system connection point and newly laid water line shall be 18'. This connection shall be in use until all flushing, pressure testing and disinfection is complete and finalized by the CCWU Inspector.
- D. Meter and Backflow device shall be rented from the CCWU Main Office.
- E. Chlorine Injection shall be pre-mixed and made a homogenous solution before injecting into the water line. The injection tap shall be done thorough an adequately sized tap not less than 1" diameter. All chlorine injection points shall be within 10' of the water feed source.
- F. Sample Tap: All sample taps installed shall extend a minimum of 12" above finish grade with a curb stop readily available to be sterilized by an open flame. Where sample taps

shall only serve as sampling sites, the appropriate pressure rated polyethylene tubing may be used with a brass curb stop. A hydrant shall not be used as a sample location. Galvanized pipe is not permitted as sample line material. Standard Detail.

- G. Sample Tap Locations shall be installed at each end of the water line and no more than 1200 feet apart along the length of the newly laid water line. A minimum of three sample taps shall be installed for shorter lengths of water lines. Service tap installations may also be used as sample points.
- H. Securing Sample Taps shall be performed by the contractor. Each curb stop shall be locked using a combination padlock or keyed padlock before disinfection begins. The contractor is responsible for purchasing and installing all locks necessary to secure taps before the disinfection is complete.
- I. Sample/Injection Tap Removal shall consist of removing curb stop, tubing and plugging, or capping corporation stop in closed position.

3.3 DISINFECTION PROCEDURE

- A. The disinfection procedure shall not begin until the water line has been thoroughly flushed and has passed the pressure testing required. The disinfection procedure takes a minimum of 4 days to complete. The CCWU Inspector shall be notified not less than 48 hours in advance to schedule required disinfection. Inspector must be present during all stages of disinfection.

All sample tap and service tap curb stops shall be locked before beginning disinfection.

- B. Day 1 (High Range): Disinfection shall consist of the injection of the chlorine solution into the entire water line and appurtenances in a homogenous solution. The line shall be tested to verify a minimum chlorine residual of 50ppm. After the inspector has verified that 50ppm exists within the entire water line, the high range shall remain in the line for a minimum of 24 hours.

No water shall be flushed, moved or used from the line at this point. Where water has been removed from the water line, Day 1 shall be repeated.

Where the inspector has determined that a chlorine residual of 50ppm has not been achieved at all sample locations, the contractor shall attempt to correct this deficiency. If the deficiency cannot be corrected, the water line shall be thoroughly flushed and Day 1 shall be repeated until a minimum of 50ppm can be achieved at all sample locations.

The maximum high range chlorine residual shall be 100ppm. Where the chlorine residual is greater than 100ppm at particular sample locations, the contractor shall flush and/or move water to maintain no more than 100ppm.

- C. Day 2 (High Range Verification, TCB Set 1): The water line shall be tested 24 hours after all sample locations were verified at a minimum of 50ppm. The chlorine residual shall not be less than 25ppm. After the inspector has verified a minimum of 25ppm within the

entire water line, the high range shall be thoroughly flushed out and the system residual shall be loaded into the water line to remain for another 24 hours. The inspector shall document system residual for later verification.

Where test locations have less than 25ppm, the disinfection procedure shall cease and be repeated beginning at Day 1.

The first set of TCB samples shall be taken.

- D. Day 3 (System Residual): The water line shall be tested 24 hours after all sample locations were verified to maintain system residual. The chlorine residual in the water line shall be approximately 70% of the previously verified system residual from Day 2. After the system residual is verified, the Total Coliform Bacteria (TCB) samples shall be drawn and sent to the CCWU Central Lab for testing. The testing requires another 24 hours.

Where test locations have less than approximately 70% of previously verified system residual, re-disinfection may be required.

- E. Day 4 (TCB Set 2): Where all of the TCB samples return with a negative result 24 hours later, the water line shall be considered disinfected. The CCWU Inspector shall notify the contractor of the result. All locks for service taps may be removed. All sample taps shall be removed in accordance with this Section of these specifications.

TCB samples cannot be drawn while it is raining.

Where any TCB is returned positive, the water line shall be completely flushed. Twenty four hours later, repeat TCB samples shall be taken. Forty eight hours later, a second set of repeat samples shall be taken to verify the initial failed sample results.

Any positive repeat sample or Ecoli positive sample shall constitute re-flushing and re-chlorination of the water line beginning at Day 1.

The contractor shall be responsible for contacting the CCWU Inspector and scheduling a connection to the existing system.

3.4 CONNECTION TO EXISTING WATER SYSTEM

- A. Disinfection of connections or repairs to the existing water system shall utilize a bleach solution of 1 1/2 parts water to 1 part bleach. The solution shall be sprayed inside pipe, valves, fittings and appurtenances before the connection is to be put back on line with the existing water system. A CCWU Inspector shall be present to witness all stages of connection.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Extent of grassing includes all lawn areas disturbed by construction operations.
- B. For roads under state jurisdiction, grassing on the right-of-way shall meet the requirements of the Department of Transportation Standard Specifications.

1.2 RELATED SECTIONS

- A. Section 02100 – Site Preparation

1.3 GENERAL

- A. The grassing operations shall consist of preparation of the soil, including tillage, liming and fertilizing, seeding, mulching, and watering, and maintenance and repair of planted areas until a satisfactory grass cover is obtained and the work is finally accepted.

1.4 SUBMITTALS

- A. Certificates of Compliance: Submit Certificates of Compliance for all materials furnished under this Section of the Specifications.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil shall be natural soil of the region, free from lumps, clay, toxic substance, sticks, debris, vegetation, stones over one-inch in maximum dimension, and suitable for growing grass.
- B. Seed: Slopes of 2 horizontal to 1 vertical and steeper shall be planted with Korean Lespedeza. All other areas to be grassed shall be seeded with Hulled Bermuda grass seed. All seed for grassing shall be tested and approved by the Georgia Department of Agriculture not more than 6 months prior to the date of sowing and packaged and labeled in accordance with the Georgia Seed Laws and Rules and Regulations in effect on the date of the Invitation for Bids. Seed which has become wet or moldy or otherwise damaged prior to the time of sowing will be rejected.
- C. Agricultural Lime shall be a pulverized limestone having the following certified chemical and physical properties:
 - 1. Total Carbonates, not less than 85%
 - 2. Passing 10-mesh screen, at least 100%
 - 3. Passing 100-mesh screen, at least 25%

- D. Fertilizer: All fertilizer shall be a dry, free-flowing commercial 10-10-10 fertilizer suitable for application by a fertilizer distributor, grain drill, planting machine or similar standard equipment. The fertilizer shall be certified to meet the requirements of Fertilizer Laws of the State of Georgia in effect on the date of the Invitation for Bids. Any fertilizer which becomes caked or otherwise damaged prior to the time of use will be rejected.
- E. Mulch: Any of the mulch materials, consisting of forest litter, hay, straw, hulls of cotton balls or peanuts, ground corncobs, stalks of corn, cane, potato vines, tobacco or other stems, or peat, which are permitted under Standard Specifications of the State Highway Department of Georgia will be acceptable provided they are properly shredded or ground. Mulch materials which contain seeds of species of weeds or plants which would germinate and be harmful to the proposed planting will not be accepted. Before collection of mulch material is begun or delivery is made, the Contractor shall submit samples for approval. Only approved mulch from approved sources will be accepted.
- F. Water for use in connection with the grassing operation may be purchased from the Utility System, or obtained from any other approved source. Such water shall be free of excess chlorine, or other chemicals or substances harmful to plant growth.

PART 3 EXECUTION

3.1 GROUND PREPARATION

- A. Prior to preparing the ground for grassing operations, all weeds, brush and other vegetation in the areas to be planted which has not been removed during clearing and grubbing and grading operations shall be removed from the site. All irregularities in the surface shall be smoothed out and all roots, stone and other foreign material to tillage, planting and proper growth and maintenance of the grass shall be removed. In all areas where the topsoil has been removed during grading operations, the topsoil which has been stockpiled shall be returned and evenly distributed over these areas. Objectionable foreign materials contained in the topsoil shall also be removed as the topsoil is distributed.
- B. Topsoil shall be placed four inches to six inches deep over all areas to be grassed, using salvaged topsoil to the extent possible and topsoil from off-site borrow to supplement that salvaged. Topsoil shall be spread over the areas to be grassed and shall be fine graded so as to be suitable for sowing

3.2 LIMING AND FERTILIZING

- A. After the areas to be seeded have been brought to finished grade, agricultural lime and fertilizer conforming to the requirements of this specification shall be uniformly distributed over the areas, lime fertilizer at the rate shown in Grassing Table. In areas where mechanical spreaders cannot be used, the lime and fertilizer may be applied by hand methods. The lime and fertilizer shall not be applied when the wind makes it difficult to obtain satisfactory distribution.

3.3 TILLAGE

- A. The lime and fertilizer shall be thoroughly and uniformly mixed with the soil to a depth of approximately 3” by plowing, discing and harrowing until the soil is friable and well pulverized. Hand tillage will be required in all areas where mechanical equipment cannot be operated.

3.4 SEEDING

- A. Hulled Bermuda grass seed conforming to the requirements of this specification shall be uniformly sown by approved mechanical power drawn drills or seeders or, in small areas, by mechanical hand seeders, at the rate of 10 pounds per acre; Lespedeza at 40 pounds per acre. The seeds shall be covered and compacted to a depth of 1/8 to 1/2 inch by means of a cultipacker and an empty traffic roller or another roller weighing less than 3 tons. Broadcast seeding shall not be done when the wind makes it difficult to get satisfactory distribution. The Bermuda grass seed shall not be planted prior to April 15 or after September 15. Seed shall not be sown unless the soil has the optimum moisture content or more through a depth of at least 3 inches.

3.5 WATERING

- A. After the seeds have been sown, the moisture content of the soil will be tested. If there is not enough moisture in the soil to insure germination and adequate plant growth, water shall be applied by sprinkling until an adequate moisture content has been reached. In the absence of adequate rainfall during the germination and early growth period, the Contractor will be required to maintain the required adequate moisture content of the soil by periodic sprinkling operations.

3.6 MULCHING

- A. Mulching of seeded areas will not be required but may be employed at the option of the Contractor as an aid in reducing erosion and conserving soil moisture. If employed, the mulch shall conform to the requirements of this specification. The rate of application of the mulch depends on the texture of the mulch. The proper application will allow some sunlight to penetrate and air to circulate, at the same time shading the ground. If desired, immediately after the mulch is spread, the material may be anchored to the soil by a cultipacker, disc harrow, or other suitable equipment.

3.7 ESTABLISHMENT AND MAINTENANCE

- A. The Contractor is responsible for providing a satisfactory stand of living seeded grass in which gaps larger than 12 inches do not occur at the time of acceptance of the project. Any areas which fail to show a uniform stand for any reason whatsoever, shall be reseeded with Hulled Bermuda seed, and such reseeding shall be repeated until acceptance by the Engineer. The Contractor shall properly water, mow and otherwise maintain all planted areas and any damage resulting from erosion, washing or other causes, shall be repaired by fill topsoil, tamping, refertilizing and reseeding at no

additional expense to the Owner, if such damage occurs prior to acceptance of the project.

B. GRASSING TO CONTROL EROSION

1. In the event completion of grading operations of areas to be planted extends beyond the specified grassing periods, grassing must be postponed until the following spring season. The Contractor will be permitted to seed such areas with Rye grass at his own expense, or by mulching shall control erosion of the graded areas. All mowing and maintenance operations during the fall and winter seasons will be the obligation of the Contractor. Erosion must be controlled by acceptable methods to prevent damage to the Owner's property or to adjacent property owners, and to limit migration of silt to the streams.

3.8 GRASSING TABLE

Permanent Cover:

Fertilizer: 10-10-10; 1000 lbs. per acre
Agricultural Lime: 1 ½ tons per acre
Mulch: 2 tons mulch straw per acre

On slopes 3:1 or less:

Hulled Common Bermuda 10 lb/ac 5/10 - 8/15 OR,
Tall Fescue 40 lb/ac 9/25 - 12/20 AND,
Annual Rye Grass 50 lb/ac 9/1 - 11/10

On slopes greater than 3:1: In addition to the above, add:

Interstate Lespedeza (scarified) 40 lb/ac 5/1-8/10

Temporary Cover:

Fertilizer: 10-10-10; 500 lbs. per acre
Agricultural Lime: 1500 lbs. per acre, required only for soil pH<5.0
Mulch: As Needed

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cast-in-place concrete
- B. Reinforcing steel
- C. Forms
- D. Concrete accessories

1.2 RELATED SECTIONS

- A. Section 03600 - Grout
- B. Section 07900 - Joint Sealants

1.3 REFERENCES

- A. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
- B. ACI 309 - Standard Practice for Consolidation of Concrete
- C. ACI 315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures
- D. ACI 318 - Building Code Requirements for Reinforced Concrete
- E. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement
- F. ASTM C31 - Making and Curing Concrete Test Specimens in the Field
- G. ASTM C33 - Concrete Aggregates
- H. ASTM C39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens
- I. ASTM C94 - Ready-Mixed Concrete
- J. ASTM C143 - Test Method for Slump of Hydraulic Cement Concrete
- K. ASTM C150 - Standard Specification for Portland Cement
- L. ASTM C171 - Sheet Materials for Curing Concrete
- M. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- N. ASTM C185 - Standard Test Method for Air Content of Hydraulic Cement Mortar

- O. ASTM C260 - Air Entraining Admixtures for Concrete
- P. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete
- Q. ASTM C404 - Standard Specification for Aggregate for Masonry Grout
- R. ASTM C494 - Chemical Admixtures for Concrete
- S. ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- T. ANSI/AWWA C651 - Standards for Disinfecting Water Mains
- U. ANSI/AWWA C652 - Disinfection Of Water Storage Facilities
- V. ANSI/AWWA C653 - Standard for Disinfection of Water Treatment Plants
- W. CRSI - Placing Reinforcing Bars

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Shop drawings of reinforcing steel shall show steel for slabs in plan and steel for walls in section. Bar lists and bending diagrams shall be submitted as part of the reinforcing steel shop drawings. All laps as required shall be shown and accounted for in lengths. All penetrations, pipes and equipment shall be shown and accounted for on shop drawings. Fabrication of reinforcing steel shall not commence prior to approval of the shop drawings by the Engineer.
- C. Shop drawings for metal forms shall be submitted if requested by the Engineer. Shop drawings for metal forms shall show the layout, framing and supports, with unit dimensions and sections, type and location of welds, and details of all required accessories. Include printed literature on Manufacturer's recommended installation instructions.
- D. Except for slabs on grade, placement drawings of all concrete floor and roof slabs showing openings for sleeves, ducts, chases, etc., which conform to the equipment, piping, passage ways, etc., being utilized for the project shall be prepared by the Contractor and submitted to the Engineer for approval. Placement of concrete for slabs shall not commence until the drawings are approved by the Engineer.
- E. Design Mixes for each class of concrete required shall be submitted for approval. Concrete proportions, including water-cement ratio, shall be established in accordance with ACI 318-11, Proportioning on the Basis of Field Experience or Proportioning by Water/Cement Ratio. Once the mixture for the concrete has been designed, tested, and accepted by the Engineer, the exact mixture proportions shall be used throughout the

subsequent casting operations. Submit copies of each design mix and each aggregate gradation for approval.

1.5 STORAGE OF MATERIALS

- A. Cement and aggregates shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Steel reinforcing shall be stored on supports that will keep the steel from contact with the ground and in such a manner as to be protected from rusting, oil, grease, and distortion. Store metal forms off the ground; pitch to shed water and cover with waterproof material.

1.6 CONCRETE QUALITY

- A. All concrete shall be classified by the 28-day compressive strength, f_c . The design slump shall not exceed 4 inches; the air content shall be $5\% \pm 1\%$. The concrete shall be a workable mixture free from segregation and bleeding. Ready-mix concrete shall conform to ASTM C94. Job mixed concrete shall be mixed with a standard type of batch mixer equipped with adequate facilities for accurate weight measurement and control of each material entering the mixer. A retarding admixture approved by the Engineer shall be used when the air temperature is 80°F or above. Care shall be taken that the mixing water shall be cold for all concrete mixed in hot weather; in hot weather, materials shall be cooled such that concrete delivered to the project shall not have a temperature higher than 75°F, or a mix designed utilizing a superplasticizer shall be used for temperatures up to 87°F. In cold weather, fresh concrete shall be protected from freezing. Concrete shall not be poured unless the air temperature is at least 40°F and rising.
- B. All concrete not otherwise designated shall be 4,000 psi concrete.
- C. Curbs, gutters and ditch paving may be 3,000 psi concrete.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cement: Portland Cement shall be Type I or Type III conforming to ASTM C150, or it shall be Type IA or Type IIIA conforming to ASTM C175. Only one brand of cement shall be used for exposed concrete in any individual structure.
- B. Fine Aggregate shall consist of clean, hard natural sand, manufactured sand or a combination thereof, conforming to the requirements of ASTM C33, Concrete Aggregates, and shall be graded from 3/8" to No. 100 sieve.
- C. Coarse Aggregate shall consist of crushed stone, gravel, or a combination thereof, conforming to the requirement of ASTM C33, Concrete Aggregates, and shall be graded to meet the requirements of size number 467, 67 and 7, as appropriate.
- D. Water shall be clean and free from oils, acids, salts, or other injurious substances.

- E. Admixtures shall be used to provide entrained air. Other admixtures shall be used only with written approval of the Engineer. Air entraining admixtures shall conform to ASTM C260. Other admixtures shall conform to ASTM C494. Calcium chloride will not be permitted.
- F. Curing Paper shall conform to specifications for Sheet Materials for Curing Concrete, ASTM C171.
- G. Reinforcing steel for concrete shall conform to ASTM A615, Grade 60. All splices shall be lapped 40 diameters unless otherwise noted. Principal reinforcement shall be shifted to miss openings through concrete work. Where the resulting spacing exceeds three times the slab or wall thickness or 18", nominal minimum steel shall be detailed at the centerline of the opening and #5 corner bars shall be added in each layer of reinforcement. Reinforcement shall be placed in accordance with CRSI Manual "Placing Reinforcing Bars".
- H. Tapered Thread Splicing Coupler for rebar shall be Lenton SA Coupler with mounting plate or equal designed for attachment to form work. Provide with screw in plug to prevent concrete paste contamination of threads.
- I. Welded Wire Fabric shall conform to ASTM A185. Splices shall be lapped one bar spacing plus 2 inches but not less than 8 inches. Fabrics from wire gauges 12 ga. and smaller shall be galvanized.
- J. Forms shall be of wood, metal, or other material approved by the Engineer. The Contractor shall furnish forms, structurally adequate for the imposed loads that result in correctly aligned concrete. For exposed concrete surfaces, Forms, thoroughly braced and tied together with approved corrosion resistant devices, shall be used for exposed concrete surfaces. Form ties shall be free of devices that will leave a hole or depression larger than 7/8" in diameter back of exposed surfaces of concrete, and such that when forms are removed, no metal shall be within one inch of finished surface. Curved surfaces concealed below grade may be formed in planes up to 2'-0" wide. Holes left by form ties shall be grouted, and the surface left smooth and flush. Exposed corners of walks, and slabs shall be rounded. Exposed corners of formed concrete shall have a 3/4 inch chamfer unless otherwise noted.
- K. Slab Forms to be left in place shall be a minimum of 2" deep, 20 ga. stainless steel Type 304. Minimum Moment of Inertia (I) shall be 0.378 inches⁴ and minimum Section Modulus (S) shall be 0.326 inches³.
- L. Prefomed Expansion Joint Filler Strips shall conform to ASTM D1752.
- M. Grout shall be a portland cement grout consisting of one part of cement, two and one-half parts of sand and the minimum quantity of water to make a workable mix. Cement shall conform to ASTM C150, Type I and sand shall conform to ASTM C404, Size 2.

- N. Joint Sealant shall be Sika® Duoflex® SL or NL with Sika® Duoflex® Primer 5050 as manufactured by Sika Chemical Corp., or the comparable products of W. R. Meadows, Inc., W. R. Grace, or Williams Equipment Co.
- O. Waterstops
1. Steel dams shall be 8"x3/16" bare steel plate and at splices, or joints shall be welded or lapped and bolted for continuity. Steel dams shall be installed where indicated on the plans and in all other construction joints subject to hydrostatic head.
 2. PVC dams shall be 9" x 3/16" sealtight polyvinyl chloride waterstops having a hollow center bulb as manufactured by W.R. Meadows, Inc. Splices or joints in PVC dams shall be fully bonded and watertight butt joints made in conformance with the recommendations of the manufacturer. Two sample splices of each plastic material used shall be submitted for approval before proceeding with concrete work.
- P. Bonding Compound: Sika "Sikadur 32, Hi-Mod" bonding compound, or approved equal.
- Q. Epoxy Adhesive (for grouting dowels): Sika "Sikadur Anchorfix-4", or approved equal
- R. Stud Anchors shall be Hilti HY-200 System Adhesive Anchors suitable for installation in drilled holes in concrete. The anchors shall be as manufactured by Hilti, Rawlplug, Simpson or approved equal.
- S. Wall Pipes shall be ductile iron pipe, except where otherwise indicated on the plans, of appropriate size and shall be provided for all pipes passing through concrete walls. Where chemical lines are to pass through a wall pipe in a concrete wall, the appropriate link seal shall be used.
- T. Access Hatches and Ventilators shall be as specified in Division 5 of these specifications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify that anchors, seats, plates, reinforcement and other items to be case into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush, sandblasting, or pressure washing, and applying bonding agent in accordance with manufacturer's instructions.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete and insert steel dowels with chemical anchor system.

3.3 CONCRETE PAVEMENT

- A. Concrete roadway pavement shall conform to all requirements including materials, quality, workmanship, finish, cleaning and testing as specified in this section of the specifications. The 28-day compressive strength of pavement along the roadway shall be 4,000 psi. Pavement shall be un-reinforced consisting of a compacted sub-base, 6" graded aggregate base, and 6" concrete pavement.

3.4 SIDEWALK AND PAVEMENT JOINTS

- A. Sidewalk contraction joints at 5'-0" spacing may be formed 1/8" by 1" deep with a jointing tool or may be saw cut. Pavement joints 1-1/2" deep at 12'-0" spacing shall be saw cut promptly after casting.

3.5 EMBEDDED ITEMS

- A. All embedded items included in an area shall be installed before concrete placement begins. Full cooperation shall be given other trades to install embedded items. Suitable templates or instructions, or both, shall be provided for setting items not placed in the forms. Embedded items shall have been installed and inspected and tests for concrete shall have been completed and approved by the Engineer before concrete is placed. No "boxing out" or "cutting" will be permitted unless indicated on plans or ordered in writing by the Engineer.
- B. Wall Pipes, Sleeves, anchor bolts, and similar items shall be accurately placed and firmly secured before concrete placement begins. Ferrous metal embedded items shall be galvanized after fabrication unless otherwise noted.
- C. Waterstops shall be installed where indicated on the plans and in all other expansion joints subject to hydrostatic head. Waterstops shall be firmly attached to the outside layer of reinforcing steel and shall be installed complete before concrete placement is started.
- D. Tapered Thread Splicing Couplers shall be installed where indicated on the drawings by screwing the coupler to the framework prior to placing concrete.

3.6 WORKMANSHIP

- A. Placing: Concrete shall not be cast without approval of the Resident Project Representative prior to ordering concrete. In accordance with the recommendations of "Guide for Consolidation of Concrete", ACI Committee 309, concrete shall be placed in the forms and mechanically vibrated to produce concrete without segregation or honeycomb. Slabs and beam stems shall be placed in one operation. Concrete shall be placed continuously between construction joints. Each batch shall be placed into the edge of previously placed concrete to avoid stone pockets and segregation. If there is a delay in placement, the concrete placed after the delay shall be thoroughly spaded and consolidated by mechanical vibration. During the casting of wall sections not less than two mechanical vibrators shall be operated continuously for each casting location. The concrete shall not be freely dropped more than 6 feet, nor moved horizontally, after being deposited, more than 5 feet. The Contractor shall provide sufficient "windows", chutes or

other means or methods of depositing the concrete to comply with these requirements. The concrete shall be brought to correct level with a straight edge and struck off. Bullfloats shall be used to smooth the surface of slabs. Power floating of the slabs shall begin when the water sheen has disappeared, and/or the mix has stiffened sufficiently that the weight of a man standing on it leaves only a slight imprint on the surface.

- B. Reinforcing bars shall be free from scale, oil, and structural defects. The system of holding the bars in place shall insure that all steel in the top layer will support the weight of the workman without displacement and be placed in accordance with ACI Codes 318 and 315. Reinforcement in slabs on grade shall be supported on stable concrete supports. All reinforcing steel within the limits of a day's pour shall be in place and firmly wired before concrete placement starts.
- C. Construction joints shall be formed at the locations shown on the plans, unless specifically approved by the Engineer. Joints which must be formed in other locations shall be waterstopped where appropriate, shall be adequately keyed and doweled, and shall be formed along either a horizontal or a vertical line.
- D. Curing and Protection: All freshly cast concrete shall be protected from the damaging effects of the elements - freezing, rapid drop in temperature, and loss of moisture, and from future construction operations. The Contractor shall maintain the concrete temperature above 50°F for the first 10 days after placing. All concrete shall be cured by flooding with clean water or by keeping forms and other protecting material wet with clean water for a minimum of 10 days. All surfaces neither protected by forms nor covered with water for the entire 10 day period shall be kept wet and covered with curing paper meeting the requirements of the specification for sheet materials for Curing Concrete, ASTM C171. If a floor is left uncovered during the curing period, a film of water shall be clearly visible at all times on the entire surface of the slab.
- E. Membrane Curing Compound may be used in lieu of water curing on concrete which will not be covered later with topping, mortar, or additional concrete. Membrane curing compound shall be spray applied at a coverage of not more than 300 square feet per gallon. Unformed surfaces shall be covered with curing compound within 30 minutes after final finishing. If forms are removed before the end of the specified curing period, curing compound shall be immediately applied to the formed surfaces before they dry out. Curing compound shall be suitably protected from abrasion during the curing period.
- F. Removal of Forms: The forms shall not be removed until the concrete has attained sufficient strength to prevent cracking or other injury, but in no case less than 75% of its design strength. When forms are removed, the Contractor shall place adequate reshores to prevent injury to the concrete by construction loads. The sole responsibility for safe practice in this regard shall be the Contractor's.

3.7 CONCRETE FINISHES

- A. Rough or Form Board Finish: All concrete wall surfaces which are not exposed to view may be given this finish. This finish has, as a prerequisite, a thoroughly vibrated concrete

which will give a surface smooth, free from air pockets, water pockets, sand streaks, or honeycomb. After the removal of the forms, all fins shall be cut off; all holes, depressions, and rough spots shall be carefully pointed up with mortar having the same proportions of cement and sand as used in the concrete being treated. The surface film of all pointed surfaces shall be carefully removed before setting occurs, otherwise, surfaces shall be left with the texture imparted by the forms.

- B. Rubbed Finish: Walls, beam, sill, equipment pad, concrete support and under slab surfaces which are exposed to view shall have a rubbed finish. As soon as the rough surface finish has set sufficiently, the entire surface shall be wet with a brush and rubbed with a No. 16 Carborundum stone, to bring the surface to a paste. The rubbing shall be continued sufficiently to remove all form marks and projections, and to produce a smooth dense surface without pits or irregularities. The material, which is ground to a paste, in the above process, shall be carefully spread or brushed uniformly over the entire surface and allowed to take a "re-set". The final finish shall be obtained by a thorough rubbing with a No. 30 Carborundum stone. This rubbing shall continue until the entire surface is of smooth texture and uniform in color. The surfaces shall be stripped evenly with a brush so as to remove excess paste, and the surface left smooth with only enough paste remaining to obtain a uniform color.
- C. Float Finish: The surface of all concrete slabs shall, unless otherwise hereinafter specified, be given a float finish. The structural slab shall be brought to the established grade by screeding. The surface shall be tested for irregularities with a straightedge. Irregularities shall be eliminated, and the entire surface finished with a wooden hand float or finishing machine. Finish shall be a true plane within a tolerance of 1/4 inch in 10 feet measured in any direction.
- D. Broom Finish: Surfaces of the roof slab, and exterior walkways or platforms shall be given a broom finish. A smooth, true and uniform surface is a prerequisite for this finish. When the progress of the set provides the proper consistency, the surface shall be raked with a broom to give parallel transverse lines in the surface, and to give a uniform texture.
- E. Standard Trowel Finish: All interior floors shall be trowel finished. Both power and hand troweling shall be required. Power troweling shall begin as soon as little or no cement paste clings to the blade. Troweling shall be continued until the surface is dense, smooth, and free of all minor blemishes, such as trowel marks. Hand troweling shall be required to remove slight imperfections left by the troweling machine and to bring the surface to a dense smooth finish. Sprinkling of dry cement or a mixture of dry cement and sand on the surface of the fresh concrete shall not be permitted. A curing compound shall be applied.

3.8 SAMPLES AND TESTS

- A. The Contractor shall be responsible for the concrete mix designs, test cylinders for proving the mix designs, tests for the aggregate gradation and quality, for molding test cylinders during the progress of the job, delivering the cylinders for testing to the laboratory, testing for slump and air content, and for conducting load tests, if required.

The Owner will pay directly for any excess 28 day tests of the concrete cylinders molded during the progress of the work. Tests made at the age of 7 days will be at the Contractor's expense. Before proceeding with the mix design, the Contractor shall obtain approval by the Engineer of the testing laboratory. Tests not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed work, shall be done at the Contractor's expense.

- B. Cylinders: Make one strength test per 50 yards of each class of concrete placed but not less than one for each days pour. Mold and cure three cylinders for each strength test in accordance with ASTM C31. Test two cylinders after 28 days for acceptance in accordance with ASTM C39; test the third cylinder only where either of the tests of the two cylinders is irregular or unacceptable. Additional cylinders must be molded if 7 day test is made at contractor's option.
- C. Slump: Tests for slump shall be performed at the job site on all concrete immediately prior to placing in accordance with the Test for Slump of Portland Cement Concrete, ASTM C143. If the slump varies from that of the design mix by more than that permitted by ASTM C94, the concrete shall be rejected. In no case shall the maximum specified water cement ratio of the approved mix design be exceeded.
- D. Air Content: One test for air content shall be made for each strength test. This test shall be made on a concrete sample that has been removed when consolidation of the concrete in the forms has been completed and shall be in accordance with the Test for Air Content of Freshly Mixed Concrete by the Volumetric Method, ASTM C173.
- E. Load Test: If there exists any evidence of faulty workmanship, violations of specifications, or likelihood of concrete having been frozen, load tests may be required in accordance with ACI 318. These tests shall be under the direction of the Engineer.
- F. Chemical Coating on Concrete: See Section 09900, Painting and Finishing of these specifications. Contractor shall keep concrete surface clean and free from any foreign material such that the bond shall not fail.

3.9 CONCRETE REPAIRS

- A. Correction of Deficiencies: The Contractor shall be responsible for correction of concrete work which does not conform to the specified requirements, including strength, honeycomb, spalls, cracks, chips, holes, fins, tolerances and finishes. Where shrinkage cracks occur in slabs, walls, etc., the cracks shall be pressure grouted with epoxy grout to restore the concrete strength and eliminate leaks.

3.10 FLOWABLE FILL ENCASEMENT

- A. Flowable fill shall be used around pipes in horizontal and vertical positions as shown on drawings. Flowable fill strength shall be a minimum of 1500 psi and be self leveling. All fittings shall be completely wrapped with 10 mil polyurethane. **The RPR must inspect all fittings and pipe thoroughly before being wrapped and flowable fill is poured as encasement.**

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grouting of column and equipment baseplates
- B. Grouting of anchors and dowels into existing concrete
- C. Other grouting specified or indicated on Drawings

1.2 RELATED SECTIONS

- A. Section 03000 - Concrete
- B. Section 05120 - Structural Steel and Miscellaneous Metal

1.3 REFERENCES

- A. ASTM C109 - Test Method for Compressive Strength of Hydraulic Cement Mortar
- B. ASTM C157 - Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
- C. ASTM C191 - Time of Setting of Hydraulic Cement by Vicat Needle

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples.
- B. Product Data: Provide manufacturer's catalog sheet for material indicating test data and physical properties.

1.5 QUALITY ASSURANCE

- A. Conform to applicable industry standard, Corps of Engineers, Specification CRD-C 621 - Specification for non-shrink grout.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Non-Shrink, Non-Metallic Grout:
 - 1. Master Builders - Masterflow 928
 - 2. Burke - Non-Ferrous Non-Shrink
 - 3. L & M Inc. - Crystex
 - 4. W.R. Meadows - Sealtight 588
 - 5. Sonneborn - SonogROUT G.P.
 - 6. Tamms - TammsgROUT 621

7. Sika - SikaGrout 212
 8. Or equal
- B. Non-Shrink, Metallic Grout:
1. Master Builders - Embecco 636 Plus
 2. Or Equal
- C. Epoxy/Grout Adhesive:
1. Hilti Hit HY-150
 2. Dayton Superior - Sure-Anchor Epoxy J-50
 3. Sika - Sikadur 32 Hi-Mod
 4. Or equal
- D. Latex Bonding Agent:
1. Speeco - B20 Liquid Latex
 2. Euclid - Flexbond
 3. W.R. Meadows - Intralok Bonding Agent
- ## 2.2 MATERIALS
- A. Non-Shrink, Non-Metallic Grout: Factory premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 4,000 psi in one day and 8,000 psi in 7 days.
- B. Non-Shrink, Metallic Grout: Factory premixed compound consisting of metallic and quartz aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 3,600 psi in one day and 8,000 psi in 7 days.
- C. Epoxy Grout: Three Component Epoxy Resin System:
1. Two liquid epoxy components.
 2. One inert aggregate filtered component.
 3. Each component furnished in separate package for mixing at job site.
- D. Water: Clean and free from deleterious substances.
- E. Latex Bonding Agent: Acrylic liquid compound readily mixable as an admixture to grout.

PART 3 EXECUTION

3.1 PREPARATION

- A. Non-Shrink, Non-Metallic Grout:
1. Clean concrete surface to receive grout
 2. Saturate concrete with water for 24 hrs prior to grouting and remove excess water just prior to placing grout.
 3. Cold weather conditions:
 - a. Warm concrete, substrate and base plate to 40 degrees F, or above; store grout in warm area.

- b. Follow manufacturer's recommendations for cold weather application.
4. Hot weather conditions:
 - a. Use cold mixing water and cool base plate if possible; store grout in cool area.
 - b. Follow manufacturer's recommendations for hot weather application.
5. Apply to clean, sound surface
6. Apply latex bonding agent to hardened concrete, mix-in-grout, or as directed by Engineer.

B. Non-Shrink, Metallic Grout: Mix in accordance with manufacturers printed instructions.

C. Epoxy Grout: Apply only to clean, dry, sound surface.

3.2 APPLICATION

A. Non-Shrink, Non-Metallic Grout:

1. Mix in a mechanical mixer
2. Use no more water than necessary to produce flowable grout
3. Provide expansion joints on long pours
4. Provide air vents where necessary to eliminate air pockets
5. Place in accordance with manufacturer's instructions
6. Completely fill all spaces and cavities below the top of baseplates
7. Provide forms where baseplates and bedplates do not confine grout
8. Where exposed to view finish grout edges smooth
9. Except where a slope is indicated on the Drawings, finish edges flush at the baseplate, bedplate, member or piece of equipment
10. Protect against rapid moisture loss by immediately covering with wet rags and polyethylene sheets or curing compound.
11. Wet cure grout for 7 days, minimum
12. Where thick grout over 3" is to be placed, it shall be done in two operations, bringing the surface up to about 1" of the machinery base and allowing the initial section to set a minimum of 24 hours before placing final grouting.
13. Maintain the temperature at a minimum of 40 degrees F until grout reaches 3,000 psi.
14. After placement of grout, eliminate excessive external vibration.

B. Non-Shrink, Metallic Grout:

1. Mix in a mechanical mixer.
2. Use no more water than necessary to produce flowable grout.
3. Provide air vents where necessary to eliminate air pockets.
4. Place in accordance with manufacturer's instructions.
5. Completely fill all spaces and cavities below the top of baseplates.
6. DO NOT VIBRATE GROUT
7. Provide metal or wood forms where baseplates and bedplates do not confine grout.
8. Where exposed to view finish grout edges smooth with chamfer.

9. Except where a slope is indicated on the Drawings, finish edges flush at the baseplate, bedplate, member or piece of equipment.
10. Protect against rapid moisture loss by immediately covering with wet rags and polyethylene sheets or curing compound.
11. Wet cure grout for 7 days, minimum.
12. Where thick grout over 3" is to be placed, it shall be done in two operations, bringing the surface up to about 1" of the machinery base and allowing the initial section to set a minimum of 24 hours before placing final grouting.
13. Maintain the temperature at a minimum of 40 degrees F until grout reaches 3,000 psi.
14. After placement of grout, eliminate excessive external vibration.

C. Epoxy Grout:

1. Mix and place in accordance with manufacturer's instructions.
2. Completely fill all cavities and spaces around dowels and anchors without voids.
3. Grout baseplates and bedplates as specified for non-shrink, non-metallic grout.
4. Obtain manufacturer's field technical assistance as required to insure proper placement.

3.3 SCHEDULE

A. Non-Shrink, Non-Metallic Grout: General Use:

1. Grouting of column and equipment baseplates
2. Grouting of water tank bottom plate

B. Non-Shrink, Metallic Grout: General Use:

1. Grouting of equipment and machinery baseplates where specifically directed by equipment manufacturer's instructions or as directed by the Engineer.
2. Where edges will be exposed, cut back $\frac{3}{4}$ inch and finish with non-metallic grout.

C. Epoxy Grout:

1. Grouting of dowels and anchor bolts into existing concrete.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete unit masonry.
- B. Acoustical concrete unit masonry.
- C. Clay unit masonry in the form of brick.
- D. Dimension stone masonry trim in unit masonry walls.
- E. Masonry accessories

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control
- B. Section 03000 - Concrete
- C. Section 07600 - Flashing and Sheet Metal
- D. Section 07900 - Joint Sealants
- E. Section 08220 - Fiberglass Reinforced Plastic Doors and Frames

1.3 REFERENCES

- A. International Building Code - Chapter 17, Special Inspections and Tests
- B. ACI 530 - Building Code Requirements for Masonry Structures
- C. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units
- D. ASTM C91 - Standard Specification for Masonry Cement
- E. ASTM C126 - Facing Brick and Solid Masonry Units
- F. ASTM C141 - Standard Specification for Hydrated Hydraulic Lime for Structural Purposes
- G. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar
- H. ASTM C476 - Standard Specification for Grout for Masonry
- I. ASTM C744 - Standard Specification for Pre-Faced Concrete and Calcium Silicate Masonry Units

J. ASTM C 1364 - Standard Specification for Architectural Cast Stone

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Product Data: Submit data for decorative masonry units and fabricated wire reinforcement, wall ties, anchors, and other accessories:
1. Mix designs for grout for masonry reinforcement. Provide test results from an independent testing laboratory certifying conformance to grout strength requirements and ASTM C476.
- C. Manufacturer's Certificate:
1. Provide certificates stating compliance with specifications for masonry unit grades, types, and classes.
 2. At time of, or prior to delivery of materials to jobsite, a certification letter from supplier of the materials shall be provided to assure materials used in construction are representative of materials used to develop prism test records in accordance with ASTM C90.
- D. Submit qualifications of masonry subcontractor, independent special inspector and testing laboratory.
- E. Prior to fabrication of masonry units, submit two sets of a full pallet of standard integral colors shown on 2 inch by 2 inch plain block pieces. Review is for color and texture only.
- F. Submit full pallet of available mortar color samples for color selection by Owner. Samples should reflect actual installed mortar color.
- G. Include masonry and mortar product data in a material and finishes manual as specified in Section 01730, Operation and Maintenance Data.
- H. Submit product literature for masonry accessories.
- I. Submit mix designs for grout for masonry cells with reinforcement. Provide test results from an independent testing laboratory certifying conformance to grout strength requirements and ASTM C476.

1.5 QUALITY ASSURANCE

- A. Comply with all requirements of local building codes and all supplements as adopted by governing agency in which jurisdiction the masonry work is performed.

1.6 QUALIFICATIONS

- A. Masonry subcontractor: Company specializing in masonry Work with a minimum of 5 years of recent relevant experience.
- B. Testing laboratory: Comply with requirements of Section 01400, Quality Control of these specifications.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600, Materials and Equipment of these specifications.
- B. Store all masonry units and materials off the ground in a manner to prevent damage, deterioration, contamination, or wetting by rain, snow or ground water:
 - 1. Reject cement which has become caked, partially set or otherwise deteriorated, or any material which has become damaged or contaminated.
 - 2. Cover all masonry materials to protect from elements.
- C. Protect facing material and all adjoining work against staining:
 - 1. Keep tops of walls covered with non-staining waterproof covering when work is not in progress.
 - 2. Extend cover 24 inches down face of wall, hold cover securely in place.
 - 3. Clean top surface of work of all loose mortar when work is resumed.
- D. Do not apply loads for at least three days after building masonry columns or walls.
- E. Prevent grout or mortar from staining face of exposed masonry: Protect all sills, ledges, projections and adjacent materials from damage.
- F. Protect and brace masonry walls during construction to prevent damage or loss due to wind.
- G. Yard age concrete masonry units a minimum of 30 days prior to delivery to jobsite.
- H. Mortar:
 - 1. Deliver in sealed unit bags. Identify each bag with project name; material name and type.
 - 2. Store stacked no more than two bags high.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Water shall be clean and free from oil, acids, salt, or injurious substances.
- B. Portland cement shall conform to ASTM C 150, Type I. It shall be a standard product, the name of which shall be submitted to the Engineer for approval.

- C. Masonry cement shall conform to ASTM C 91 and shall be a standard product approved by the Engineer.
- D. Hydrated lime shall conform to ASTM C 141.
- E. Aggregate for masonry mortar shall conform to ASTM C 144.
- F. Concrete Block: All concrete block shall be load bearing block conforming to ASTM C 90. Bearing block shall be Type II units made with normal weight aggregate. Exposed faces of blocks shall be free of chips, cracks, or other imperfections.
- G. Decorative block units: ASTM C90, Type 1 (Moisture Controlled), compressive strength (f'm) of masonry assemblage shall be a minimum of 1,500 psi.
- H. Split Face with integral color
- I. Acoustical Concrete Masonry Units (ACMU) shall include funnel-shaped face shell slots, metal septum, and fibrous filler to produce a minimum NRC rating of 0.80. ACMU shall be Soundblox Type RSC or approved equal.
- J. Cast Stone to match block color
 - 1. Manufacturer
 - 2. Stone Legends, Dallas, TX
 - 3. Approved Equal
- K. Comply with ASTM C1364
- L. Wall Caps: Unit number 1432 – Extrados 4
- M. Pier Caps: Unit number 981 Extrados 4
- N. Face Brick: Face brick shall be used where indicated or otherwise shown on the drawings. All face brick shall be select, sound, whole, new clay or shale, conforming to ASTM C216, Grade SW, Type FBS. Brick shall be modular size with a reddish toned mortar. Brick color shall be red to brown range with a slightly distressed finish similar to Boral Brick “Old Columbia” and shall be selected from a series of 24” x 18” sample panels.
- O. Masonry wall reinforcement shall be #5 A615 grade 60 vertical @ 4’-0” minimum, on center, grouted. Horizontal reinforcement shall be galvanized truss type extra heavy Dur-O-Wall or equal (3/16 dia. Side rods and No. 9 cross rods) at 16” minimum, on center, morted.
- P. Mortar: Aggregate and other materials for masonry mortar shall conform to applicable specifications listed above. Mortar color for decorative block, stone and face brick shall be selected by the Owner from the manufacturers’ full pallet of available colors. Mortar mixtures shall be portland cement mortar and shall contain the following proportions by volume, measured loose:

Type	Portland Cement	Masonry Cement	Hydrated Lime or Lime Putty	Aggregate Measured in Damp Loose Condition
M	1	None	1/4	Not less than 2-1/4 and not more than 3 times the sum of the volumes of cement and lime used
	1	1	None	
S	1	None	1/4 - 1/2	
	1/2	1	None	

- Q. Board Type Insulation: shall be 1" or 2" as shown on the drawings, cellular polystyrene conforming to ASTM C578.
- R. Wall Flashing: shall be 3 ounce copper armored Sisalkraft.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other Sections of Work are properly sized and located.
- C. Verify built-in items are in proper location and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied to other sections.
- B. Furnish temporary bracing during installation of masonry work.
- C. Maintain bracing in place until building structure provides permanent support.

3.3 INSTALLATION

- A. Joints in the exposed face of all masonry walls shall be finished with a concave jointing tool to compact the setting mortar and form a continuous contact with the masonry unit. All holes and cavities shall be filled with mortar before tooling.
- B. Pointing and Cleaning: When the work is completed, all holes or defective mortar joints in exposed masonry shall be pointed, or where necessary, cut out and repointed. All exposed masonry shall be thoroughly cleaned within 24 hours of placement, and all cavities shall be kept free of droppings. Exposed masonry shall be protected against staining from wall covering or other sources and excess mortar shall be wiped off the surface as the work progresses.

- C. Acoustical Concrete Masonry Units (ACMU) shall be installed in accordance with the block manufacturer's instructions. Slots shall be exposed to the area where sound absorption is required. Slots shall be kept free of mortar or debris above the mortar joint. Lines shall be straight and true.
- D. Weep Holes: shall be located at 24" o.c. horizontally in the exterior wythe of cavity walls directly above all foundations, flashing, or other water stops in the wall. The holes may be formed by placing 3/8" round fiberglass or similar cord in the mortar then withdrawing the cord after the wall is completed. Weep holes shall be kept free of obstructions.

3.4 WORKMANSHIP

- A. Brick and block shall be laid in running bond. Only experienced masons shall be employed. Masonry shall be laid plumb and true with full bed joints, buttered with sufficient mortar to fill end joints, and all units shoved in place. Where cutting of exposed masonry is necessary, the cuts shall be made with a motor driven masonry saw. No masonry shall be laid when the temperature is below 45°F unless it is rising and at no time when it is below 40°F. The top of exposed walls shall be protected by waterproof material when work is not in progress. The walls shall be solid and without voids in the joints. Bond beams shall be filled with 4000 psi concrete conforming to the requirements of the Concrete section. Keep cavity free of mortar.
- B. Joints: Both interior and exterior joints shall be tooled; vertical joints shall be tooled before horizontal joints. Tooling and toweling shall compact the setting mortar and form a continuous contact with the block. All holes and cavities shall be filled with mortar before tooling. Exposed interior masonry joints shall be neatly finished for painting.
- C. Pointing and Cleaning: When the work is completed, all holes or defective mortar joints in exposed masonry shall be pointed, or where necessary, cut out and repointed. All exposed masonry shall be thoroughly cleaned. If stiff brushes and water do not suffice, the surface shall be thoroughly cleaned by procedures utilizing a mild acid application followed by full rinsing. If so cleaned, all sash, frames, or metal lintels shall be completely protected.
- D. Types of Mortar: Exterior walls and interior bearing walls shall be laid in types M or S mortar.
- E. Sample Panels: Provide sample brick and block wall panel approximately 4' long by 3' high showing workmanship, bond, thickness, tooling of joints, color range of brick and mortar. Approval of the Engineer shall be required prior to construction of any walls. Lay sample panel as a unit to show composite construction including any wall reinforcing, flashing, and insulation. Finish work shall match sample. Panel to remain in place through completion of the work.
- F. Masonry wall reinforcement installed in horizontal courses at 16 inches o.c. in all cavity walls unless otherwise noted. The cross rods in cavity walls shall have no moisture drips.

Vertical reinforcement is required at each side of all openings and at the ends of all walls. Horizontal reinforcement is required at the tops of all walls, and across all openings.

- G. Masonry wall anchors shall be provided at the intersection of abutting walls. Where intersecting partitions are not bonded by masonry headers, 1-1/2" x 14 gauge stainless steel anchors shall be provided at no more than 16" vertical spacing. Brick fascia shall be anchored in accordance with ACI 530 with anchors approved by the Engineer. Anchorage for steel trusses, metal roof decking, and composite floor decking shall be provided in accordance with manufacturer's recommendations, unless otherwise shown on the drawings.
- H. Board Type Insulation: installed on the inner wythe side of the cavity. It shall be cut to fit neatly around adjoining surfaces, applied in moderate contact with adjoining units, and supported by the masonry reinforcement.
- I. Wall Flashing: shall be installed over heads and under sills of all openings in exterior masonry walls, including windows, doors, and louvers, and shall be installed at each line of floor construction. Flashing at floors or roofs shall be made continuous. Joints in continuous flashing shall be lapped at least 4 inches and tightly sealed with mastic. Wall flashing shall carry upward across the cavity at an angle and through the next higher joint of the inner block wall where it shall bend back on itself 1/2 inch. Flashing over or under openings that are discontinuous shall have the ends turned up to form a pan.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural metalwork, beams, ladders, angle frames, bearing plates, anchors, anchor bolts and all other miscellaneous metal items to fully complete the structures in strict accordance with this section of the specifications and the applicable plans and subject to the terms and conditions of the Contract.

1.2 RELATED SECTIONS

- A. Section 03600 – Grout
- B. Section 09900 - Painting and Finishing
- C. Individual Equipment Sections - Component Parts of Equipment

1.3 REFERENCES

- A. AISC - Steel Construction Manual
- B. AISC - Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings
- C. ANSI A202.1 - Metal Bar Grating Manual for Steel and Aluminum Gratings and Stair Threads
- D. ASTM A36 - Carbon Structural Steel
- E. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- F. ASTM A193 - Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- G. ASTM A241 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- H. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- I. ASTM A325 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- J. ASTM A386 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- K. ASTM B221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

- L. ASTM B241 - Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
- M. ASTM B308 - Aluminum-Alloy 6061-T6 Standard Structural Profiles
- N. AWS A2.4 - Standard Symbols for Welding, Brazing and Nondestructive Examination
- O. AWS A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
- P. AWS A5.4 - Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding
- Q. AWS D1.1 - Structural Welding Code-Steel
- R. GSA: FF-S-325 - Shield, Expansion; Nail Expansion, And Nail, Drive Screw Devices, Anchoring, Masonry

1.4 TOLERANCES

- A. Structural steel:
 - 1. All members level, plumb and aligned within 1:500
 - 2. Top elevation of roof and floor members within 1/16 inch of that indicated on Drawings
 - 3. Girt faces and other supporting members in vertical planes within 1/8 inch

1.5 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Shop Drawings: Fabrication of structural steel, metalwork, brackets hatches, ladders, frames, and handrails shall not commence prior to approval of shop drawings by the Engineer. Five sets of shop drawings which have been checked by the Contractor for dimensions and conformance to the plans and specifications shall be submitted for approval. Shop drawings shall include complete details and schedules for fabrication for shop assembly of members, and details, schedules, procedures and diagrams showing the sequence of erection.
- C. Product Data: Provide manufacturers information describing fabricated metal specialty items. Include sizes, dimensions and assembled weights.

1.6 REGULATORY REQUIREMENTS

- A. Comply with all applicable provisions of adopted building code and OSHA for handrails, guardrails and ladders.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials and equipment under provisions of Section 01600, Materials and Equipment of these specifications.
- B. Store on blocking so that no metal touches the ground and water cannot collect thereon.
- C. Protect materials from bending under its own weight or super-imposed load.
- D. Welding electrodes shall be delivered in unbroken packages and stored when opened in a closed, dry heated box.
- E. Do not store materials on the structures in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 PRODUCTS

2.1 MATERIALS, EXCEPT STAINLESS STEEL

- A. Structural Steel: Except as otherwise indicated, structural steel shall be ASTM A36, $F_y = 36$ ksi.
- B. Aluminum pipe: shall be ASTM B241, $F_y = 35$ ksi.
- C. Aluminum shapes: shall be ASTM B308, alloy 6061-T6, $F_y = 35$ ksi.
- D. Exterior Pipe Railing: Conform to the requirements of Section 05520, Handrails and Railings of these specifications.
- E. Aluminum Ladders: Ladders shall have 2-1/2" x 1/2" stringers with 15/16" square non-slip rungs spaced at 1'-0" on center maximum. Ladders shall be aluminum, alloy 6061-T6, $F_y = 35$ ksi. All necessary anchor bolts will be stainless steel and furnished with ladder. All material will have a standard mill finish. The portion of the ladder in contact with concrete shall have a heavy shop coat of bituminous paint.
- F. Unfinished Threaded Fasteners: Fasteners greater than 1/2 inch in diameter shall be A325, all others shall be ASTM A307, Grade A, regular low-carbon steel bolts and nuts with hexagonal heads and nuts.
- G. Electrodes for Welding: For carbon steel conform to AWS Code D1.1, A5.1, A505, or A588, as appropriate utilizing Series E70XX electrodes.
- H. Welding of stainless steel and non-ferrous materials shall use electrodes appropriate for the application.
- I. Cast Nosing and Thresholds shall be cast aluminum abrasive type cross hatched style as manufactured by American Safety Tread Co. or shall be the comparable products of

Wooster, White Foundry, Construction Castings or approved equal. Except as otherwise detailed, thresholds shall be Type 815 or 815S, 6 inches wide; nosings for concrete steps shall be Type 801, 3/8 inch thickness by 4 inches wide and 6 inches less in length than the full width of the stair.

- J. Expansion Anchors shall have stainless steel shanks and nuts, unless otherwise specified. Anchors shall be either expansion type or chemical adhesive drop-in type as manufactured by Hilti or approved equal. Expansion anchors shall be installed in conformity with the manufacturer's recommendations for maximum holding power, but in no case shall the depth of hole be less than four hole diameters. Minimum distance between the center of any expansion anchor and an edge or exterior corner of concrete shall be not less than 4-1/2 times the diameter of the hole in which it is installed.

2.2 STAINLESS STEEL MATERIALS

- A. All metal framing materials within the clearwell and cascade shall be stainless steel.
- B. Unfinished Threaded Fasteners shall be ASTM A193, stainless steel bolts and nuts shall be Grade 8, Type 304 stainless steel. Provide hexagonal heads and nuts for all connections.

2.3 FABRICATION

- A. Structural Steel shall be fabricated in accordance with appropriate AISC Specifications and as indicated on the final shop drawings. Fabricate with natural camber of the member up. Properly mark and matchmark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations. Welders shall be certified for all positions and thicknesses appropriate to their work on this project.
- B. Non-Ferrous and Other Miscellaneous Metal shall be fabricated in accordance with appropriate aluminum association specifications and to a quality comparable to the Commercial Quality of the National Association of Architectural Metal Manufacturers. Metal surfaces exposed to view shall be free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names and roughness.
- C. Connections: Weld or bolt shop connections. Bolt field connections, except where welded connections or other connections are shown or specified. All butt welds shall be full penetration butt welds. Fillet welds not otherwise noted shall be 3/16". Welders shall be certified for all positions and thicknesses appropriate to their work on this project. Bolted connections not otherwise noted shall be two 3/4"Ø ASTM A307 HEX HD Bolt.
- D. Holes for Other Work: Provide holes required for securing other work to structural steel and miscellaneous metal, and for the passage of other work through the members. Provide threaded nuts welded to framing as needed to receive other work.

- E. Painting: Stainless steel, galvanized steel, and aluminum will not be painted. All steelwork shall be shop primed with one coat of gray chromate primer Tnemec poxiprime 65 over a surface which has received commercial blast (SSPC-SP6) or better surface preparation. The prime coat shall be compatible with the coating system specified in the Section 09900, Painting and Finishing. Where paint has been withheld from areas to be welded and other bare spots, scrapes, etc., the areas shall be touched up with the original primer. Minimum prime coat dry thickness shall be 2 mils.
- F. Aluminum in contact with concrete shall receive a heavy coating of epoxy or other coating suitable for exposure to drinking water.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that surfaces and areas to receive structural and miscellaneous metal are prepared to required grades and dimensions, level, and otherwise in conformance with the Drawings.

3.2 ERECTION

- A. Structural steel and miscellaneous steelwork shall be erected in conformance with current edition of AISC Specifications.

3.3 PROTECTION

- A. Protect all metal erections from all damage prior to subsequent work of other trades.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum component handrail including all fittings, anchors, bases and accessories.
- B. Mounting hardware and trim.

1.2 RELATED SECTIONS

- A. Section 05120 - Structural Steel and Miscellaneous Metals

1.3 REFERENCES

- A. AA DAF-45 - Aluminum Association Designation System for Aluminum Finishes
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
- D. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

1.4 SYSTEM DESCRIPTION

- A. The component aluminum handrail system shall be designed and constructed in strict compliance with the requirements of OSHA and the Standard Building Code. It shall be engineered, fabricated, and installed to withstand the structural loadings as required by applicable codes or as defined below, whichever is greater.
 - 1. Guardrails shall be designed to withstand a uniform horizontal load of 50 pounds per foot with a simultaneous vertical load of 100 pounds per foot applied to the top rail.
 - 2. Handrail and stair rails shall be designed to withstand a uniform horizontal load of 50 pounds per foot applied to the top rail.
 - 3. All guardrails, handrails and stair rails shall be designed to withstand a concentrated load of 200 pounds applied in any direction, at any point on the railing system.
- B. The handrail system design and installation should allow for thermal movement resulting from the maximum changes in ambient temperature, preventing opening of joints, buckling, overstressing of connections, and other detrimental effects. Expansion joints shall be placed at 60-foot intervals and at all concrete expansion joints.

1.5 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Submit product data including manufacturer's specifications and installation instructions for all components of each product type specified.
- C. Shop Drawings shall be prepared specifically for this project which includes the following:
 - 1. Show complete layout; plan views, elevations, connections, details for fabrication and attachment to other elements, and other installation details.
 - 2. Include structural calculations and anchorage if requested by the Project Engineer. The submittal should be signed and sealed by the registered engineer responsible for the structural design of the system, certifying compliance with structural performance requirements.

1.6 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** The manufacturer and craftsmen having resources to provide consistent quality in appearance and physical properties, without delay of work.
- B. **Installer Qualifications:** Approved by the manufacturer.
- C. Handrail shall be the product of a company regularly engaged in the manufacture of pipe railing for a minimum of 5 years. Railing shall be shop assembled in lengths not to exceed 24 feet for field erection.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handrails shall be properly packaged to prevent scratching and denting during shipment, storage and erection. Inspect materials to ensure that specified products have been received. Maintain protective wrapping until project is completed.
- B. Store components to avoid damage from moisture, abrasion, and other construction activities.

1.8 SEQUENCING

- A. Review and coordinate setting drawings, shop drawings, templates, and instructions for installation of related items to be embedded in concrete and masonry.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Tri Tech, Inc., Austell, GA
- B. Design Components, Inc., Fayetteville, GA

- C. Nystrom Building Products, Minneapolis, MN
- D. Approved equal.

2.2 MATERIALS

- A. Posts and rails shall be a minimum of 1 1/2" schedule 40 aluminum pipe, alloy 6063-T6 or 6105-T5, ASTM B429 or B221. Post spacing shall be a maximum of 6'-0".
- B. Bars, Rods, and Tubes: ASTM B221. Plate and Sheet: ASTM B209.
- C. Handrail shall be made of pipe and fittings mechanically fastened together with Series 300 stainless steel hardware. Handrail systems, which use fittings that are cast, glued, pop-riveted or sheet metal screws will not be acceptable.
- D. Toe-boards shall conform to OSHA standards. Toe-boards shall be a minimum of 4" high and attach to the post using clamps which allow for expansion and contraction between posts. Toe-boards shall be set 1/4" above the walking surface.
- E. Wedge anchors shall be AISI Type 303 stainless steel. Wedge anchors to be spaced 10d apart and have 5d edge distance for no reduction in pullout strength. A safety factor of 4 shall be used on pullout values published by the manufacturer.
- F. Drainage: Provide weep holes or other means to allow trapped water to drain from hollow sections exposed on exterior or to condensation or moisture from other sources.
- G. All aluminum surfaces in contact with concrete, grout or dissimilar metals will be protected with a coat of bituminous paint, teflon isolators or other approved material.

2.3 ACCESSORIES

- A. Provide appropriate returns, corners, and mounting brackets as required to properly finish handrail system and to support it in conformance with Uniform Federal Accessibility Standards.

2.4 FABRICATION

- A. Factory or shop-fabricate to comply with specifications, manufacturer's printed requirements, and shop drawings. Field fabrication of the railing system is not permitted.
 - 1. Maintain post spacing and anchorage as required to comply with specified structural requirements.
 - 2. Use connections that maintain structural capacity of joined members.
- B. Pre-assemble railing system, including posts, in easy to lift sections whenever possible; clearly mark units for site assembly and installation.

2.5 FINISHES

- A. All handrail and components shall be clear anodized per Aluminum Association M12C22A41 (215-R1). The pipe shall be plastic wrapped to protect the finish.

PART 3 EXECUTION

3.1 INSTALLERS

- A. Field fabrication of the railing system is not permitted.
- B. Set handrails plumb within 1/8" of vertical and align horizontally to within 1/8" in 12 feet.
- C. Install wedge anchors to proper depth to develop full pullout and shear values. Check all fasteners and bolts in base connections and splices for tightness.
- D. Adequate provisions for expansion and contraction shall be incorporated into the rail.
- E. Toe-boards shall be shipped loose and attached to the handrail in the field. Attachment to the posts will be made with clamps.

3.2 EXAMINATION

- A. Examine substrate and conditions where railing systems are to be installed.
- B. Notify in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Prepare surrounding construction to receive railing system installations in accordance with manufacturer's requirements.

3.4 INSTALLATION

- A. Install in strict accordance with manufacturer's printed installation instructions and shop drawings.
- B. Install posts in concrete with pipe sleeves preset and anchored into concrete whenever possible, or by core drilling.
 1. Separate aluminum, which might contact concrete, masonry, or other metals, by means of asphaltic paint or other approved method to prevent electrolytic action.
 2. After posts are inserted, solidly fill the remaining space between post and side of sleeve or hole, with non-shrink nonmetallic grout to approximately 1/2 inch below exposed surface.
 3. Install appropriate waterproof sealant as recommended by the manufacturer; slightly taper away from posts.

- C. Adjust, level, and securely install railing system components.
 - 1. Avoid springing assembled components of system into place.
 - 2. Align rails so that variations from level for horizontal members, and from parallel with rake of steps and ramps for sloping members, do not exceed 1/4 inch in 12 feet.
- D. Provide for thermal expansion and contraction by use of expansion joints/gaps in top rails, at intervals required by manufacturer; strictly adhere to manufacturer's instructions for locations of expansion joints and fastening of expansion sleeves.
- E. If installed configuration will not allow water drainage from hollow sections, drill weep holes at bottom locations or use other approved methods to provide drainage.

3.5 REINSTALLATION

- A. All defective, damaged or otherwise improperly installed handrail shall be removed and replaced with an appropriate material, which complies with this section at no additional cost to the Owner.

3.6 ADJUSTING

- A. Verify that handrail is level and rigidly secured to substrate; make any adjustments required.

3.7 CLEANING

- A. Following installation, aluminum handrail shall be cleaned with a mild soap and clean water. Acid solutions, steel wool or harsh abrasives shall not be used.

3.8 PROTECTION SCHEDULES

- A. Provide adequate protection for all surfaces of completed installations to prevent damage during remainder of construction activities.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this section of the specifications consists of furnishing all labor, materials, equipment and services necessary for or reasonably incidental to complete all carpentry and cabinetry work in strict accordance with this section of the specifications and the applicable plans and subject to the terms and conditions of the Contract.

1.2 RELATED SECTIONS

- A. Section 03000 - Concrete
- B. Section 09900 – Painting and Finishing

1.3 REFERENCES

- A. AF&PA - Design Specification for Stress Grade Lumber and its Fastening
 Wood Structural Design Data
- B. AITC-108 - Standard for Heavy Timber Construction
- C. APA/EWA - Plywood Specifications and Grade Guide
- D. AWI - Architectural Woodwork Quality Standards, Guide Specifications and Quality
 Certification Program
- E. AWC - Wood Frame Construction Manual
- F. FS L-P-508F - Plastic Sheet, Laminated, Decorative, and Non-Decorative.
- G. FS MMM-A-130A - Adhesive, Contact
- H. ICC - International Building Code
- I. NIST PS-1 - Construction and Industrial Plywood
- J. NIST PS-20 - American Softwood Lumber Standard
- K. NIST PS-58 - Basic Hardwood
- L. SFPA - Southern Pine Use Guide
- M. WWPA - Western Lumber Products Use Manual

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples
- B. Shop Drawings:
 - 1. Framing connection details, fastener connections and dimensions except when details are included on Drawings.
 - 2. Shop Drawings shall be submitted prior to fabrication. All counter tops and curbs shall be factory prepared for sinks, fitting all accessories and openings. Refer to Plumbing Specification for fixture installation and other requirements.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Immediately upon delivery to job site, place materials in area protected from weather.
- B. Store materials a minimum of 6 inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation of ventilation.
- C. Do not store seasoned materials in wet or damp portions of building.
- D. Protect sheet materials from corners breaking and damaging surfaces while unloading.

1.6 QUALITY ASSURANCE

- A. Lumber to have visible grade stamp, of an agency certified by the NFPA, The Southern Pine Association, The West Coast Lumbermen's Association, American Plywood Association, or other recognized lumber producing associations.
- B. Each panel of plywood shall bear the grade-trade mark of the American Plywood Association and shall meet requirements of Product Standard PS-I. Hardwood shall conform to requirements of Commercial Standard CS-35.
- C. Perform finish carpentry work in accordance with recommendations of the Millwork Standards of the Architectural Woodwork Institute. No sub-grade, defective, or damaged pieces shall be installed.
- D. All work shall conform to the applicable sections of the standards referenced herein.

1.7 PRODUCT DELIVERY STORAGE AND HANDLING

- A. Protect sheet material from having corners broken and surfaces damaged while handling. Immediately upon delivery to job site, place materials in area protected from the weather at least 6 inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation or ventilation. Protect seasoned materials against high humidity and moisture during storage and erection.

PART 2 PRODUCTS

2.1 LUMBER

- A. Lumber for rough carpentry shall be kiln dried and well seasoned with moisture content not to exceed 15% and shall be graded by the producing association.
- B. Treated lumber shall be pressure treated with wood preservative for all lumber in contact with masonry or concrete and other locations indicated on the drawings.

2.2 FRAMING

- A. Masonry top plates shall be No.2 KD Southern Yellow Pine.
- B. Miscellaneous framing shall be metal studs as listed in the Building Accessories section of these specifications. Where metal studs are not appropriate, spruce, cedar, or Southern Yellow Pine, grade No. 2 may be used.

2.3 CONSTRUCTION PANELS

- A. Standards: Comply with PS 1 U.S. Product Standard for Construction and Industrial Plywood for plywood panels and, for products not manufactured under PS 1 provisions, with APA Performance Standard and Policies for Structural-Use Panels, Form No. E445.
- B. Trademark: Factory-mark each construction panel with APA trademark evidencing compliance with grade requirements.
- C. Concealed APA Performance-rated Panels: Provide APA Performance Rated Panels complying with requirements indicated for grade designation, span rating, exposure durability classification, edge detail (where applicable), and thickness.
- D. Roof Sheathing: APA-rated sheathing:
 - 1. Exposure Durability Classification: Exterior.
 - 2. Exposure Durability Classification: Exposure 1.
 - 3. Span Rating: As required to suit rafter spacing indicated. Thickness not less than 19/32 inch.
- E. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire retardant treated-plywood panels with grade designation, APA C-D PLUGGED INT, with exterior glue, in thickness indicated or, if not otherwise indicated, not less than 15/32 inch.

2.4 LUMBER FOR FINISH CARPENTRY

- A. Moisture content of finish softwood lumber shall not exceed 6% for interior work and 10% for exterior.
- B. Moisture content of finish hardwood lumber shall not exceed 6%.

- C. Lumber for all exposed trim, moldings, frames, and shelves, unless otherwise shown on the drawings or specified herein shall be:
1. Paint grade Alder or Ponderosa Pine for all painted finishes.
 2. Stain grade Basswood for stained cabinetwork.
- D. Wood moldings shall be equal to products of Randall Brothers, Brown Molding Co., or Western Pine. Interior moldings shall be douglas fir, ponderosa pine, or white pine. Finger joints are NOT be permitted.
- E. Finish lumber shall conform to the American Woodwork Institute Standards, Section 100, Grade I and Section 300, Premium Grade. The following defects will NOT be permitted in finished lumber:
1. Tight knots exceeding 1/8" diameter in hardwoods and 3/8" diameter in softwoods, loose or open knots, splits or splinters, and mill marks.
- F. Break Area Cabinets: Break Area Cabinets shall be the Melamine Series product of Monarch Cabinetry, Inc., Atlanta, or approved equal with high-density particleboard, thermal-fused 2 mil laminate coating and 3 mil PVC edge banding. Base cabinets shall be 22" deep x 34-3/4" high. Wall cabinets shall be 12" deep x 30" high with swinging. Drawers shall be Blum Metabox drawers and doors shall be equipped with self closing hinges. All front hardware shall be brushed or satin finish chrome plated steel wire type pull. Color of laminate facing will be selected by Engineer from a full range of patterns and colors.
- G. Break Area Counter Tops and Sinks: Break Area counter tops shall be post formed, plastic laminate covered with beveled edges, backsplash, and end splashes where appropriate. Plastic Laminate shall be 1/16" Wilson Art or approved equal. Color shall be selected from a full range of patterns and colors. Counter top edging and backsplash shall match top. Break area sinks and associated fixtures and plumbing shall be as specified in the plumbing portion of these specifications.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that surfaces to receive rough carpentry materials are prepared to required grades and dimensions.
- B. Securely attached finish carpentry work to substrates by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill and sand holes. Use finishing nails on all exposed fastenings. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required. Blind nailing shall be provided where practicable. Exposed surfaces of all work shall be sanded to an even, smooth surface ready to receive finish.

- C. Each item specified in this section shall be installed plumb, rigid, square and level with all moving parts working.
- D. Insure all mechanical and electrical items affecting the Section of work are properly placed and complete prior to commencement of installation.
- E. Prime paint, contact surfaces of items and assemblies in contact with cementitious materials.

3.2 FRAMING AND BLOCKING

- A. Refer to drawings for framing sizes, spacing and details.
- B. Framing for locations not detailed shall be provided with supporting members in general 2" thick, depth shown and spaced not over 16" o.c. No.2 KD Southern Yellow Pine or Douglas Fir, unless noted otherwise.
- C. Framing shall be cut and fitted, true to line and level, avoiding shims and wedges.
- D. Nailing and fastening shall be done using special nails and fasteners.
- E. Bolt nailers and blocking to steel members with 3/8" rnd. bolts, spaced 3'-0" o.c., except as otherwise noted on the drawings or required by the Standard Building Code or provisions of other referenced standards.
- F. Provide blocking, bucks, and framing for other trades.
- G. Provide solid blocking behind all bathroom accessories, grab bars, handrails, and at the upper corners of all windows for the attachment of curtain rods.
- H. Plates bolted or anchored to concrete as detailed.
- I. Where finish trim is applied directly to framing members or blocking, such framing members or blocking will be straight clear, and well seasoned. Warp or other poor characteristics not allowed. Wall and partition plates, studs, and sill shall be installed straight and true.
- J. All wood construction shall be performed in accordance with Chapter 17, of the Standard Building Code.

3.3 ROUGH CARPENTRY

- A. Provide all nails, screws, bolts, and anchors.
- B. Expansion Bolts:
 - 1. Provide 3/4" X 4" expansion bolts or sizes as detailed on drawings.
 - 2. Place not over 4'-0" o.c. within 4" of each end of the plates and at splices and corners.

- C. Anchor Bolts:
 - 1. Provide sizes as noted on the drawings or herein specified.
 - 2. Space bolts as detailed or not greater than 4'-0" o.c. and within 4" of each end of sole plates at splices and corners.
 - D. Nailing Schedule: See Standard Building Code.
 - E. All hardware for exterior use to be galvanized.
- 3.4 INSTALLATION OF CONSTRUCTION PANELS
- A. Comply with applicable recommendations contained in Form No. E 30K, APA Design/Construction Guide - Residential and Commercial, for types of plywood products and applications indicated.
 - B. Comply with "Code Plus" provisions in above-referenced guide.
 - C. Fastening Methods: Fasten panels as indicated below:
 - 1. Sheathing:
 - a. Nail to framing.
 - b. Screw to cold metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.
 - 2. Plywood Backing Panels: Nail or screw to supports.
- 3.5 FINISH CARPENTRY
- A. Inspection: Inspect finish materials, trim, door, to insure that no sub grade, defective or machine marked pieces are installed.
 - B. Painting and Backpainting: Arrange to have all doors; exterior plywood material, exterior trim, interior finish, cabinet work, movable storage units, and other wood equipment primed and backpainted after delivering to building, and before installation.
 - C. Fit plywood shelving and site made casework with 1/4" thick edging. Width: governed by thickness of plywood.
 - D. Install hardware, fixtures, and accessories supplied under other Sections for installation. Install in strict accordance with manufacturer's recommendations.
- 3.6 FINISH HARDWARE
- A. Installation:
 - 1. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item of hardware is delivered to the job not marked, return it to the supplier for marking before attempting to install it.
 - 2. Install and make adjustments for correct working order.
 - 3. Any hardware damaged by improper adjustment or abuse will be replaced by the contractor at his expense.

4. Fit all surface applied hardware.
 5. Provide clean, sized, and placed mortises and drilled holes for all mortise hardware such as locksets, flush bolts and pivots.
 6. After hardware installations, protect exposed surfaces from wear and abuse by the use of heavy paper and masking tape and maintain until job completion.
 7. Center kick plates at bottom of doors and provide same margin at bottom as at sides.
- B. Removal for Painting: Remove all hardware, except that which is primed for painting, before painter's finish is applied and replace and readjust for function after painter's finish has been completed and has dried hard.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES BOARD INSULATION FOR SHEET METAL ROOF SYSTEM

- A. Fiberglass batt insulation.
- B. Board insulation for masonry cavity walls.

1.2 RELATED SECTIONS

- A. Section 02200 - Excavation, Filling and Backfilling
- B. Section 04200 - Unit Masonry

1.3 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Submit Product Data for each item specified with manufacturer's certification that insulation products comply with specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600, Materials and Equipment of these specifications.
- B. Do not deliver plastic insulation materials to the project site prior to time of installation. Protect the materials of this section before, during, and after installation. Protect at all times against ignition. Complete the installation and concealment of plastic materials as rapidly as possible.
- C. Store materials in a safe, dry place with all labels intact and legible at time of installation. In the event of damage, repair, remove and replace materials to the approval and at no cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Rigid Insulation. Cavity Wall Insulation: Polystyrene foam, ASTM C578, Type X, 1 inch thick, 16 inches wide by 96 inches long, total R value =5.0, Styrofoam Cavitymate by Dow Chemical Company, or accepted substitution.
- B. Thermal Batt Insulation: Glass fiber batts with membrane fused face conforming to ASTM C-665, Type II; 3-1/2 inch thickness = R-11, 6 inch thickness = R-19 or 9 inch thickness = R-30. Thickness as shown on the Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. General

1. Install building insulation in strict accordance with the manufacturer's printed instructions. Install insulation into all framing spaces, behind electrical outlets and piping, framing members and any other area in such a way as to form a complete insulating blanket around the heated/cooled areas of the structure and to provide a complete sound attenuation blanket.
2. Install perimeter insulation at interior of all exterior foundation walls starting at a point 4 inch below grade and extending to top of footing.

B. Rigid Installation

1. Cavity wall insulation: Clean surface of walls of foreign material which would keep insulation from fitting snug to the wall. Apply board to exterior face to load bearing masonry wall. Lay boards against the wall and mechanically fasten or spot bond to hold material between wall ties. Tightly fit end joints.

- C. Batt Insulation:** Install snugly between framing members. Staple kraft faced batts to framing members. Do not install kraft faced insulation in an unprotected condition. Protect kraft faced insulation with gypsum board.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roof and deck insulation as shown on the Drawings and as specified herein.

1.2 RELATED SECTIONS

- A. Section 07530 - Single Ply Membrane Roofing

1.3 QUALITY ASSURANCE

- A. Provide roof insulation approved for FM Class I (I-60), and UL Class A classification roof assembly applications.
- B. Provide polyisocyanurate insulation conforming with Federal Specification HH-I-1972/GEN and HH-I-1972/1,2.
- C. Factory Mutual Loss Prevention Data Bulletin 1-29S, dated June 1986: Sure-Seal Mechanically-Fastened Roofing Systems Factory Mutual Membrane and Insulation Securement Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600, Materials and Equipment of these specifications.
- B. Deliver materials in manufacturer's original, unopened protective packaging. Store, where directed, off the ground.
- C. Keep insulation materials dry at all times.
- D. If stored outside, raise insulation above ground or roof level on pallets and cover with a tarpaulin or other waterproof material. Plastic wrapping installed at the factory should not be used as outside storage covers.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Verify that surfaces are in suitable condition. Correct unsuitable surfaces.
- B. Do not lay more insulation than can be completely covered with roofing materials the same day.
- C. Do not lay insulation on roof surface that has ponded water, snow or ice.
- D. Do not expose insulation to excessive heat, sparks or open flame.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Submit Product Data for each item specified with manufacturer's certification that products comply with specified requirements.
- C. Submit shop drawings for insulation layout. Clearly indicate insulation types, slopes and thicknesses.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. GAF Materials Corporation, 1361 Alps Road, Wayne New Jersey 07470
- B. Firestone Building Products, 250 West 96th Street, Indianapolis, IN 46260

2.2 MATERIALS

- A. Non-tapered insulation: Rigid closed cell, polyisocyanurate foam insulation with nonasphaltic fiberglass facing chemically bonded in the manufacturing process.
- B. Cant strip: 3 inches by 3 inches, perlite or wood fiber as manufactured by International Permalite, Inc. or equivalent.
- C. Roof insulation must be compatible with the membrane roofing and must be an approved product of the roofing manufacturer.
- D. R-VALUE
 - 1. Non tapered insulation:
 - a. Minimum conditioned thermal value: 1 inch thickness = R-Value of 6.0 as determined in accordance with RIC/TIMA Technical Bulletin 281-1
 - b. Polyisocyanurate insulation minimum thickness: 1.5 inches

2.3 ACCESSORIES

- A. Fasteners: Corrosion resistant fasteners with minimum 3 inch round stress plate, lengths as required and approved for specific use by roofing manufacturer, NRCA General Guide to Fasteners and Factory Mutual.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Verify that substrate is firm, dry and clean.

- B. Apply insulation as noted below, or in strict accordance with insulation manufacturer's specifications to meet requirement of FM Class 1, I-90 installation for mechanically-fastened roofing systems in accordance with Factory Mutual Loss Prevention Data Bulletin 1-29S:
1. In the field of the roof, insulation boards less than or equal to 4 feet by 4 feet require a minimum of 2 FM approved fasteners and plates; insulation boards between the sizes of 4 feet by 4 feet and 4 feet by 8 feet require a minimum of 4 fasteners and plates.
 2. Fastening density requirements listed above must be increased by 50 percent (1.5 times as many fasteners) at roof corners and perimeter.
- C. Cut and fit insulation board around all roof penetrations and projections. Feather insulation board around roof drains.
- D. In no event shall more insulation be placed on the surface to be roofed than can be covered with roofing membrane prior to the onset of inclement weather or termination of each day's work.
- E. At no time shall surfaces or edges of insulation be left exposed. Remove and replace installed insulation which becomes wet.
- F. Protect insulation from water at all temporary terminations during installation by a suitable cut-off and/or water dam. Protect applied insulation and completed roofing against damage by roof traffic at all times.
- G. Apply units of insulation with long joints continuous. Stagger end joints. All joints shall be tightly butted.
- H. In applications of more than one layer, apply succeeding layers using same procedure as for first layer. Stagger all joints between layers. Tightly butt all joints.
- I. Remove and reinstall roof system at any area ponding or causing ponding.

END OF SECTION

PART 1 GENERAL

1.1 DESCRIPTION

- A. Thermoplastic Polyolefin (TPO) fully-adhered single ply roof system and related finishings and accessories as shown on the Drawings, specified herein and as required for a complete roof installation.

1.2 RELATED SECTIONS

- A. Section 07220 - Roof and Deck Insulation
- B. Section 07600 - Flashing and Sheet Metal
- C. Section 07900 - Joint Sealants

1.3 PERFORMANCE AND DESIGN REQUIREMENTS

- A. External fire resistance: UL Class A
- B. Wind uplift: FM I-60

1.4 QUALITY ASSURANCE

- A. Roof manufacturer licensed applicator:
 - 1. Applicator's experience: Continuously applied roofing materials in State of South Carolina for minimum of five years.
 - 2. Written statement: Provide written statement from manufacturer authorizing and approving the roofing system applicator.
- B. Conduct coordination conference with manufacturer's representative, applicator, General Contractor, sheet metal installer, and Construction Manager.
- C. Keep records indicating temperature and moisture conditions and type and location of work being done during each day of roofing operations.

1.5 WARRANTY

- A. Provide 15 year written warranty covering materials and installation for total roofing system including insulation. Include watertight condition.

1.6 PROJECT CONDITIONS

- A. Environmental requirements:
 - 1. Do not expose membrane and accessories to constant temperature in excess of 180°F.
 - 2. Follow manufacturer's recommendations during cold weather.

- B. Adjacent materials: Do not use oil based or plastic roof cement. Do not allow waste products (petroleum, grease, oil, solvents, vegetable or mineral oil, animal fat) or direct steam venting to come in contact with membrane roofing system.

1.7 SUBMITTALS

- A. Submit shop Drawings to roof manufacturer and Engineer for approval. Approved shop Drawings are required for inspection of the roof:
 - 1. Shop Drawings shall be approved and assigned a number by the Roof Manufacturer.
 - 2. Shop Drawings shall include:
 - a. Completely executed Notice of Award
 - b. Outline of roof and size
 - c. Deck type
 - d. Roof slope and designated direction of slope
 - e. Location and type of all penetrations
 - f. Perimeter and penetration details
 - g. Key plan
 - h. Sheet layout and sizes
 - i. Number of uncured flashing rolls by width
 - j. Insulation manufacturer, brand and thickness
 - k. Fastener manufacturer, brand and length
 - l. Warranty type and period
- B. When field conditions necessitate modifications to the originally approved shop Drawings, submit a copy of the shop drawings outlining all modifications to Carlisle for revision and approval.
- C. Submit written statement from manufacturer's representative prior to commencement of roofing installation and after inspection of completed roofing system accepting the substrate for start of roof system installation and accepting the completed installation of the roof system.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handle insulation and rolled goods to prevent damage to edges or ends. Store off ground and keep covered with waterproof covering. Do not leave insulation exposed to weather.
- B. Store materials in dry area and at temperature between 60°F and 80°F.
- C. Replace damaged or wet materials.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Firestone Ultraply TPO

- B. GAF Everguard TPO
- C. Or approved equal

2.2 MATERIALS

- A. Membrane: Thermoplastic polyolefin (TPO), 0.060 inch thick sheet, color:white
- B. Flashing: Firestone TPO 0.060 inch thick sheet, color: white
- C. Accessories: Cements, lap sealants, nailing strips, fasteners, one way roof vents, etc., as recommended by manufacturer

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify layout of work before beginning installation. Verify that work of other trades which penetrates roof deck has been completed.
- B. Examine surfaces for inadequate anchorage, drainage, foreign material, moisture, and unevenness which would prevent execution and quality of application of roofing system as specified.
- C. Coordinate work of this section with work of other sections:
 - 1. Verify placement of wood blockings, inserts, nailing strips, cants, drain pan linings, etc.
 - 2. Coordinate roof penetrations, equipment bases and other conditions, as required
 - 3. Reset roof drains or scuppers that are not at proper level to drain finished roof before installation.
- D. Beginning work under this section signifies acceptance of existing conditions by installer.

3.2 PREPARATION

- A. Dry and broom clean surfaces before beginning work.
- B. Protect paving and building walls adjacent to hoist prior to starting work. Lap suitable protective materials at least six inches. Secure protective coverings against wind. Leave protective covering in place for duration of roofing work.

3.3 APPLICATION

- A. Install roofing system in accordance with manufacturer's recommendations, design requirements, and reference standards. Install in accordance with manufacturer's standard details unless otherwise indicated.

- B. Membrane: Apply, lap and splice using methods and materials per manufacturer's instructions except where indicated otherwise herein:
1. Mechanically fasten to perimeter using approved fasteners and recommended spacing.
 2. Lay membrane smooth and wrinkle-free using a roller type device (no brooms). Remove air bubbles and securely adhere membrane to substrate.
 3. Splices 3-inch minimum lap sealed with lap sealant.
 4. Daily seal loose edge of membrane at completion of each day's work.
- C. Flashing: Apply, lap, and splice using methods, materials, and details per manufacturer's instructions:
1. Flash around penetrations using factory prefabricated pipe seals where possible.
 2. Field fabricated seals may be used where necessary using manufacturer's standard details.
- D. Terminations: Make terminations according to manufacturer's standard details, NRCA Standard Details, and as indicated on the Drawings.
- E. Seal all joints between roof substrate and penetrations, flashings, and other roof system components and accessories per Section 07900, Joint Sealants of these specifications.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flashing and sheet metal as indicated on Drawings and as specified herein
- B. Metal counter flashing and base flashing
- C. Metal wall flashing and expansion joints
- D. Exposed metal trim/fascia units
- E. Miscellaneous sheet metal accessories

1.2 RELATED SECTIONS

- A. Section 07530 - Single Ply Membrane Roofing
- B. Section 07900 - Joint Sealers

1.3 REFERENCES

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- B. ASTM D2822 - Standard Specification for Asphalt Roof Cement, Asbestos Containing
- C. NRCA Roofing and Waterproofing Manual, 1985, Construction Details
- D. SMACNA Architectural Sheet Metal Manual

1.4 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01340, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
 - 1. Manufacturer's technical product data, installation instructions, and general recommendations for each specified sheet material and fabricated product.

1.5 WARRANTY

- A. Sheet metal work shall be warranted for a period of 2 years from date of substantial completion. Sheet metal work associated with roofing shall be warranted for a period of 15 years under the roofing warranty.
- B. Warranty shall include replacement at Contractor's expense of any defects which occur during the warranty period which, in the opinion of Engineer are due to defective materials, workmanship, or for failure to allow for expansion/contraction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Aluminum: ASTM B209, alloy 3003, temper H14, AA-C22A41 clear anodized finish; 0.032" thick (20 gage) except as otherwise indicated for flashing and cleats, and gauges as specifically noted on Drawings.

2.2 ACCESSORIES

- A. Plastic cement: ASTM D2822, Type 1

PART 3 EXECUTION

3.1 INSPECTION

- A. Assure that surfaces over which sheet metal is to be applied is smooth and free of defects.
- B. Correct roughness in substrate or anything in the construction that would make it difficult or impossible to produce a first-class installation of sheet metal work.
- C. Keep work clean at all times. (All flashing as a finish shall not bare any asphaltic material on it. Flashing shall be cleaned thoroughly.)

3.2 DISSIMILAR MATERIALS

- A. Where sheet metal abuts into adjacent dissimilar materials, the juncture shall be executed in a manner that will prevent electrolysis between the two materials.
- B. Cover all treated wood with base ply prior to flashing.

3.3 FLASHING

- A. Single Ply Membrane Roofing for sheet metal flashing detail of flue penetrations.
- B. Form sheet metal on a bending brake.
- C. Shaping, trimming and hand seaming shall be done on the bench as far as practicable, with the proper sheet metal working tools.

3.4 INSTALLATION

- A. Provide for thermal expansion of all exposed sheet metal work exceeding 10'-0 in length and 1'-0 from corners and intersections.
- B. Install flashing and sheet metal in locations and configurations as shown on Drawings. Hem all edges.

- C. Coordinate flashing and sheet metal work with other trades to provide weathertight and neat installation.
- D. Wherever possible fasten metal flashing separately from roofing membranes and flashing to allow independent movement.
- E. Provide two piece flashing at all intersecting planes.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preparing substrate surfaces
- B. Sealant and joint backing for joints

1.2 RELATED SECTIONS

- A. Section 03000 - Concrete
- B. Section 04200 - Unit Masonry
- C. Section 07530 - Single Ply Membrane Roofing
- D. Section 07600 - Flashing and Sheet Metal
- E. Section 08220 – FRP Doors and Frames
- F. Section 08800 - Glazing
- G. Division 15 - Mechanical
- H. Division 16 - Electrical

1.3 REFERENCES

- A. ASTM C790 - Use of Latex Sealing Compounds
- B. ASTM C804 - Use of Solvent-Release Type Sealants
- C. ASTM C834 - Latex Sealing Compounds
- D. ASTM C919 - Use of Sealants in Acoustical Applications
- E. ASTM C920 - Elastomeric Joint Sealants
- F. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber
- G. ASTM D1565 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam)
- H. SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification
- I. ANSI 116.1 - Multi-Component Elastomeric Sealing Compounds for the Building Trade

- J. FS TT-S-227E - Sealing Compound, Rubber Base, Multi-Component for Caulking, Sealing, and Glazing in Building Construction
- K. FS TT-S-230C - Sealing Compound, Rubber Base, One-Component for Caulking, Sealing, and Glazing in Building Construction

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, color availability and intended use.
- C. Samples: Submit two samples, 2-inch by 2-inch in size, illustrating sealant colors for selection.
- D. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, perimeter conditions requiring special attention for field installation.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform acoustical sealant application work in accordance with ASTM C919.
- C. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Applicator: Experience in performing the work of this section approved by manufacturer

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
- B. Install sealants only when the air and surface temperatures are above 50 degrees F.

1.8 WARRANTY

- A. Provide five year warranty under provisions of Section 01700, Contract Closeout.
- B. Warranty: Include coverage for installed sealants and accessories which fail to achieve air tight seal, water tight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 SEALANTS

- A. Bituminous Based (Type A): Single component, asphalt compound, elongation capability of 0 to 2 percent of joint width; manufactured by Sonneborn or approved equal.
- B. Acrylic Emulsion Latex (Type B): ASTM C920, Grade P, Class 25, Use T; Multi component, non-staining, non-bleeding, non-sagging; color as selected; Sonolastic SL2 manufactured by Sonneborn or approved equal:
 - 1. Elongation Capability: 500 percent
 - 2. Service Temperature Range: 20 to 150 degrees F
 - 3. Shore A Hardness Range: 25 to 35
- C. Butyl Sealant (Type C): ASTM C920, Grade NS, Class 25, Use T; single component, solvent release, non-skinning, non-sagging, black color; manufactured by Sonneborn or approved equal:
 - 1. Elongation Capability: 7 to 10 percent
 - 2. Service Temperature Range: -13 to 180 degrees F
 - 3. Shore A Hardness Range: 10 to 30
- D. Polysulfide Sealant (Type D): FS TT-S-227E, ASTM C920, Grade NS, Class 25, Use NT; two component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type; color as selected; Sonolastic manufactured by Sonneborn or approved equal:
 - 1. Elongation Capability: 25 percent
 - 2. Service Temperature Range: -40 to 180 degrees F
 - 3. Shore A Hardness Range: 20 to 35
- E. Polyurethane Sealant (Type E): FS TT-S-227E, ASTM C920, Grade NS, Class 25, Use NT; single component, chemical curing, non-staining, non-bleeding, non-sagging type; color as selected; Sonolastic NP2 manufactured by Sonneborn or approved equal:
 - 1. Elongation Capability: 50 percent
 - 2. Service Temperature Range: -40 to 180 degrees F
 - 3. Shore A Hardness Range: 20 to 35
- F. Silicone Sealant (Type F): FS-TT-S-230C, ASTM C920, Grade NS, Class 25, Use NT; single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding; color as selected; Proglaze manufactured by Tremco Omniseal manufactured by Sonneborn or approved equal:
 - 1. Elongation Capability: 50 percent
 - 2. Service Temperature Range: 20 to 350 degrees F
 - 3. Shore A Hardness Range: 20 to 35

2.2 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: ASTM D1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width; non-gassing; Sofrod manufactured by AET, Sonofoam manufactured by Sonneborn, Cera-Rod manufactured by W.R. Meadows or approved equal.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces and joint openings are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove all dust, grease oil, wax and loose materials and foreign matter which might impair adhesion of sealant.
- B. Wipe surfaces with clean rag soaked in suitable solvent.
- C. Remove loose materials and foreign matter which might impair adhesion of sealant.
- D. Clean and prime joints in accordance with manufacturer's instructions.
- E. Perform preparation in accordance with manufacturer's instructions.
- F. Protect elements surrounding the work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Install sealant in accordance with manufacturer's instructions.
- B. Measure joint dimensions and size materials to achieve required 2:1 width/depth ratios with minimum depth 1/2 inch.
- C. Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.
- D. Install bond breaker where joint backing is not used.

- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave to a smooth even finish, flush with the edges of the sealant recessed.
- H. Keep adjacent surfaces clean and free of overlapping sealant.
- I. Remove sealant and reseal joints when:
 - 1. Excess sealant is outside the joint and feathered onto surfaces
 - 2. It is not possible to paint adjacent surfaces to a clean line

3.4 CLEANING

- A. Clean work under provisions of 01710, Contract Closeout
- B. Clean adjacent soiled surfaces

3.5 PROTECTION OF FINISHED WORK

- A. Protect finished installation under provisions of Section 01500, Construction Facilities and Temporary Controls.
- B. Protect sealants until cured

3.6 SCHEDULE

<u>Location</u>	<u>Type</u>	<u>Color</u>
Window perimeter	E	To match frame color
Metal Roofing	D	To match roofing color
Door Frame/Walls	B	To match adjacent paint colors
Under Thresholds	C	Black
Shower/Ceramic Tile	F	To match grout colors
Paving Joints	A	To match grout colors
Casework	B	To match casework color

- A. Non-Sag Polysulfide or Polyurethane:
 - 1. Entire perimeter of frames for exterior metal doors.
 - 2. Entire perimeter of metal louvers.
 - 3. Entire perimeter of metal dampers and metal surfaces.
 - 4. Watertight joints in aluminum sheet metal work.
 - 5. Joints between cast-in-place concrete or where indicated on the Drawings.
 - 6. Other locations where caulking is shown on the Drawings or specified in other sections.

- B. Self-Leveling Polysulfide or Polyurethane:
 - 1. Expansion and contraction joints in walks.
 - 2. Expansion, contraction and saw joints in traffic-bearing slabs.

- C. Silicone:
 - 1. Non-Porous substrates.

- D. Color:
 - 1. Schedule of colors for caulking used in each location for approval by Engineer.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiberglass Reinforced Plastic (FRP) Doors
- B. Fiberglass Resin Transfer Molded Door Frames

1.2 RELATED SECTIONS

- A. Section 03000 - Concrete
- B. Section 04200 - Masonry
- C. Section 05120 – Structural Steel and Miscellaneous Metal
- D. Section 07900 - Joint Sealants
- E. Section 08711 - Door Hardware
- F. Section 08800 - Glazing

1.3 REFERENCES

- A. ASTM C177 - Thermal Properties
- B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
- C. ASTM D882 - Tensile Strength
- D. ASTM D790 - Flexural Strength
- E. ASTM D2583 - Barcol Hardness
- F. ASTM D256 - Impact Resistance
- G. ASTM D792 - Density/Specific Gravity Of Laminate
- H. ASTM D1622 - Density/Specific Gravity
- I. ASTM D1761 - Mechanical Fasteners
- J. ASTM E84 - Surface Burning Characteristics

1.4 SUBMITTALS

- A. Summary door schedule indicating the specific reference numbers as used on owner's drawings, with columns noting door type, frame type, size, handing, accessories and hardware.
- B. A drawing depicting front and rear door elevations showing hardware with bill of material for each door.
- C. Drawing showing dimensional location of each hardware item and size of each door.
- D. Individual part drawing and specifications for each hardware item and FRP part or product.
- E. Construction and mounting detail for each frame type.
- F. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, color availability and intended use.
- G. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, perimeter conditions requiring special attention for field installation.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company specialized in the manufacture of fiberglass reinforced plastic (FRP) doors and frames as specified herein with a minimum of 25 years documented experience and with a record of successful in-service performance for the applications as required for this project.
- B. Installer Qualifications: An experienced installer who has completed fiberglass door and frame installations similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.
- C. Source Limitations: Obtain fiberglass reinforced plastic doors and frames through one source fabricated from a single manufacturer, including fire rated fiberglass frames.
- D. Source Limitations: Hardware and accessories for all FRP doors as specified in Section 08710 should be provided and installed by the fiberglass door and frame manufacturer.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Applicator: Experience in performing the work of this section approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Each door and frame should be delivered individually crated for protection from damage in cardboard containers, clearly marked with project information, door location, specific reference number as shown on drawings, and shipping information. Each crate should contain all fasteners necessary for installation as well as complete installation instructions.
- B. Doors should be stored in the original container out of inclement weather for protection against the elements.
- C. Handle doors pursuant to the manufacturer's recommendations as posted on outside of crate.
- D. Coordinate work under provisions of Section 01010, Summary of Work of these specifications.
- E. Coordinate the work with all sections referencing this section.

1.8 WARRANTY

- A. Warranty all fiberglass doors and frames for a period of 25 years against failure due to corrosion. Additionally, warranty all fiberglass doors and frames on materials and workmanship for a period of 10 years, including warp, separation or delamination, and expansion of the core.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Chem-Pruf Door Co., Ltd., P.O. Box 4560, Brownsville, Texas 78523
Phone: 1-800-444-6924, Fax: 956-544-7943, Website: www.chem-pruf.com
 - 1. Color: Royal Blue (Option 15) Jim Blanchard Plant
 - 2. Surface Finish: High Gloss Deep Red (Option 20) Clarks Hill Plant
 - 3. Door Frame: Style 4

2.2 FRP DOORS

- A. Doors shall be made of fiberglass reinforced plastic (FRP) using chemically proven resins resistant to contaminants typically found in the environment for which these specifications are written. Doors shall be 1 3/4 inch thick and of flush construction, having no seams or cracks. All doors up to 4'0 x 8'0 shall have equal diagonal measurements with a maximum tolerance of +/- 1/32 inch.

- B. Door Plates shall be 1/8 inch thick, molded in one continuous piece, starting with a 25 mil gelcoat of the color specified, integrally molded with at least two layers of 1.5 ounce per square foot fiberglass mat and one layer of 16 ounce per square yard unidirectional roving. This will yield a plate weight of 0.97 lbs per square foot at a ratio of 30/70 glass to resin.
- C. Stiles and Rails shall be constructed starting from the outside toward the inside, of a 25 mil gel coat of the color specified followed by a matrix of at least three layers of 1.5 ounce per square foot of fiberglass mat. The stile and rail shall be molded in one continuous piece to a U-shaped configuration and to the exact dimensions of the door. In this manner there will be no miter joints or disparate materials used to form the once-piece stile and rail.
- D. Core material shall be 2 psf expanded polyurethane foam or 3/8 inch triangular cell phenolic impregnated Kraft honeycomb.
- E. Internal Reinforcement shall be firestop of sufficient amount to adequately support required hardware and function of same.
- F. Finish of door and frame shall be identical in color and texture. At time of manufacture, 25 mil of resin-rich gelcoat must be integrally molded into both the door and frame. Color will be selected by the Owner and may include standard and/or optional colors.
- G. Window openings shall be provided for at time of manufacture and shall be completely sealed so that the interior of the door is not exposed to the environment. Fiberglass retainers which hold the glazing in place shall be resin transfer molded with a profile that drains away from glazing. The retainers must match the color, texture and finish of the door plates. Glass shall be furnished and installed by door and frame manufacturer.
- H. Louver openings shall be sealed in the same manner as the window openings. Louvers are to be solid fiberglass inverted "V" vanes and shall match the color, texture and finish of the door plates.
- I. Transoms shall be identical to the doors in construction, materials, thickness and reinforcement.

2.3 FRAMES

- A. Frames shall be fiberglass and manufactured using the resin transfer method in closed rigid molds to assure uniformity in color and size. Beginning with a minimum 25mil gel coat and a minimum of two layers continuous strand fiberglass mat saturated with resin, the frame will be of one-piece construction with molded stop. All frame profiles up to 3/4" will be solid fiberglass. All frame profiles greater than 3/4" shall have a core material of 2 psf polyurethane foam. Metal frames or pultruded fiberglass frames will not be accepted.

FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES

- B. Finish of frame shall be identical in color and texture to the door. 25 mil resin rich gel coat will be integrally molded into the frame at time of manufacture.
- C. Jamb/Header connection shall be coped by CNC for tight fit.
- D. Internal Reinforcement shall be continuous within the structure to allow for mounting of specified hardware. Material shall be completely non-organic with a minimum hinge screw holding value of 656 lbs. Frame screw holding value to accommodate screw shall be a minimum of 1,000 lbs per screw. Documented strength of frame screw holding value after third insert must be submitted. Dissimilar materials, such as steel, will be deemed unacceptable as reinforcement for hardware attachment.
- E. Mortises for hardware shall be accurately machined by CNC to hold dimensions to +/- 0.010 inch in all three axis.
- F. Hinge pockets shall be accurately machined by CNC to facilitate heavy duty hinges at all hinge locations, using spacers when standard weight hinges are used.

2.4 HARDWARE

- A. See Section 08711, Door Hardware
- B. Due to the special nature of the material in this section, all related hardware as specified must be furnished and installed by the door and frame manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that Openings are correctly prepared to receive doors and frames.
- B. Verify that Openings are correct size and depth in accordance with shop drawings or submittals.
- C. Have the installer examine conditions under which construction activities of this section are to be performed and submit a written report if conditions are unacceptable.
- D. Transmit two copies of the installer's report to the architect within 24 hours of receipt.
- E. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.

3.2 INSTALLATION

- A. Install door-opening assemblies in accordance with shop drawings and manufacturer's printed installation instructions, using installation methods and materials specified in installation instructions.

FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES

- B. Field alteration of doors or frames to accommodate field conditions is strictly prohibited.
- C. Site tolerances: Maintain plumb and level tolerance specified in manufacturer's printed installation instructions.
- D. Fire labeled doors and frames must be installed in strict accordance with manufacturer's instructions and the latest revision of NFPA 80.

3.3 ADJUSTING

- A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding and to remain in place at any angle without being moved by gravitational influence.
- B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions.

3.4 CLEANING

- A. Clean work under provisions of Section 01710, Cleaning of these specifications.
- B. Clean surfaces of door opening assemblies and exposed door hardware in accordance with respective manufacturer's maintenance instructions

3.5 PROTECTION OF FINISHED WORK

- A. Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Overhead coiling doors as indicated on Drawings and Schedules.
- B. Provide complete operating door assemblies including door curtains, guides, counterbalance mechanism, hardware, operators, and installation accessories.
- C. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section.

1.2 RELATED SECTIONS

- A. Section 05120 – Structural Steel and Miscellaneous Metals
- B. Section 09900 – Painting and Finishing

1.3 REFERENCES

- A. ASTM A480 - Flat Rolled Stainless Heat Resisting Steel Plate, Sheet and Strip
- B. ASTM A525 - Steel Sheet, Zinc-coated (Galvanized) by the Hot-Dip Process
- C. ASTM A653 - Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy – Coated (Galvannealed) by the Hot-Dip Process

1.4 PERFORMANCE REQUIREMENTS

- A. Wind Loading: Design and reinforce overhead coiling doors to withstand a 20 pounds per square foot (85 miles per hour) wind loading pressure unless otherwise indicated

1.5 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Product Data: Provide general construction, component connections and details, electrical equipment, and controls.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- D. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01730, Operation and Maintenance Data of these specifications.
- B. Operation Data: Include manufacturer's instructions, descriptions of system operation, start-up data, troubleshooting check lists, and repair data for door operator and control.
- C. Maintenance Data: Include manufacturer's literature, cleaning procedures, lubrication guidelines, adjustment requirements, replacement parts lists, wiring diagrams for door operator and control.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600, Materials and Equipment of these Specifications.
- B. Accept Door components on site in factory packing. Inspect for damage. Comply with manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in work include:
 - 1. Overhead Door Corp. Storm-Tite 625 (Powder Coat; Color RAL 5015)

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtain: Fabricate overhead coiling door curtain of interlocking slats designed to withstand required wind loading, of continuous length for width of door without splices. Unless otherwise indicated, provide slats of material gauge recommended by door manufacturer for size and type of door required, and as follows:
 - 1. Steel Door Curtain Slats: Structural quality, cold-rolled galvanized steel sheets complying with ASTM A653, Grade A, with G90 zinc coating, complying with ASTM A525, and phosphate treated before fabrication.
- B. Endlocks: Malleable iron castings galvanized after fabrication, secured to curtain slats with galvanized rivets. Provide locks on alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Bottom Bar: Consisting of two angles, each not less than 1-inch by 1-inch by 1/8-inch thick, galvanized or stainless steel or aluminum extrusions to suit type of curtain slats.

1. Provide a replaceable gasket of flexible vinyl or neoprene between angles as a weather seal and cushion bumper for manually operated doors unless shown as an overlapping joint.
 - D. Curtain Jamb Guides: Fabricate curtain jamb guides of steel angles, or channels and angles with sufficient depth and strength to retain curtain loading. Build-up units with minimum 3/16-inch-thick steel sections, galvanized after fabrication. Slot bolt holes for track adjustment.
 - E. Secure continuous wall angle to wall framing by 3/8-inch minimum bolts at not more than 30 inches o.c., unless closer spacing recommended by door manufacturer. Extend wall angles above door opening head to support coil brackets, unless otherwise indicated. Place anchor bolts on exterior wall guides so they are concealed when door is in closed position. Provide removable stops on guides to prevent over-travel of curtain and continuous bar for holding windlocks.
 - F. Weather Seals: Provide vinyl or neoprene weather stripping for exterior exposed doors, except where otherwise indicated. At door heads, use 1/8-inch thick continuous sheet secured to inside of curtain coil hood. At door jambs, use 1/8-inch thick continuous strip secured to exterior side of jamb guide.
- 2.3 COUNTERBALANCING MECHANISM
- A. Counterbalance doors by means of adjustable steel helical torsion spring, mounted around a steel shaft and mounted in a spring barrel and connected to door curtain with required barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
 - B. Counterbalance Barrel: Fabricate spring barrel of hot-formed structural quality carbon steel, welded or seamless pipe, of sufficient diameter and wall thickness to support roll-up of curtain without distortion of slats and limit barrel deflection to not more than 0.03 inch per foot of span under full load.
 1. Provide spring balance of one or more oil tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast steel barrel plugs to secure ends of springs to barrel and shaft.
 2. Fabricate torsion rod for counterbalance shaft of case-hardened steel, of required size to hold fixed spring ends and carry torsional load.
 - C. Brackets: Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate with bell mouth guide groove for curtain.
 - D. Hood: Form to entirely enclose coiled curtain and operating mechanism at opening head and act as weather seal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and any portion of between-jamb-mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.

2.4 PAINTING

- A. Shop clean and prime ferrous metal and galvanized surfaces, exposed and unexposed, except faying and lubricated surfaces, with door manufacturer's standard rust-inhibitive primer.

2.5 MANUAL DOOR OPERATORS

- A. Chain Hoist Operator: Provide manual chain hoist operator consisting of endless steel hand chain, chain pocket wheel and guard, and geared reduction unit with maximum 35 pounds pull for door operation. Design chain hoist with self-locking mechanism allowing curtain to be stopped at any point in its travel and to remain in position until movement is reactivated. Provide alloy steel hand chain with chain holder secured to operator guide.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports in accordance with final Shop Drawings, manufacturer's instructions, and as specified in this Section.
- B. Upon completion of installation, including Work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

3.2 ERECTION TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work
- B. Maximum variation from plumb: 1/16 inch
- C. Maximum variation from level: 1/16 inch
- D. Longitudinal or diagonal warp: Plus or minus 1/8 inch per 10 feet straight edge

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Architectural thermally broken aluminum windows and related components as shown on Drawings and as specified herein

1.2 RELATED SECTIONS

- A. Section 07900 - Joint Sealants
- B. Section 08800 - Glazing

1.3 REFERENCES

- A. AAMA 1503.1 - Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
- B. AAMA 2605-98 - Specifications, Performance Requirements and Test Procedure for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
- C. ANSI/AAMA 101 - Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors
- D. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
- E. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
- F. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

1.4 QUALITY ASSURANCE

- A. Test in accordance with ANSI/AAMA 101. Windows shall bear the AAMA certification label.
- B. Test units: Air, water and structural test unit sizes and configuration shall conform to the requirements set forth in ANSI/AAMA 101.
- C. Test procedures and performance: Conform to all ANSI/AAMA 101 HC-40 requirements. In addition, meet the following requirements with window sash and ventilators closed and locked:

1. Air infiltration:
 - a. Test in accordance with ASTM E283 at static air pressure difference of 1.57 psf
 - b. Not to exceed 0.6 cfm per foot of perimeter crack length
2. Water resistance:
 - a. Test in accordance with ASTM E331 at static pressure difference of 15 psf
 - b. No uncontrolled water leakage allowed
3. Uniform load structural test:
 - a. Test in accordance with ASTM E330 at a static air pressure difference of not less than 90 psf positive and negative pressure
 - b. No glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms, nor any other damage which would cause the window to be inoperable will be allowed
4. Condensation resistance test:
 - a. Test in accordance with AAMA 1503.1
 - b. Condensation Resistance Factor (CFR) must be 51 or greater
5. Thermal transmittance test:
 - a. Test in accordance with AAMA 1503.1
 - b. Provide unit with a maximum U-value of 0.51 BTU/hr/sf/degrees F

1.5 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples.
- B. Submit product data for each type of window required, including:
 1. Construction information and fabrication methods
 2. Data on hardware, accessories and finishes
 3. Recommendations for maintenance and cleaning of exterior surfaces
- C. Submit shop drawings for each type of window required. Include information not fully detailed in manufacturer's standard product data and the following:
 1. Layout and installation details, including anchors
 2. Elevations of each type of window at 1/4 inch scale minimum
 3. Sections (half scale minimum) of each window installation condition showing:
 - a. Window section with all accessories and reinforcement
 - b. Adjacent substrate and finishes and location of window within the wall opening
- D. Submit sample set of specified color showing the full range of variations expected.

1.6 WARRANTY

- A. Total window system:
 1. Assume full responsibility and warrant for one year, from the date of substantial completion of the project, the satisfactory performance of the total window installation which includes that of the windows, hardware, glazing, anchorage, and

setting system, sealing, flashing, etc. as it relates to air, water, and structural adequacy as called for in the specifications.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Winco Manufacturing Co.
- B. Hope's
- C. Rebco
- D. Approved equivalent

2.2 PRODUCTS

A. General:

- 1. Window units:
 - a. Fixed and Operable Projected or Single-Hung Windows: ANSI/AAMA 101-88 (HC-45)
 - b. Window units with sealed insulating glass
 - c. Provide all windows with continuous thermal breaks
- 2. Material:
 - a. All frame and vent members are extruded from 6063-T5 aluminum alloy
 - b. Frame and sash extrusions nominal wall thickness: 0.125 inches
 - c. Frame member depth: Not less than 2 inches
- 3. Mechanical fasteners, welded components and hardware items shall not bridge thermal barriers
- 4. Align thermal barriers at all frame and sash corners

B. Frame:

- 1. Mortise and tenon or weld frame members
- 2. Use of mechanical fasteners is not permitted

C. Sash:

- 1. Provide tubular sash extrusions
- 2. Miter corners, reinforced with an extruded aluminum corner key, hydraulically crimp and cold weld with epoxy adhesive
- 3. Provide with two rows of weatherstripping installed in dovetail grooves in sash extrusion

2.3 FINISH

A. Windows – Water treatment Plant: (Jim Blanchard Side A and B)

- 1. Anodized aluminum, AA-M12-C22-A31, Class I
- 2. Minimum coating thickness = 1.0 mil
- 3. Color: Clear Anodized

- B. Windows – Water treatment Plant: (Clarks Hill)
 - 1. Anodized aluminum, AA-M12-C22-A31, Class I
 - 2. Minimum coating thickness = 1.0 mil
 - 3. Color: Clear Anodized

- C. Accessories:
 - 1. Visible screws, bolts, rivets, and other fastening devices shall match and blend with the finish of the member to which secured

2.4 SEALANTS:

- A. Comply with Section 07900, Joints and Sealants of these specifications.

2.5 GLAZING

- A. Preglazed fabrication:
 - 1. Preglaze windows where possible and practical for applications indicated
 - 2. Comply with Section 08800, Glazing of these specifications.

PART 3 EXECUTION

- A. Inspect openings before start of installation.
- B. Verify that masonry opening is the correct size, square and sill plate is level.
- C. Verify masonry surfaces are visibly dry and free of excess mortar, grout and other debris.
- D. Verify metal surface are dry; clean; free of grease, oil, dirt, rust and corrosion, and welding slag; without sharp edges or offsets at joints.

3.2 INSTALLATION

- A. Set windows plumb, square, and true to line, without warp or rack of frames or sash and in alignment with surrounding work.
- B. Anchor to maintain positions permanently when subjected to normal thermal and building movement.
- C. Seal units to provide a weathertight installation at all joints and intersections and at opening perimeters.

3.3 ADJUSTING

- A. Adjust sash and hardware to provide a tight fit at contact points for smooth operation.

3.4 INSPECTION AND CLEANING

- A. Inspect window units and replace scratched, chipped, or defective units.

- B. After inspection, remove labels.
- C. Clean surfaces without using abrasive cleaners or solutions containing corrosive solvents.
- D. Clean aluminum surfaces promptly after installation of window.
- E. Exercise care to avoid damage to protective coatings and finishes.
- F. Remove excess glazing and sealant compounds, dirt, and other foreign substances.
- G. Lubricate hardware and other moving parts.
- H. Clean glass of preglazed units promptly after installation of windows.
- I. Comply with requirements of Section 08800, Glazing of these specifications.

3.5 PROTECTION

- A. Initiate and maintain protection and other precautions required through remainder of construction period, to ensure that, except for normal weathering, window units will be free of damage or deterioration at time of Final Inspection.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Commercial door hardware

1.2 REFERENCES

- A. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications
- B. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
- C. BHMA A156 - Hardware Standards
- D. DHI A115 - Hardware Installation Standards
- E. NFPA 80 - Standard for Fire Doors and Other Opening
- F. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies
- G. UL 305 - Fire Rated System Design
- H. UL 1784 - Air Leakage Tests of Door Assemblies and Other Opening Protectives

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Include details of electrified door hardware and wiring diagrams.
- C. Samples: For each exposed finish and/or products as requested by the Architect or Owner.
- D. Door Hardware Schedule: Organized into door hardware sets, in a horizontal format, per the DHI Handbook/January 1996, Sequence and Format for the Hardware Schedule indicating type, style, function, size, label, hand, manufacturer, fasteners, location, and finish of each door hardware item. Include description of each electrified door hardware function, including sequence of operation.
- E. Keying Schedule: Detail Owner's final keying instructions for locks, in the format recommended by the DHI Handbook/June 1989 Keying Systems and Nomenclature.

1.4 QUALITY ASSURANCE

- A. **Supplier Qualifications:** The supplier shall be or employs a qualified DHI Architectural Hardware Consultant.
- B. **Source Limitations:** Obtain electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that are listed to perform electrical modifications, by a testing and inspecting agency acceptable to authorities having jurisdiction, are acceptable.
- C. **Keying Conference:** Conduct conference at Project site. Incorporate keying conference decisions into final keying schedule.
- D. **Keys:** Deliver keys to Owner by registered mail.
- E. **Templates:** Obtain and distribute templates for doors, frames, and other work specified to be factory prepared for installing door hardware.
- F. **Standards:** Comply with BHMA A156 series standards, Grade 1 as indicated in Part 3 for this section.
- G. **Certified Products:** Provide door hardware that is listed in BHMA directory of certified products.

1.5 WARRANTY

- A. **Special Warranty:** Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within warranty period.
 - 1. **Warranty Period for Manual Closers:** Ten years from date of Substantial Completion.
 - 2. **Warranty Period for Locksets and Cylinders:** Five years from date of Substantial Completion.
 - 3. **Warranty Period for Exit Devices:** Three years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. **Product:** Subject to compliance with requirements, provide the product named for each door hardware item indicated in Door Hardware Sets.
- B. **Basis-of-Design Product:** Product named for each door hardware item indicated in Door Hardware Sets establishes the basis of design. Provide either the named product or a comparable product by one of the manufacturers specified for each type of hardware item.

2.2 DOOR HARDWARE

- A. Scheduled Door Hardware: Provide door hardware according to Door Hardware Sets at the end of Part 3. Manufacturers' names are abbreviated.

2.3 PIVOTS AND HINGES

- A. Manufacturers:
 - 1. Hinges:
 - a. See product legend, Part 3 of this section.
 - 2. Pivots and Pivot Hinges:
 - a. See product legend, Part 3 of this section.
- B. General: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- C. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - 1. Exterior Hinges: Brass or bronze, with steel pin.
 - 2. Interior Hinges: Steel, with steel pin, except as indicated in hardware sets.
 - 3. Hinges for Fire-Rated Assemblies: Steel, with steel pin.
- D. Non-removable Pins: Provide set screw in hinge barrel that prevents removal of pin while door is closed; for outswinging exterior doors and as indicated in Hardware Sets, Part 3 of this section.
- E. Screws: Phillips flat-head screws; screw heads finished to match surface of hinges.
 - 1. Metal Doors and Frames: Machine screws (drilled and tapped holes).
 - 2. Wood Doors and Frames: Wood screws.
 - 3. Fire-Rated Wood Doors: Threaded-to-the-head wood screws.

2.4 MECHANICAL LOCKS AND LATCHES

- A. Manufacturers:
 - 1. See product legend, Part 3 of this section Marks USA (MK).
- B. Lockset Design: As indicated in Hardware Sets, Part 3 of this section.
- C. Dummy Trim: Match lock trim and escutcheons.
- D. Lock Throw: Comply with labeled fire door requirements.
- E. Backset: 2-3/4 inches unless otherwise indicated.

2.5 ELECTRIFIED LOCKS AND LATCHES

- A. Self-Contained Electronic Locks and Latches: Internal, battery-powered locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device.

Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.

1. Manufacturers:
 - a. See product legend, Part 3 of this section

2.6 BOLTS

- A. Fire-Rated Doors: Comply with labeled fire door requirements.
- B. Surface Bolts: Flush bolt heads of minimum 1/2-inch diameter rods of brass, bronze, or stainless steel with minimum 12-inch long rod.
- C. Flush Bolts: BHMA Grade 1, as indicated, designed for mortising into door edge.
 1. Manufacturers:
 - a. See product legend, Part 3 of this section.

2.7 EXIT DEVICES

- A. Manufacturers:
 1. See product legend, Part 3 of this section.
- B. Panic Exit Devices: Listed and labeled for panic protection, based on testing according to UL 305.
- C. Fire Exit Devices: Complying with NFPA 80 that are listed and labeled for fire and panic protection, based on testing according to UL 305 and NFPA 252.
 1. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 2. Outside Trim: Lever and Lever with cylinder material, finish, and design to match locksets and latchsets, unless otherwise indicated.
 3. Through Bolts: For exit devices and trim on all wood doors.

2.8 OPERATING TRIM

- A. Push-Pull Design: As scheduled.
 1. Manufacturers:
 - a. See product legend, Part 3 of this section.

2.9 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3.
 1. Manufacturers:
 - a. See product legend, Part 3 of this section.
- B. Removable Mullions: BHMA A156.3.
 1. Manufacturers:
 - a. See product legend, Part 3 of this section.
 2. Fire-Exit Removable Mullions: Complying with NFPA 80 that are listed and labeled for fire and panic protection, based on testing according to UL 305 and

NFPA 252. Mullions shall be used only with exit devices for which they have been tested.

- C. Carry-Open Bars: Provide carry-open bars for inactive leaves of pairs of doors, unless automatic or self-latching bolts are used.

2.10 CLOSERS

- A. Surface-Mounted Closers:
 - 1. Manufacturers:
 - a. See product legend, Part 3 of this section.
- B. Size of Units: Factory-sized, adjustable to meet field conditions and requirements for opening force.

2.11 PROTECTIVE TRIM UNITS

- A. Protective Trim Units: Sized 2 inches less than door width on push side, by height scheduled or indicated. Fasten with exposed machine or self-tapping screws.
 - 1. Material: Metal
 - a. Manufacturers:
 - 1) See product legend, Part 3 of this section.

2.12 STOPS AND HOLDERS

- A. Stops and Holders: Provide floor stops for doors, unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
 - 1. Manufacturers:
 - a. See product legend, Part 3 of this section.

- B. Silencers for Door Frames: Neoprene or rubber; fabricated for drilled-in application to frame.

2.13 DOOR GASKETING AND THRESHOLDS

- A. Door Gasketing: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
 - 1. Manufacturers:
 - a. Gasketing and Door Bottoms
 - 1) See product legend, Part 3 of this section
 - 2. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E283.
 - 3. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled, based on testing according to UL 1784.
 - 4. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled, based on testing according to UL 10B or NFPA 252.

5. Gasketing Materials: Comply with ASTM D2000 and AAMA 701/702.

- B. Thresholds: Of type scheduled or indicated.
 - 1. Manufacturers:
 - a. See product legend, Part 3 of this section.

2.14 SLIDING AND FOLDING DOOR HARDWARE

- A. Sliding Door Hardware: Complete sets consisting of rails, hangers, supports, bumpers, floor guides, and accessories indicated.
 - 1. Manufacturers:
 - a. See product legend, Part 3 of this section.
 - 2. Bypassing Sliding Door Hardware: Rated for doors weighing up to 125 lb.

2.15 CYLINDERS, KEYING, AND STRIKES

- A. Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
 - 1. Manufacturers:
 - a. Same manufacturer as for locks and latches.
 - 2. Number of Pins: Six.
 - 3. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- B. Keying System: Factory-registered keying system.
 - 1. Keys: Provide nickel-silver keys permanently inscribed with a visual key control number and "DO NOT DUPLICATE" notation. Provide three change keys and five master, or grand master keys.
- C. Key Control System: Include key-holding hooks, labels, key tags with self-locking key holders, envelopes, and markers. Contain system in wall-mounted type metal cabinet with baked-enamel finish. Include cross-index system set up by key control manufacturer, with card index.
 - 1. Manufacturers:
 - a. See product legend, Part 3 of this section.
- D. Strikes: Manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.16 FABRICATION

- A. Base Metals: Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials if different from specified standard.
- B. Fasteners: Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated. Provide steel machine or wood screws or steel through bolts for fire-rated applications.

- C. Spacers or Sex Bolts: For through bolting of hollow metal doors.
- D. Fasteners for Wood Doors: Comply with requirements of DHI WDHS.2, "Recommended Fasteners for Wood Doors."
- E. Finishes: Comply with BHMA A156.18.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Examine doors and frames for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- B. Steel Door and Frame Preparation: Comply with DHI A115 series. Drill and tap doors and frames for surface-applied hardware according to SDI 107.
- C. Wood Door Preparation: Comply with DHI A115-W series.
- D. FRP Door Preparation: Comply with Section 08220, FRP Doors and Frames.
- E. Mounting Heights: Comply with the following requirements, unless otherwise indicated:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- F. Adjust and reinforce attachment substrates as necessary for proper installation and operation. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 - 1. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- G. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with accessibility requirements.
 - 1. Door Closers: Adjust sweep period so that from an open position of 70 degrees, the door will take at least three seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

3.2 FIELD QUALITY CONTROL

- A. Inspections: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

3.3 DOOR HARDWARE SETS

HARDWARE SCHEDULE

Legend:

Products:	Manufacturer:	Approved Substitute:
Hinges	(HA) Hager	McKinney, Stanley
Pivots	(RI) Rixson	Dorma, ABH
Locks/Latches	(SA) Sargent	Corbin, Schlage, Yale
Entry Control Locks	(SA) Sargent	Corbin, Schlage, Yale
Exit Devices	(SA) Sargent	Corbin, Von Duprin, Yale
Closers	(NO) Norton	Corbin, Sargent, Yale
O'Head Stop/holders	(RI) Rixson	ABH, Glynn-Johnson
Misc. Door Trim	(TR) Trimco/BBW	Ives, Rockwood
Weatherstripping	(PE) Pemko	Reese, Hager
Sliding Door Hardware	(HA) Hager	Lawrence, Stanley
Key Cabinets	(LU) Lund	Telkee
Fire Dept. Key Box	(KN) Knoxbox	no substitute

Furnish all items in US32D/630, except as indicated in the schedule. Thresholds to be Mill Finish Aluminum. Weatherstripping to be Clear Anodized Aluminum. Closers to be EN/689 Finish. Miscellaneous door trim may be furnished in US32D/630, Dull/Satin Stainless Steel.

Use 2 pair of hinges or 2 each intermediate pivots at doors 7'-6" and over.

Use 5-inch by 4.5-inch hinges at doors 3'-6" and over.

Furnish glass bead kits at exit devices where required.

Fasten all exit devices and closers with SNB fasteners.

Furnish all brackets required to mount closers, as required by frame or door details.

Door Jambs must be cleaned of all dirt, grease, oil, solvents or solvent residue and dust before applying Pressure-Sensitive Adhesive backed Gasketing, Smoke Seal or Weatherstripping.

Hardware sets shall be as follows:

HW SET – 1 (Single Exterior)

1 each Exit Device 8943 ETL		32D	Sargent
1 each Latch Protector x 320	630		Rockwood
1 each Hydraulic Closers series 3511		32D	Sargent
1 each 8400-12 xB4E-CS Kick Plate, Push side		32D	Ives
1 each Perimeter Seal x S88D		Black	Pemko
1 each Door Bottom Sweep x 345AP		Clear	Pemko
1 each Overhead Rain Drip x 346C	Clear		Pemko
1 each Cast Threshold x GS-300A x 5” width			

HW SET – 1A (Single Interior Office)

1 each 8256 CE L Mortise Lockset		32D	Sargent
1 each Cast Wall Stop x 401		626	Rockwood
3 each Silencer x 608		Gray	Rockwood
No Hydraulic Closer			
	Gray	Rockwood	
No Hydraulic Closer			

HW SET - 2 (Exterior Pair)

1 each Exit Device x 16-43-8904 x 815 x PTB x TB x CPC	32D		Sargent
1 each Exit Device x 14-8710 x TB x CPC	32D		Sargent
2 each Closer x 351 x CPS x SRI x TB		EN	Sargent
1 each Overhead Rain Drip x 346C	Clear		Pemko
1 Set Meeting Stile Astragal x 18041CP x 18041CP		Clear	Pemko
1 each Perimeter Seal x S88D		Black	Pemko
2 each Door Bottom Sweep x 345AP		Clear	Pemko
1 each Cast Threshold x GS-300A x 5” width			

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass and glazing for storefront windows and doors
- B. Glass and glazing for aluminum windows
- C. Glass and glazing for hollow metal doors
- D. Glass and glazing for fiberglass reinforced plastic (FRP) doors
- E. Glass mirrors
- F. Interior borrowed lites

1.2 RELATED SECTIONS

- A. Section 07900 - Joint Sealants
- B. Section 08220 - FRP Doors and Frames
- C. Section 08520 - Aluminum Windows

1.3 REFERENCES

- A. AAMA 800 - Voluntary Specifications and Test Methods for Sealants
- B. AAMA 807.3 - Glazing Tape
- C. ANSI/ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
- D. ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings
- E. ASTM C509 - Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
- F. ASTM C1036 - Flat Glass
- G. ASTM C1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated, and Uncoated Glass
- H. ASTM C1115 - Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories
- I. ASTM C1281 - Standard Specification for Preformed Tape Sealants for Glazing Applications

-
- J. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass
 - K. ASTM E546 - Test Method for Frost Point of Sealed Insulating Glass Units
 - L. ASTM E576 - Test Method for Dew/Frost Point of Sealed Insulating Glass Units in Vertical Position
 - M. ASTM E773 - Test Method for Seal Durability of Sealed Insulating Glass Units
 - N. ASTM E774 - Sealed Insulating Glass Units
 - O. FGMA - Glazing Manual
 - P. FGMA - Sealant Manual
 - Q. FS TT-C-00598 - Caulking Compound, Oil, and Resin Base Type
 - R. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type
 - S. FS TT-S-00227 - Sealing Compound, Rubber Base, Two Components
 - T. FS TT-S-00230 - Sealing Compounds, Synthetic-Rubber Base, Single Component, Chemically Curing
 - U. FS TT-S-01543 - Sealing Compound, Silicone Rubber Base
 - V. FS TT-G-410 - Glazing Compound, Sash (Metal) for Back Bedding and Face Glazing (Not for Channel or Stop Glazing)
 - W. Laminators Safety Glass Association - Standards Manual
 - X. SIGMA - Sealed Insulated Glass Manufacturers Association
- 1.4 SUBMITTALS
- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
 - B. Product Data on Glass Types Specified: Provide structural, physical and environmental characteristics, size limitations, special handling, or installation requirements.
 - C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with FGMA Glazing Manual, FGMA Sealant Manual, SIGMA for glazing installation methods.
- B. Each unit of glass shall be factory labeled as to quality, thickness and manufacturer.

1.6 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.7 COORDINATION

- A. Coordinate the Work with glazing frames, wall openings, and perimeter air and vapor seal to adjacent Work.

PART 2 PRODUCTS

2.1 MANUFACTURERS - FLAT GLASS MATERIALS

- A. L-O-F Glass
- B. P.P.G
- C. Viracon
- D. Or approved equal

2.2 FLAT GLASS MATERIALS

- A. Safety Glass: ASTM C1048, Kind FT fully tempered with horizontal tempering Condition A uncoated, Type 1 transparent flat, Class 1 clear, Quality Q3 glazing select conforming to ANSI Z97.1; 1/4 inch thick minimum.
- B. Wired Glass: Clear, polished both sides, square mesh of woven stainless steel wire of 1/2 inch grid size; 1/4 inch thick minimum.
- C. Annealed Float Glass: ASTM C1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
 - 1. Ultra-Clear (Low-Iron) Float Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.
- D. Heat-Treated Float Glass: ASTM C1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 - 2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of

- individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
3. For uncoated glass, comply with requirements for Condition A.
 4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
 5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.
- E. Monolithic fire-rated safety glass: Provide product in the form of 3/16 inch clear flat sheets.
1. Manufacturers:
 - a. Old Castle Glass
 - b. CGI International, Ltd.
 - c. Pilkington
 - d. Or approved equal
 2. Fire-Protection Rating: As indicated for the fire window in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 3. Surface Finish: Equal to annealed glass.
- F. Pyrolytic-Coated Float Glass: ASTM C1376, float glass with metallic-oxide coating applied by pyrolytic deposition process during initial manufacture, and complying with other requirements specified.
- G. Mirrored Glass: Nominal 6.0-mm (0.23 in.) thick, conforming to ASTM C1036, Type I, Class 1, Quality q2, and with silvering, electroplated copper coating and protective organic coating.
- 2.3 MANUFACTURERS - SEALED INSULATING GLASS MATERIALS
- A. Basis-of-Design: PPG
 - B. L-O-F Glass
 - C. Viracon
 - D. Or approved equal
- 2.4 SEALED INSULATING, LOW-E GLASS MATERIALS
- A. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
1. Basis-of-Design: PPG, Solarban 60 + Solarbronze
 2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

3. Sealing System: Dual seal.
4. Spacer Specifications: Manufacturer's standard spacer material and construction.
5. Overall Unit Thickness, 1 inch, and Thickness of Each Lite: 25 and 6.0 mm.
6. Interspace Content: Air.
7. Outdoor Lite: One layer 1/4"
 - a. Tint Color: Bronze
 - b. Visible Light Transmittance: 35-45 percent
 - c. Low-e coating on #2 surface
8. Indoor Lite: One layer 1/4 inch Clear Annealed Glass

2.5 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
 1. Neoprene, ASTM C864.
 2. EPDM, ASTM C864.
 3. Thermoplastic polyolefin rubber, ASTM C1115.
 4. Any material indicated above.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C509, Type II, black; and of profile and hardness required to maintain watertight seal:
 1. Neoprene.
 2. EPDM.
 3. Thermoplastic polyolefin rubber.
 4. Any material indicated above.

2.6 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturer's written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Engineer from manufacturer's full range.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass

manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

3.3 INSTALLATION

- A. Set glazing in accordance with manufacturer's recommendations and the Glazing Manual published by the Flat Glass Marketing Association.
- B. Set glazing using glazing tape against fixed stop, mono head bead and setting blocks, and vision strip between glazing and applied stop.
- C. Install fire rated glass using Meta Caulk as recommended by the glass manufacturer.

3.4 CLEANING

- A. Remove glazing materials from finish surfaces
- B. Remove labels after work is complete
- C. Clean glass

3.5 PROTECTION OF FINISHED WORK

- A. Protect finished Work
- B. After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this specification consists of furnishing all plant, labor, equipment, appliances, and materials, and in performing all operations in connection with the painting of metals, masonry, concrete, wood, plastic, and equipment of the buildings and process work. Painting shall be performed at such times and in such places as the Contractor and Engineer may agree upon in order that dust-free and neat work shall be obtained. All painting shall be done in strict accordance with the recommendations of the manufacturer and shall be performed in a manner satisfactory to the Engineer. Ferrous metals shall be prime coated in the shop as specified herein or in other sections and shall have any bare spots resulting from handling or welding touched up with one coat of the respective shop coat.

1.2 RELATED SECTIONS

- A. Section 05120 - Structural Steel and Miscellaneous Metal
- B. Section 15060 - Pipe and Pipe Fittings
- C. Section 15100 - Valves, Cocks and Hydrants
- D. Section 16050 - Basic Materials and Methods
- E. Section 16075 - Electrical Identification

1.3 REFERENCES

- A. ASTM D4258 - Surface Cleaning of Concrete
- B. ASTM D4259 - Abrading Concrete
- C. AWWA D100-84 - Welded Steel Tanks for Water Storage
- D. AWWA D102-97 - Painting Steel Water Storage Tanks
- E. SSPC-SP 1 - Solvent Cleaning
- F. SSPC-SP 2 - Hand Tool Cleaning
- G. SSPC-SP 3 - Power Tool Cleaning
- H. SSPC-SP 6 - Commercial Blast Cleaning
- I. SSPC-SP 7 - Sweep Blast Cleaning

- J. SSPC-SP 10 - Near White Blast Cleaning
- K. Unless otherwise specified, all work and materials for the preparation and coating of all metal surfaces shall conform to the applicable requirements specified in the Steel Structures Painting Manual, Volume 2, Systems and Specifications Revised, latest edition, published by the Steel Structures Painting Council.

1.4 QUALITY ASSURANCE

- A. All paints shall be fresh and shall arrive on the job in the original, unopened containers that clearly show the name of the manufacturer and directions for application. This specification utilizes the products of the Carboline Company as the standard of quality and color; the comparable products of Induron or Tnemec may be substituted upon approval by the Engineer.

1.5 SHIPPING, STORAGE AND HANDLING

- A. All paints shall be properly prepared by the manufacturer and delivered to the site for field painting in the original unbroken containers with manufacturer's label plainly printed thereon. Each container shall provide labels with following information: Name or title of material; manufacturers name; date of manufacture; list of hazardous ingredients; thinning instructions; and application instructions. Type of material to be applied at each location shall be submitted to the Engineer with the manufacturer's written recommendation of the type paint for each item to be painted. Containers that are broken, opened, watermarked and/or contain caked, lumpy, or otherwise damaged materials, are unacceptable and shall immediately be removed from the work site.
- B. The Contractor shall exercise every precaution in the storing of paints, solvents, cleaning fluids, rags, and similar materials as to eliminate the risk of spontaneous combustion or other hazardous conditions. Portable fire extinguishing equipment shall be provided in a convenient location for emergency access. All painting materials stored on the job site shall be stored in a location outside of the work area. The Contractor shall take all safety precautions in accordance with Section 7 of AWWA D-102, NFPA Bulletin No. 101 and all federal, state and local regulations.

1.6 SURFACES REQUIRING PAINTING

- A. The painting required by this section shall include painting the piping and equipment of this contract, including the steel work associated with the project.
- B. Exterior painting shall include: all ferrous metal associated with the work of this contract, exposed piping and equipment, the interior and top of the chemical tank containment structure, and any other exterior work shown as requiring a coating or finish. The filter side of the common walls between the gallery and the filters and all contiguous surfaces extending out 1' perpendicular to the gallery wall shall be coated to the elevation of the bottom of the walkways. Exterior masonry, concrete, aluminum, chrome, stainless

steel, and prefinished fiberglass shall not be painted except as specifically noted elsewhere.

- C. Interior painting shall include all new exposed interior concrete and block (except floors and the interior of the clearwell), drywall, exposed wood, ferrous metal work, piping, fittings, valves, equipment and other metal work of this contract. Interior painting shall also include touch up of all surfaces modified or damaged during construction.
- D. Unions, screwed fittings, and flanges on PVC pipe shall not be painted.
- E. Equipment prefinished by the manufacturer shall conform to the special requirements of the specification section in which the equipment is specified but shall not have a finish of lower quality than herein specified for exterior and interior metal work.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Chemical Resistant Coating:
 - 1. Chemical Resistant coating of the tank containment structure shall be the E5000 fiberglass reinforced system of ChemProof Polymers, Inc. of Tulsa Oklahoma or approved equal. Surface preparation and application shall be done in strict accordance with manufacturer's instructions.

2.2 COATING SYSTEMS

- A. Surface: Exposed ferrous metal, machinery, and equipment – non-immersion; interior or exterior; new or existing. (Bituminous coated pipe shall be sealed before recoating.)

Surface Prep - SSPC SC6

Primer - Carbozinc 859 @ 3.0-5.0 mils DFT. Shop apply primer for new work.

1st Coat - Carboguard 690 or 890 @ 5.0-8.0 mils DFT

2nd Coat - Carbothane 133HB @ 3.0-5.0 mils DFT

Total System - 11.0-18.0 mils DFT

- B. Surface: Ferrous metal – immersion (NSF); interior or exterior; new or existing.

Surface Prep - Abrasive blast clean (SSPC SP10) with 3.5 mil anchor profile.

Primer - None

Finish – Polyclad 708 / 100% solids elastomeric polyurethane @ 25.0mils (or 40.0 mils for pitted steel) DFT in a single coat (multiple passes)

Total System - 25.0 mils DFT (new) or 40.0 mils DFT (pitted steel)

C. Surface: Polyvinyl chloride pipe, interior exposed.

1st Coat: Carboguard 690 or 890 @ 5.0-8.0 mils DFT

2nd Coat: Carboguard 690 or 890 @ 5.0-8.0 mils DFT

Total System – 10.0-16.0 mils DFT

D. Surface: Polyvinyl chloride pipe, exterior exposed.

1st Coat: Carboguard 690 or 890 @ 5.0-8.0 mils DFT

2nd Coat: Carbothane 133HB @ 3.0-5.0 mils DFT

Total System - 8.0-13.0 mils DFT

E. Surface: Concrete and CMU – non-immersion, interior, new or existing

Surface Prep - Concrete must be cured for 28 days at 75°F & 50% relative humidity (laitance, form oils, curing agents or surface hardeners must be removed by suitable method prior to coating application. CMU - Mortar joints should be thoroughly cured a minimum of 15 days at 50% relative humidity.

Primer - Sanitile 600 @ 2.0-20.0 mils DFT

1st Coat - Carboguard 690 or 890 @ 5.0-8.0 mils DFT

2nd Coat - Carboguard 690 or 890 @ 5.0-8.0 mils DFT

Total System - 10.0-16.0 (without primer)

F. Surface: Concrete walls in interior of filters adjacent to gallery. Coat to bottom of sidewalks. - immersion; NSF approved.

Surface Prep - Abrasive blast clean (ASTM D4259) to produce a rough surface texture

Resurfacer (as needed) - Carboguard 501 or 510 or 510SG

Primer - Phenoline 311 moisture tolerant epoxy @ 2.0-3.0 DFT

Finish - Polyclad 708 / 100% solids elastomeric polyurethane @ 75.0 mils DFT in a single coat (multiple passes)

Total System - 77.0-78.0 mils DFT

G. Surface: Gypsum Board, interior.

Primer - One coat latex primer sealer 1.5 mils DFT

Finish - Two coats acrylic latex finish, eggshell 1.5 mils DFT

H. Surface: Interior Wood Surfaces.

Primer - One coat alkyd enamel prime sealer 1.5 mils DFT

Finish - Two coats alkyd enamel, semi-gloss 1.5 mils DFT

I.

PAINTING/COLOR SCHEDULE

ITEM	SURFACE	COLOR	REMARKS
Doors, Trim	Smooth/ High Gloss	Deep Red	Clarks Hill
Doors, Roll Up		Royal Blue	Jim Blanchard
Windows, Trim	N/A	Medium Bronze SW2846, Aluminum	Clarks Hill
			Jim Blanchard
Louvers, Fan	N/A	Aluminum	Clarks Hill
			Jim Blanchard
Walls (Internal Block)	CMU, Semi Smooth	White SW7005	Clarks Hill
			Jim Blanchard
Piping, Associated Vaults	Semi Smooth	Hyper Blue SW 2846, Match	Clarks Hill
			Jim Blanchard
Facia, Flashing	N/A	Medium Bronze SW2846	Clarks Hill
		Aluminum	Jim Blanchard
Gutters	N/A	Aluminum	Clarks Hill
			Jim Blanchard

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 01010, Summary of Work.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

- C. Examine surfaces scheduled to be finished that will adversely affect execution, permanence, or quality of work and which will not allow preparatory work outlined in preparation of surfaces. Report any condition that may potentially affect proper application prior to commencement of work.
- D. Do not proceed with surface preparation or coating application until conditions are suitable.
- E. Test shop applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and gypsum wallboard: 10 percent
 - 2. Masonry, concrete, and concrete unit masonry: 8 percent
 - 3. Interior wood: 12 percent
 - 4. Exterior wood: 12 percent
 - 5. Concrete floors: 8 percent

3.2 SURFACE PREPARATION

- A. All surfaces that are to be painted shall, prior to application of paint, be cleaned, washed and further prepared as specified herein. Surfaces of ferrous metal to receive Phenolic, Vinyl, Epoxy, or Alkyd Primers shall be thoroughly cleaned by sandblasting to commercial blast metal (SSPC-SP6). Where long oil primers are elsewhere specified, SSPC-SP3, power brush cleaning is acceptable; submerged surfaces shall be near-white blast (SSPC-SP10).
- B. Polyvinyl Chloride (PVC) pipe surfaces shall be solvent wiped and lightly sanded.
- C. Masonry and concrete surfaces requiring paint shall be free of moisture, dust, dirt, oil, grease or stains. Efflorescence or laitance shall be removed by brushing, sandblasting, or, subject to the directions of the Engineer, by acid etching. Reference coating manufacturer's product data sheets for specific surface preparation guidelines.
- D. Prepainted surfaces: Primed surfaces where the coating is in good condition shall be lightly sanded, wire brushed, or brush blasted to slightly roughen the surface. Where the paint is showing rust, or otherwise failing, the surface shall be sand blasted for repainting as new material. Surfaces shall be sanded to eliminate the scale marks and other imperfections which will not permit a smooth finished surface. Cracks, nail holes, and other defects shall be appropriately filled and smoothed.

3.3 WORKMANSHIP

- A. All painting shall be done in a workmanlike manner, leaving the finished surface free from drops, ridges, waves, laps and brush marks. Sufficient time shall be allowed between coats to insure proper drying. Paint shall be applied under dry and dust free

conditions. Paint shall be applied in a manner that the coverage shall not exceed that recommended by the manufacturer. Where there is any doubt, either about generic composition or compatibility of existing coatings a test application shall be made and after 14 days checked for adhesion characteristics and other forms of incompatibility.

3.4 COLORS

A. Where two field coats or more are required by these specifications, the colors shown in this section shall be used for all except the final coat. Final paint shades must be approved after application of the initial coats and before the application of the final coat. Selected colors for the project are from the Carboline color book. Trim shall be finished same as wall colors. A color schedule complete with color chips shall be submitted for approval.

B. Exterior Work:

Manhole frames and covers Black

Electrical Equipment & Poles Aluminum Color

Street Marking Yellow

Guards and Caution Marking Safety Yellow

Piping - Stenciled names and Color Code
Direction Arrows every 36"

Valves - To match Pipe Color Code

C. PIPING, PUMPS, VALVES: Color Code

1. Identification painting shall be provided for all piping in accordance with the following schedule. Names and flow arrows shall be stenciled on all the piping in an appropriate approved contrasting color.

3.5 CLEAN UP

A. The work area shall be kept free from surplus materials, dirt and rubbish at all times. After completion of the work, all paint spots or other marks shall be removed from floors, walls, doors, and windows, etc. All exposed metal work and glass shall be carefully cleaned, and the work area left clean.

3.6 UNSATISFACTORY APPLICATION

A. If the item has an improper finish, color, or insufficient film thickness, the surface shall be cleaned and topcoated with the specified material to obtain the specified color and coverage. Specific surface preparation information will be secured from the coatings manufacturer and approved by the Engineer. All visible areas of chipped, peeled, or abraded paint shall be hand or power-sanded, feathering the edges. The areas shall then

be primed and finish coated in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections. Evidence of these conditions shall be cause for rejection. Any defects in the coating system shall be repaired by the Contractor per written recommendations of the coating manufacturer and as approved by the engineer.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this section of specifications consists of furnishing all plant, labor, supervision, equipment and materials and performing all operations in connection with Equipment Erection as shown on the Drawings and as specified herein.

1.2 RELATED SECTIONS

- A. Section 03000 - Concrete
- B. Section 03600 - Grout

1.3 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these Specifications.
- B. Product Data: Provide manufacturer's catalog sheet for material indicating physical properties.

1.4 GENERAL REQUIREMENTS

- A. All equipment and pipe supports shall be grouted with plain grout, unless otherwise directed.
- B. The Contractor, unless instructed otherwise by the Resident Project Representative (RPR) shall comply with the markings where shown for lifting and other such notations placed upon the packages.
- C. The Contractor shall be responsible for the final alignment of all motors purchased directly by the Owner or furnished with the equipment purchased by the Owner or furnished by the Contractor.
- D. All work necessary for preservation of and preventive maintenance for equipment, whether stored or erected, shall be performed by the Contractor. Preservatives shall be furnished by the Contractor. Contractor to maintain written records of all preservation and preventive maintenance performed on major equipment before time of final acceptance.
- E. Spare parts furnished with equipment, but not to be erected, shall be placed in the storage area designated by the RPR.
- F. The Contractor shall furnish such expendables as welding rods, oxygen, acetylene, stainless steel (ss) shims, cleaning solvents, cleaning rags, etc.

- G. Equipment guards, platforms, railings, etc., furnished with equipment, shall be completely erected by the Contractor.

PART 2 PRODUCTS

2.1 TAGS

- A. All equipment shall be provided with stainless steel equipment identification tags (not painted) showing equipment number, permanently attached to the equipment.
- B. Information on the equipment tag is to include equipment identification, equipment size, basic operating characteristics; such as RPM, GPM, HP, volts, amperes, full load efficiency and any other information pertinent to the use and operation of the equipment.

2.2 GROUT

- A. Conform to requirements of Section 03600, Grout of these Specifications.

PART 3 EXECUTION

3.1 ERECTION AND ASSEMBLY

- A. The Contractor shall place and assemble equipment and machinery in accordance with the best practice of the trades involved.
- B. Wherever equipment manufacturer's special setting or erection instructions are furnished or called for by the manufacturer's representative, they shall be followed.
- C. Wedging will not be permitted. Only flat shims shall be used in leveling equipment. All shims shall be furnished by the Contractor. Jack nuts shall not be used on anchor bolts for leveling, aligning or supporting machinery and equipment.
- D. Dial indicators shall be used for equipment alignment unless otherwise instructed by the RPR.
- E. Couplings shall be aligned within .003" tolerance overall unless otherwise instructed by the RPR.
- F. Only oil bath heaters shall be used to expand bearings, couplings, etc. Oil temperature shall be controlled to prevent overheating of bearings. Should bearings be heated to temperature higher than that recommended by the bearing manufacturer, the Owner shall have the right to require the Contractor to provide new bearings in exchange for those overheated.
- G. No piping shall be permanently bolted to equipment flanges until the pipe is sufficiently supported and has been checked by the RPR to see that no strain is placed on the equipment. All mechanical drive couplings assembled by the vendor shall be broken and checked by the Contractor prior to start-up and any misalignment shall be corrected. All

mechanical drive couplings shall be rechecked prior to start-up for misalignment and any misalignment shall be corrected by the Contractor.

- H. The work includes the flushing of gear cases and lubricant boxes where necessary and placement of initial fill of lubricants.
- I. Equipment erection shall include furnishing and installing dowels which shall be standard taper pins (1/4 inch to ft.) with pulling nut. Dowels shall be installed for each component piece, in a drilled and taper reamed hole in each of the diagonally opposite feet near the anchor bolt. Dowels shall not be installed until after the final alignment, immediately prior to start-up, has been completed.
- J. The Contractor shall remove any beams, bracing, etc., which interfere with erection of equipment and shall reinstall all components so removed immediately after erection of the equipment. The Contractor shall install any temporary supports required to permit erection of equipment.
- K. Openings for access into the building shall be made and closed by the Contractor.
- L. The Contractor must furnish, install, and dismantle any temporary access platforms that he deems necessary to erect the equipment.
- M. All drives involving two or more items of equipment and a motor, shall generally be installed in a sequence in which the motor is installed last. This sequence is mandatory in cases involving a direct-connected motor drive. All items shall be in place and aligned prior to grouting.
- N. Spare parts and maintenance tools furnished with equipment shall not be used for installation work, and shall be turned in to the RPR.

3.2 GROUTING OF EQUIPMENT AND MACHINERY

- A. Forms for grout shall be properly designed and constructed to hold grout in position, without leakage until the cement has set up. Form plank shall be dressed and of uniform thickness, tongue and grooved sufficiently tight to prevent the loss of mortar.
- B. Plywood or metal forms, approved by the RPR, may be used at the Contractor's option.
- C. Exposed edges shall have chamfer as directed.
- D. All necessary ties, wires, braces, etc., required to properly align the forms, shall be furnished by the Contractor.
- E. Grout shall be mixed in a mechanical mixer, either concrete mixer or mortar mixer type. For small amounts, hand mixing may be permitted if approved by the RPR. Material shall be accurately measured by volume or by weight, with mixing water carefully measured.

- F. Foundation surface shall be clean dense concrete, free from laitance, oil, soaps, or other foreign material before placing grout. Surface of foundation shall be chipped to remove deleterious material and expose aggregate. All sand, paper, or other packing shall be removed by the Contractor from anchor bolt sleeves before placing equipment. Surface to receive grout shall be thoroughly wet ahead of grouting operation. All dirt and excess water shall be removed by blowing with compressed air, or other means suitable to the RPR.
- G. Any required chipping of foundations to prepare a satisfactory surface shall be done prior to placing machinery by the Contractor.
- H. Grouting of equipment, for which the manufacturer furnished equipment erection supervision, shall be done when directed by and under the general supervision of the manufacturer's erection supervisor.
- I. Unless otherwise directed, grout shall fill the entire base and shall be finished off smoothly and flush at the grout holes.
- J. Any equipment that is required to be grouted with Non-shrink, metallic grout by the manufacturer or manufacturer's erection supervisor shall be grouted with same unless otherwise changed by the RPR.
- K. Add just enough water to make a placeable mix. Mix shall be stiff and rammed into place unless otherwise instructed by the RPR or manufacturer's erection supervisor. Where thick grout (over 3") is to be placed, it shall be done in two operations, bringing the surface up to about 1" of the machinery base and allowing the initial section to set a minimum of 24 hours before placing final grouting.

3.3 INSTALLATION OF DIRECT DRIVEN EQUIPMENT

- A. Direction and speed of rotation of driving shafts and motors shall be checked before connecting to driven shafts. Driving shafts having axial end play, such as those of motors and certain other equipment, shall be run at operating speed; and the running position shall be marked, using chalk and scribe or other similar method. The shafts shall be blocked in this position while aligning the equipment.
- B. Shaft leveling shall be by use of a machinist's (Starrett #98, or equivalent) level placed across the faces of the two coupling halves. Radial alignment shall be checked at the same time by use of a straight edge placed across the faces of the two coupling halves in both the horizontal and vertical planes.
- C. Angular alignment and end clearance shall be checked by use of a feeler gauge of proper thickness inserted at four equally spaced points, 90° apart, around the outer edges of coupling halves.

- D. Rechecks shall be made for level, radial, and angular alignment and end clearance in the same order as originally made and readjustments made until all four are in satisfactory adjustment, since any readjustment of one of the above may destroy prior readjustment of another. Final recheck shall be made with dial indicators of high accuracy.

3.4 TEST RUN

- A. Before starting an item of equipment for the first time, all of the following shall be performed:
 - 1. Direction and speed of rotation shall be checked.
 - 2. Removal of all shaft blocks used for blocking shafts in running position during installation.
 - 3. Lubrication of all parts with manufacturer's recommended grade and quantity of lubricant, and under the Owner's supervision.
 - 4. Tightening of all bolts and cap screws.
 - 5. Torch trim bolt projections to approximately 1/8 inch above nut and grind smooth.
- B. When ready to start, and before applying power, the connected equipment shall be rotated manually, if possible, to make sure that the rotating parts move freely and that there are no foreign objects in the equipment. Otherwise, a thorough visual inspection shall be made.
- C. Start-up and test run shall be conducted in the presence of the RPR and Engineer.
- D. Upon completion of test run and after all final corrections have been made, and wherever applicable, the equipment base and grouted foundation plate shall be doweled. Dowels shall be in place before placing the equipment in operation. In addition, torch trim bolt projections to approximately 1/8 inch above nut.
- E. The equipment supplier shall provide a qualified "equipment technician(s)" at the job site who is knowledgeable and competent with all aspects of the equipment and the particular application required of the equipment. Such an individual(s) is to have demonstrated competence in the following areas:
 - 1. Equipment erection, installation, and tie-ins.
 - 2. Equipment operation.
 - 3. Equipment maintenance.
 - 4. Equipment trouble-shooting, problem analysis and problem correction.
- F. Since the installation and start-up of equipment must proceed in an orderly manner and according to schedule, the "equipment technician(s)" is to be available at the job site when scheduled and is expected to cooperate with all personnel.
- G. Trials shall be run in the presence of the RPR and shall be conducted in such a way and to such an extent to demonstrate to the RPR that all provisions of the equipment specifications have been complied with in full.

- H. All results from tests, trials, and final acceptance tests shall be documented and turned over to the RPR as required by the RPR.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The Work covered by this section of the specifications consists of furnishing all plant, labor, equipment, materials and appliances and in performing all operations in connection with the furnishing, installation, testing and initial operation of the static mixer for mixing chemical additives into the water stream, complete with all appurtenances, in strict accordance with this specification and the applicable drawings, and subject to the terms of the Contract.

1.2 RELATED SECTIONS

- A. Section 11000 - Equipment Erection

1.3 GENERAL

- A. Standard Products: The equipment furnished under this section of the specifications shall be standard products in regular production by manufacturers who are regularly engaged in the production of equipment of this type, and who have produced such units which have been in satisfactory and successful operation for a period of at least five years.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these Specifications.
- B. Show materials, size, configuration, flow characteristics, headloss at minimum and maximum flow rates and weight.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. The contractor shall be responsible for protecting all components, connections, and surfaces from damage. Repair or replace all items damaged during delivery or shipment.

1.6 WARRANTY

- A. The contractor shall warrant the equipment against defects in materials and workmanship for one year from the date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURER

Mixer shall be Westfall Manufacturing Co. Counter Swirl Static Mixer Model 6000 as specified or pre-approved equal.

2.2 STATIC MIXER

- A. Blanchard WTP Side A - 36" diameter mixer shall provide uniform mixing of dilute aqueous solutions into the stream at flow rate of 28.5 MGD with a pressure drop of less than 0.36 psi maximum though its 36-inch NPS diameter housing at the maximum flow rate. The mixer overall length shall not exceed 55 inches.
- B. Blanchard WTP Side B - 36" diameter mixer shall provide uniform mixing of dilute aqueous solutions into the stream at flow rate of 23 MGD with a pressure drop of less than 0.24 psi maximum though its 36-inch NPS diameter housing at the maximum flow rate. The mixer overall length shall not exceed 55 inches.
- C. Clarks Hill - 30" diameter raw water mixer shall provide uniform mixing of dilute aqueous solutions into the raw water stream at flow rate of 12 MGD with a pressure drop of less than 0.14 psi maximum though its 30-inch NPS diameter housing at the maximum flow rate. The mixer overall length shall not exceed 51 inches.
- D. Headloss value claims, including K-Values, must be supported by independent third-party professional CFD Lab studies. This information must be supplied to the engineer at the time of submittal for pre-approval.
- E. Mixer shall be fabricated in minimum 0.375" thick carbon steel.
- F. Mixer housing ends shall be 150# RFSO flanges.
- G. Interior of mixer to be coated with 3m Skotchcoat 134 Fusion bonded epoxy coating. Exterior of mixer to be coated with Rustoleum Brown Primer. See Section 09900, Painting and Finishing of these Specifications for Painting Schedule.
- H. Basis for the mixer design shall features three curved fins welded to a pipe interior to create a counter swirling motion downstream of the mixer.
- I. Mixer shall contain a minimum of three (3) mixing fins.
- J. Mixer should achieve 0.025 CoV (coefficient of variance) mixing efficiency at 3 pipe diameters downstream of the mixer.
- K. The mixer shall have one 3/4" FNPT injection ports for chemical addition.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed by the contractor in accordance with the manufacturer's instructions and these drawings.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Chemical metering pumps for hydrogen peroxide.
- B. Pre-engineered, skid mounted, chemical metering pump system to consist of controls, piping, diaphragm metering pumps, instrumentation, valves, and appurtenances.

1.2 RELATED SECTIONS

- A. Section 13216 – Chemical Storage Tanks
- B. Section 13400 – Instrumentation
- C. Section 15060 - Pipe and Pipe Fittings
- D. Section 15100 - Valves, Cocks and Hydrants
- E. Section 16050 - Basic Materials and Methods

1.3 REFERENCES

- A. NEC - National Electrical Code
- B. NEMA - National Electrical Manufacturer's Association
- C. NSF International - National Sanitary Foundation

1.4 GENERAL

- A. Standard Products: The equipment furnished under this section of the specifications shall be standard products in regular production by manufacturers who are regularly engaged in the production of equipment of this type, and who have produced such units which have been in satisfactory and successful operation for a period of at least five years.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications
- B. Show materials, size, configuration, flow characteristics and weight.
- C. Operation and Maintenance Manuals: Submit manuals for items included under this Section and in accordance with requirements of Section 01730, Operation and Maintenance Data of these specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. The contractor shall be responsible for protecting all components, connections, and surfaces from damage. Repair or replace all items damaged during delivery or shipment.

1.7 WARRANTY

- A. The contractor shall warrant the equipment against defects in materials and workmanship for one year from the date of substantial completion.

1.8 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Hydrogen Peroxide Feed System:

- 1. Chemical Characteristics:
 - a. Physical state: Clear liquid
 - b. Maximum concentration by weight: 6.0- 12.5 percent
 - c. Specific gravity: 1.2 @ 68 degrees F
 - d. Viscosity: 1.75 to 2.5 cPs
 - e. Minimum temperature: 40 degrees F
 - f. Maximum temperature: 80 degrees F
- 2. The equipment to be provided shall include, but is not necessarily limited to, the following:
 - a. Three (3) skid mounted peristaltic pumps (P1102, P1103, P1104) with VFD's and control panels. (Qty 1) (Blanchard Plant)
 - b. Two (2) Skid mounted peristaltic pumps (P4202, P4203) with VFD's and control panels (Qty 1) (Clarks Hill Plant)
 - c. Post-Treatment
 - 1) Feed Rate (GPH): 0.8 min-8.0 max
 - 2) Back Pressure: 14 psig
 - d. All necessary valves, instrumentation and ancillary equipment necessary to make the system completely operational.

1.9 QUALITY ASSURANCE

- A. All peristaltic pumps and appurtenances furnished for this Contract shall be supplied by the same manufacturer.
- B. The pre-engineered skid mounted metering pump dosing package shall be fully tested at the manufacturer's facility to meet pressure and flow ratings prior to shipment.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600, Materials and Equipment.
- B. Accept pumps and accessories on site in factory packing. Inspect for damage. Comply with manufacturers installation instructions.

- C. Protect pumps and accessories from physical damage including effects of weather, water, and construction debris.
- D. Provide temporary inlet and outlet caps, and maintain in place until installation.

1.11 MAINTENANCE MATERIALS

- A. Provide spare parts under provisions of Section 01700, Contract Closeout
 - 1. Peristaltic pumps:
 - a. 3 sets of replacement pump tube and lubricant per pump

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Peristaltic pumps:
 - 1. Watson Marlow Qdos 120
 - 2. Approved Equal.

2.2 MATERIALS

- A. Hydrogen Peroxide Feed Pump
 - 1. Pump Type: Peristaltic Hose Pump.
 - 2. Shaft: High tensile steel.
 - 3. Pump Housing and Bearing Cartridge: Powder Coated Steel.
 - 4. Rotor: Cast Iron.
 - 5. Baseplate: Cast Steel.
 - 6. Tube: Hypalon.
 - 7. Piping connections: ½ inch, 150 lb Polypropylene Flanges.

2.3 ACCESSORIES

- A. Externally adjustable, combination back pressure and anti-syphon valves for each application:
 - 1. Factory adjusted for backpressure recommended for pump:
 - a. Not less than 15 psi
 - 2. Pressure setting indicated on nameplate
 - 3. Materials:
 - a. Body, spring, seat, support disc: As appropriate for chemical resistance
 - b. Diaphragm, seat gasket: Teflon—verify with chemical resistance
- B. Calibration columns:
 - 1. Capacity to match chemical feed pumps
 - 2. Clear glass construction, 500 ml
 - 3. Embossed graduations in standard divisions for rating gph capacity based on a one minute draw down and in 5 mL increments

4. Calibration column must be integral to equipment skid and rigidly mounted to skid with pipe clamps. Mounting calibration column to plumbing alone shall not be acceptable.
- C. Pressure relief valves in addition to the internal relief valves in the pumps:
1. 5-100 psi adjustable relief setting
 2. Materials:
 - a. Lower body, seat, ball guide, ball: As appropriate for chemical resistance
 - b. Diaphragm, seat gasket: Teflon—verify with chemical resistance
- D. Pulsation Dampeners
1. Pulsation dampeners shall be installed in the locations as shown on the Drawings to dampen the pulsating flow of the metering pumps. The pulsation dampener shall consist of a pressurized vessel containing a flexible, elastomeric bladder which separates the pressurized gas in the upper chamber from the process liquid in the lower chamber. The dampeners shall be sized such that peak pressures are within 10 percent of average pressure. The bladder and wetted end of the dampener shall be compatible with the chemical. All dampeners shall include a pressure gauge and gas fill valve.
- E. Pressure Gage: Stainless steel, 2-1/2 inch dial, glycerin filled with diaphragm seals for chemical isolation.

2.4 FABRICATION AND MANUFACTURE

- A. Frame/skid:
1. All structural members - Pultruded fiberglass reinforced plastic
 2. Mounting panels - Pultruded fiberglass reinforced plastic
 3. Gusseted members longer than 36 inch shall be tubing
 4. Provide mounting holes for installation on concrete floor pad
 5. Suitable for lifting by fork-lift
 6. Table top mounted minimum 30" above floor

2.5 CORROSION PROTECTION

- A. Electrically isolate dissimilar metals or connectors in direct contact.
- B. Use corrosion resistant materials and color code all piping, equipment and coat ferrous materials with epoxy paint system under provisions of Section 09900, Painting and Finishing.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pumps per manufacturer's instructions.
- B. Mount skids where shown on Drawings.

- C. Fit and align connecting piping to eliminate all stresses.
- D. Provide couplings, valves and fittings under provisions of Section 15060, Pipe and Pipe Fittings and Section 15100, Valves, Cocks and Hydrants of these specifications.
- E. Install combination backpressure and anti-siphon valve, pressure relief valve and pulsation dampener on the discharge of each chemical feed as close to the pumps as possible.
- F. After initial fitting and alignment, place non-shrink grout under skids, fill voids, and allow to set.

3.2 START-UP AND PERFORMANCE WARRANTY TESTS

- A. Make equipment adjustments required to place system in proper operating condition.
- B. Test each feed system for proper operation in the presence of the Owner. All testing costs are the Contractors.
- C. Furnish all testing equipment, special instruments and devices required for performance testing.
- D. Modify and/or replace defective equipment until it meets specified requirements. Re-test system to verify satisfactory operation.
- E. Demonstrate the accuracy of each metering pump using job supplied calibration column.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Provide for a minimum of one (1) days under provisions of Section 01400, Quality Control and Section 01650, Starting of Systems of these specifications.
- B. Check installation and alignments and assist in placing the equipment into initial operation.
- C. Provide a minimum of 4 hours operation and maintenance training for Owner's personnel after start-up is complete.

END OF SECTION

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope

1. Furnish all labor, materials, equipment and appurtenances required to provide a pressurized closed-vessel Ultraviolet (UV) Oxidation system complete with medium pressure amalgam lamps, automatic mechanical/chemical wiping system, and variable output electronic ballasts. The UV system shall be complete and operational with all control equipment and accessories specified herein and as shown on the contract drawings.

1.2 QUALITY ASSURANCE

- A. The UV-Oxidation Manufacturer shall be regularly engaged in the manufacture of UV-Oxidation systems in municipal drinking water applications and must provide evidence of at least ten (10) municipal installations in North America, each with a flow rate of at least 1.0 USMGD (158 m³/hr) treating either MIB or geosmin. For further clarification, UV-Oxidation Systems in industrial applications shall not be considered relevant experience
- B. The UV-Oxidation Manufacturer shall have a minimum of 10 years of experience in the design and production of ultraviolet systems for water and wastewater disinfection, and experience in the destruction by photolytic degradation of trace contaminants.
- C. The UV-Oxidation System shall be based on the use of medium pressure (MP) lamps to accomplish the specified objectives. Conventional low pressure or low-pressure-high-output amalgam lamps will not be acceptable. UV Reactors that are not validated for disinfection or that have not been previously used for advanced oxidation at an existing municipal drinking water treatment plant will not be accepted.
- D. The UV-Oxidation Manufacturer must demonstrate that the electrical consumption based on the treatment objectives, at peak flow and specified water quality (UV transmission), does not exceed the amount specified in kW defined herein.
- E. Validation testing shall also verify that the headloss generated by the proposed reactor is less than or equal to the specified limits less than 5 inches per reactor at a flow of 8500 gpm.
- F. Pre-qualification submittals from the UV-Oxidation Manufacturer shall include a complete and detailed proposal of equipment offered, including the number of lamps proposed and a detailed description of any exceptions taken to the specification.
- G. All UV-Oxidation Manufacturers shall be required to pre-qualify, unless the manufacturer is the Base Bid Manufacturer.

- H. Documentation of the UV-Oxidation Manufacturer's service capabilities including location and experience must be submitted.

1.3 SYSTEM DESCRIPTION

A. Design Criteria

1. The UV-Oxidation Manufacturer shall provide equipment to treat filtered water to the following characteristics:

- a. Blanchard Water Treatment Plant, Side A:

Peak (Design) Flow:	24 MGD
Design UVT (minimum):	96 % (at 254 nm, 1 cm path length)
Primary Target Contaminant Influent Concentration:	(MIB) 2-methylisoborneol
Primary Target Contaminant log reduction to be provided:	2.0 Log
Secondary Contaminant Influent Concentration:	Geosmin
Secondary Target Contaminant log reduction to be provided:	2.0 Log
Hydrogen Peroxide Dose:	9.5 PPM

- b. Blanchard Water Treatment Plant, Side B:

Peak (Design) Flow:	12 MGD
Design UVT (minimum):	96 % (at 254 nm, 1 cm path length)
Primary Target Contaminant Influent Concentration:	(MIB) 2-methylisoborneol
Primary Target Contaminant log reduction to be provided:	2.0 Log
Secondary Contaminant Influent Concentration:	Geosmin
Secondary Target Contaminant log reduction to be provided:	2.0 Log
Hydrogen Peroxide Dose:	9.5 PPM

c. Clarks Hill Water Treatment Plant:

Peak (Design) Flow:	8 MGD
Design UVT (minimum):	95 % (at 254 nm, 1 cm path length)
Primary Target Contaminant Influent Concentration:	(MIB) 2-methylisoborneol
Primary Target Contaminant log reduction to be provided:	2.0 Log
Secondary Contaminant Influent Concentration:	Geosmin
Secondary Target Contaminant log reduction to be provided:	2.0 Log
Hydrogen Peroxide Dose:	8.5 PPM

B. System Components

1. The UV-Oxidation System shall be comprised of the following components:
 - a. UV Reactors: 30" reactor
 - b. Number of lamps per reactor: 16
 - c. Control Power Panel(s): 1 per reactor
 - d. Master Control Panel: 1 per system
 - e. UV Intensity Sensor(s): 1/Disinfection Lamp
 - f. Automatic Cleaning System: On-line Chemical/Mechanical

C. Guaranteed Performance Requirements

- D. The UV-Oxidation Manufacturer shall provide a written guarantee that the equipment will continuously meet the specified performance requirements for each unit as follows:
 1. The UV-Oxidation System shall disinfect post-filtered water providing, a minimum, 2 log inactivation of *Cryptosporidium* when the system is operated in disinfection only mode and in T&O Control+Disinfection mode.
 2. The UV-Oxidation System shall destroy Taste and Odor (T&O) compounds 2-methylisoborneol (MIB) and geosmin while the UV system is operated in T&O Control+Disinfection Mode. The system shall be designed to achieve a minimum 2 log reduction of geosmin/MIB for the given influent water quality specified in 1.3.A and equal to that of the water samples provided to the UV-Oxidation Manufacturer.
 3. The UV-Oxidation System shall be able to continue providing disinfection while the automatic cleaning system is in operation.
 4. The UV-Oxidation System supplier must submit a third party validation report if a fouling factor higher than 0.80 is being proposed. If the proposed UV-Oxidation system does not have an automatic chemical/mechanical cleaning system than a default fouling factor of 0.80 must be used.

5. The UV-Oxidation System shall be able to continue providing disinfection while the UV intensity sensor calibration is being checked.
6. The UV-Oxidation System shall be designed to operate in an environment with ambient relative humidity of 5-90% and ambient air temperature of 0-40°C (32° – 104°F).
7. The UV-Oxidation System must meet the performance requirements outlined above at a maximum hydrogen peroxide dose of 10 ppm.
8. In the event that any part(s) of the UV-Oxidation System fail(s) to meet the guaranteed or other specified performance requirements, the UV-Oxidation Supplier shall guarantee that at their sole expense, they will provide all necessary material and personnel to modify the system to meet the specified performance requirements and rerun the performance tests or remove that part(s) of the system that is not operating properly and replace it with equipment that meets the necessary performance criteria.
9. All costs incurred for retesting, including, but not limited to the energy and the Owner's and Engineer's time, shall be borne entirely by the UV-Oxidation Manufacturer.
10. In the event that, after exercising the above remedies, the UV-Oxidation System fails to meet the Guaranteed Values, performance requirements, liquidated damages will be assessed.
11. UV System performance is contingent on the full-scale supply of water meeting the quality of the water sample provided to UV-Oxidation Manufacturer for analysis.

1.4 SUBMITTALS

- A. Submit for review, engineering drawings showing the following:
 1. Complete description in sufficient detail to permit comparison with the specifications.
 2. Dimensions and installation requirements.
 3. Descriptive information including catalogue cuts and manufacturers' specifications for all major components.
 4. Electrical schematics and layouts.
 5. Performance guarantee and warranty letters.

1.5 GUARANTEE

- A. Equipment: The equipment furnished under this section (excluding UV lamps) shall be free of defects in materials and workmanship, including damages that may be incurred during shipping for a period of one (1) year from start-up or 18 months after shipment, whichever occurs first.
- B. UV Lamps: The UV lamps shall be warranted for 9,000 hours of operation (prorated after 1,000 hours) or 36 months after shipment, whichever occurs first, without exception.
- C. Ballasts: The ballasts shall be warranted for 10 years, prorated after 1 year, without exception.

PART 2 PRODUCTS**2.1 MANUFACTURER**

- A. The physical layout of the system shown on the contract drawings and the equipment specified herein are based solely upon the TrojanUVSwift™ECT Model 16L30, as manufactured by Trojan Technologies, London, Ontario, Canada.
- B. To be acceptable, the UV system must operate in a closed vessel, use high intensity medium pressure UV lamps, use fully electronic ballasts with multiple power settings, and incorporate an automatic on-line mechanical/chemical sleeve cleaning system for both lamp sleeves and sensor sleeves/windows.
- C. To consider one product an equal, it must meet the physical characteristics required by the drawings and herein.

2.2 DESIGN, CONSTRUCTION AND MATERIALS

- A. UV Reactor:
 - 1. The UV Reactor shall be of welded construction manufactured from Type 316L stainless steel. The UV Reactor shall be passivated and bead blasted for uniform external finish.
 - 2. UV Reactor shall occupy a plan footprint no greater than 25 ft². To be considered as an alternate, UV-Oxidation Manufacturers whose reactors occupy greater than 25 ft² shall demonstrate to the satisfaction of the Engineer the proper placement of the reactor within the current design layout.
 - 3. The UV Reactor shall be designed to handle a maximum operating pressure of 75 psig, and shall be fully assembled and hydrostatically tested to 1.25 times the rated operating pressure, for at least 10 minutes without leakage, in the factory prior to shipment.
 - 4. Each UV Reactor shall be supplied with 30 inch AWWA Class B flanged inlet/outlet connections.
 - 5. Each UV Reactor shall be a nominal 30 inches in diameter.
 - 6. Each UV Reactor shall fit within a 53 inch pipe length.
 - 7. Each UV reactor shall consist of high intensity medium pressure UV lamps arranged horizontally and perpendicular to the direction of flow.
 - 8. Each lamp shall be enclosed in an individual quartz sleeve, one end of which shall be closed and the other sealed with compressed o-rings.
 - 9. Each quartz sleeve shall be independently sealed within the reactor.
 - 10. The UV reactor shall be designed such that operating personnel at the plant can change the lamps without draining the reactor.
 - 11. The UV reactor shall be provided with access ports for easy access to the quartz sleeves and cleaning system.
 - 12. All access for reactor components, including lamps, sleeves, UV intensity sensors, and cleaning system shall be from the same side. Designs requiring access from more than one side of the reactor are not permitted.

13. Piping shall be designed so that the reactor will be full of water at all times. Air trapped in the reactor shall result in reactor shut down to avoid overheating.
 14. The UV reactor shall be installed either vertically or horizontally; however lamps must be installed horizontally.
 15. The UV Lamps shall reach maximum UV output within three (3) minutes (defined as the warm-up period).
 16. Dry weight of the reactor shall not exceed 2178 lbs. / 990 kg.
 17. Wet weight of the reactor shall not exceed 4050 lbs. / 1837kg. If pipe supports are necessary, they shall be supplied by Others.
 18. All wetted components within the reactor shall be NSF 61 certified.
- B. UV Lamps:
1. The UV lamps shall be high intensity, medium pressure type with a 30 inch arc length and a maximum power input of 11.7 kW.
 2. The filament shall be significantly rugged to withstand shock and vibration.
 3. The lamp bases shall be resistant to UV and ozone.
 4. The lamps shall be operated by variable output electronic ballasts with 1% power increments, from 30% to 100% of full rated output.
- C. UV Lamp Sleeves:
1. The UV lamp sleeves shall be manufactured from Type 021AL (Synthetic), fully annealed clear fused quartz tubing or better.
 2. Lamp sleeves shall be domed at one end.
 3. The open end of the lamp sleeve shall be sealed by means of an o-ring and Type 316 stainless steel compression plate.
- D. UV Intensity Sensor(s):
1. The UV Intensity Sensor(s) shall be located inside the reactor and contained within protective quartz sleeves.
 2. One (1) sensor shall be provided per disinfection lamp.
 3. Sensor(s) shall incorporate SiC diodes, and provide NIST-traceable measurement with a total absolute uncertainty of 15% or less at an 80% confidence level.
 4. Sensor(s) must meet the requirements of the EPA 815-R-06-007. Sensor(s) must filter out wavelengths below 240 nm, and have a spectral response peaking between 250 nm and 280 nm with less than 10% coming from wavelengths greater than 300 nm.
 5. The complete Sensor assembly and the internal circuit board containing the diode shall each be serialized.
- E. Ballasts:
1. Ballasts shall be of a high frequency output, fully electronic design with a minimum efficiency of 95% at full load, and a power factor of 99% or better.
 2. Ballasts shall have a variable operation range of 30% to 100% of full rated output and be adjustable in 1% increments.
 3. The maximum allowable total current harmonic distortion (current THD) shall not exceed 10% at the maximum power level.

4. Each ballast shall supply power to one (1) lamp only.
 5. Ballasts shall have a mean design life expectancy of at least 10 years.
- F. Control Power Panel (CPP):
1. Power distribution and control for each UV Reactor shall be through the associated CPP. The CPP shall house all power supplies and control hardware.
 2. The CPP shall be designed to operate with the following electrical supply:
 - a. 400 to 480V, 50/60Hz, 3-phase, 3-wire + ground (from a grounded wye source)
 3. The maximum total power consumption rating per CPP shall be no greater than 250 amps maximum current per phase (unbalanced load).
 4. The CPP enclosure shall be painted mild steel.
 5. The CPP enclosure shall be Type 12 (IP54), ventilated.
 6. The CPP enclosure shall be forced-air cooled.
 7. Signal wiring interfacing the UV Reactor with the CPP, shall be as shown on the contract drawings.
 8. The CPP shall be installed within 72 feet (22 meters) (external running cable length) of the UV Reactor.
 9. Each CPP shall be provided with a lockable disconnect handle that shall shut down the reactor/cabinet power when the cabinet door is opened.
 10. CPP enclosure shall be floor mounted.
 11. CPP enclosure dimensions shall not exceed 117.5" (2210 mm) high x 86.75" (2388 mm) wide x 23.5" (610 mm) deep. Weight shall not exceed 2482 lbs. (1132 kg) **(16 lamp system)**.
- G. Master Control Panel (MCP)
1. General
 - a. One (1) Master Control Panel (MCP) is provided to control the functions of the UV system.
 - b. The MCP enclosure material of construction shall be Mild Painted Steel.
 - c. The MCP enclosure shall be Type 12, ventilated with forced air cooling suitable for indoor installation.
 - d. The MCP enclosure shall be UL or CSA approved.
 - e. UV reactors shall be controlled by a PLC controller (Allen Bradley CompactLogix) which continuously monitors and controls the UV reactor functions. Custom electronics, an input flow signal (supplied by others), UV Transmittance signal, UV sensor(s) and feedback from the peroxide dosing system provide the PLC with the necessary indication of system parameters.
 - f. The UV control system shall be capable of operating in dual modes 1) Disinfection-Only Mode and 2) T&O + Disinfection Mode. The UV-Oxidation control system shall be capable of adjusting both the amount of UV light delivered and the hydrogen peroxide feed rate based on input parameters in a manner consistent with minimizing O&M costs.

2. Operator Interface
 - a. Complete control and monitoring of each TrojanUVSwift™ECT reactor shall be accomplished through the operator interface located on the MCP.
 - b. The operator interface shall be the Allen Bradley PanelView Plus 1000.
 - c. The operator interface shall be menu driven, and shall display the following system information when prompted: reactor status, individual lamp status, lamp operating hours, RED (dose), UV intensity, power level, alarms, alarm history.
 - d. The most recent alarms shall be displayed on the operator interface when prompted, recorded by alarm type, date and time of occurrence, and date and time of correction.
 3. Remote Monitoring/Control
 - a. The communication between the UV reactors and the plant Distributed Control System (DCS) shall be through the following protocol:
 - 1) Allen Bradley – Ethernet
 - b. Each reactor shall be able to operate in either Local or Remote (automatic) mode.
 - c. Each system shall be provided with the following hardwired I/O for operator interface:
 - 1) Discrete input for Reactor On/Off Control from remote location.
 - 2) Discrete output indicating Critical Alarm.
 - 3) Discrete output indicating Major Alarm.
 - 4) Discrete output indicating Minor Alarm.
 - 5) Discrete output indicating System Ready.
 - 6) Discrete ON/OFF status.
 - 7) 4-20ma Flow Signal Analog input.
 - 8) 4-20ma UV Intensity Analog output.
- H. Reactor Control
1. In “Disinfection Only” mode a dose-pacing system shall be supplied to modulate the lamp power levels based on the flow rate, UV sensor signal and UV transmission values.
 2. The UV-Oxidation System must have the ability to automatically adjust power levels and hydrogen peroxide dose based on UVT and flow rate to achieve the targeted level of treatment. The level of treatment shall be user-entered up to the maximum design criteria specified herein.
- I. Safety Features
1. Each UV Reactor shall be equipped with a temperature switch to prevent the reactor from overheating. The temperature switch shall be wired to the CPP, and shall shut the reactor down and initiate a critical alarm condition when activated.
 2. Each UV Reactor shall be equipped with a water level sensor to prevent operation of the UV lamps in air. The level sensor shall be wired to the CPP and shall shut the reactor down and initiate a critical alarm condition if low water level is detected.

3. Each UV Reactor shall be equipped with a cover to protect the lamp electrical connections. For Operator safety, the protective cover shall be equipped with a switch to trigger a power shutdown to the lamps when the cover is removed.
 4. Each UV Reactor shall be equipped with an indicator light to visually signal that power to the reactor is on.
 5. Each UV Reactor shall be equipped with a reactor mounted junction box for wiring terminations with separation of high and low voltage circuits.
 6. Each CPP and reactor shall be equipped with an Emergency Stop button to shut off power to the lamps.
- J. On-line UV Transmission Monitor (Trojan OptiView™)
1. An on-line UV Transmission (UVT) monitor shall be supplied to automatically monitor the UV Transmission of the process stream (measured at 254 nm, 1 cm path length). UV Transmission range shall be 70% to 100%.
 2. The UVT Monitor shall include a UV lamp, UV sensor, drive system, system controller and operator interface.
 3. The operator interface shall display the system status and allow for manual on/off system control. The operator interface of system shall be located on the door of the enclosure.
 4. Enclosure shall be stainless steel, Type 4X. Enclosure shall wall mounted and weigh no more than 65 pounds / 30 kg.
 5. Inlet/outlet fittings to be 3/8" female for connection to process stream and drain. Supply tubing/piping (by Others) shall be a maximum of 1/4" internal diameter.
 6. Enclosure dimensions shall be no greater than 20 inches (508 mm) wide by 20 inches (508 mm) high and 10 inches (254 mm) deep.
 7. A 4-20 mA output shall be provided for data transmission to remote devices. A discrete common alarm shall be provided for remote indication of alarm condition.
 8. The system shall be designed to handle flow rates of 0.1 gpm (0.4 l/min.) – 0.5 gpm (2.0 l/min) at a maximum inlet pressure of 30 psi. If flow regulators and/or pressure reducers are required to maintain specified minimum and maximum values, they shall be provided by Others.
 9. Power supply to the OptiView™ system shall be 120V, single phase, 60 Hz, 250 VA.
 10. OptiView™ panel shall be UL, CSA, and CE approved.
 11. OptiView™ panel to be installed in an indoor, non-freezing environment.
 12. The process stream temperature range to be 36-104°F (2-40°C).
 13. The expected life of the OptiView™ lamp shall be 9,000 hours.
- K. Cleaning System
1. Each UV Reactor shall be equipped with an automatic on-line chemical/mechanical sleeve cleaning system.
 2. The cleaning system shall be driven by a hermetically sealed magnetically coupled hydraulic drive. The drive system shall be designed such that all hydraulic connections are outside the UV reactor. The hydraulic fluid used shall be biodegradable.

3. The cleaning system shall provide both mechanical and chemical cleaning abilities for both the lamp sleeves and the UV Sensor sleeves complete with an automatically initiated and controlled cleaning cycle. The cleaning system shall be fully operational while still providing disinfection.
 4. Cleaning cycle intervals shall be field adjustable via the operator interface. Manual cleaning system control shall also be through the operator interface.
 5. The system shall be provided with the cleaning reagents and solutions required for initial equipment testing and equipment start-up.
 6. Cleaning reagents and solutions used shall be NSF™ 60 approved.
- L. Spare Parts:
1. The following spare parts and safety equipment shall be supplied:
 - a. 10 UV Lamps 5%
 - b. 10 sleeves 5%
 - c. 10 ballasts 5%
 - d. 2 UV intensity sensors
 - e. 3 reference sensor
 - f. 3 set of seals and o-rings per reactor
 - g. 3 set of replacement wiper seals per reactor
 - h. 2 Face Shield, able to block UV light wavelengths between 200 and 400nm
 - i. Cleaning solution for 1 year of operation
- M. Water Sampling Ports:
1. To carry out effective performance testing and post start-up service and support, water sampling ports shall be installed in two locations
 - a. One sampling port shall be located post hydrogen peroxide injection and upstream of the UV reactor
 - b. One sampling port shall be located at least two(2) pipe diameters downstream of the UV reactor.
- N. Injection Ports:
1. Injection ports used for spiking various testing agents into the system for performance testing shall be installed upstream of the hydrogen peroxide injection port.

PART 3 EXECUTION

3.1 INSTALLATION

- A. In accordance with the contract drawings, manufacturer's engineering drawings and instructions.

3.2 MANUFACTURER'S SERVICES

- A. Installation Supervision: As required by phone or fax.
- B. Start-up and Operator training: 2-3 full days on site, per reactor.
- C. Warranty Service: As required during the warranty period.
- D. Commissioning Test:
1. Prior to Startup, the UV-Oxidation Manufacturer shall inspect the installed UV System for proper alignment, correct operation, proper connection, and satisfactory function of all components. The UV-Oxidation Manufacturer's representative shall approve the installation and provide certification that the system components have been installed correctly and are ready for operation. If the UV System needs corrective action prior to beginning of commissioning test, the UV-Oxidation Manufacturer shall work with the Contractor to make all necessary modifications to meet these specified requirements. The proposed commissioning test procedure shall have been developed by the UV-Oxidation Manufacturer and submitted to and approved by the Engineer before scheduling and performing the Commissioning Test.
 - a. Commissioning test shall include confirming the operability of the communications between the UV control panels, PLC, and the plant DCS. The UV-Oxidation Manufacturer shall require the presence of both the Contractor and the plant control system UV-Oxidation Manufacturer during the communication test.
 - b. Commissioning test shall be witnessed by the Engineer and shall demonstrate that the UV equipment and related control system operate in accordance with the specifications, including all operating, monitoring, and shutdown functions.
- E. Acceptance Testing:
1. The acceptance testing shall be performed following the commissioning. Acceptance testing shall include head loss testing and intensive effluent quality testing. The proposed acceptance testing procedure shall have been developed by the UV-Oxidation Manufacturer and submitted to and approved by the Engineer before scheduling and performing the acceptance test.
 - a. During the acceptance test, the construction contractor shall monitor the UV System continuously for ten days to demonstrate that the system meets the Guaranteed Performance Requirements of this specification
 - b. Hydraulic Tests: Acceptance testing shall include measuring hydraulic losses through each module which shall be plotted on a curve showing flow rate on the horizontal axis and head loss in inches of water on the vertical axis. The pressure shall be measured at the upstream side of the trains and immediately downstream of the train.
 - c. Effluent Quality Tests:

- 1) Acceptance testing shall include effluent quality tests to confirm that the effluent quality is satisfactory under the specified design conditions. The testing period shall be for 3 consecutive days
 - a) Prior to the start of the intensive test, the UV-Oxidation Manufacturer shall propose the number, location of online UV lamps based on the measured filtered UV transmittance and average lamp age in order to achieve the performance metrics specified in this section. The lamps shall be cleaned during testing at the frequency recommended by the UV-Oxidation Manufacturer and approved by the Engineer.
 - b) The timing for the tests shall be determined based on available flow rates variations and laboratory working hours and shall be approved by the Engineer. The construction contractor shall undertake the collection of laboratory testing of all samples taken. Analytical laboratories shall be certified by the regulating body (Georgia Environmental Protection Division) for the specific tests being run and approved in advance by the Engineer.
 - c) On each of the 3 days during acceptance test, grab samples for the influent and effluent of the UV system shall be collected and analyzed for the concentration of T&O compounds. The influent sample shall be taken prior to the effluent being divided into separate UV trains and the effluent sample shall be taken after the recombination of the flow going through the UV-Oxidation System. At the time when the samples are collected, the time, UV intensity, lamp age, power output levels (if applicable) and effluent flow rates shall be recorded. The influent samples shall also be analyzed for UV transmittance.
 - d) The acceptance test shall be considered to be successful if the effluent results for each day of the test period meet the following:
 - (1) The target contaminant concentration of geosmin/MIB the influent samples is reduced by at least 2.0 log units
 - e) A qualified representative of the UV-Oxidation Manufacturer shall supervise acceptance testing and certify the system's performance during the tests. Tests shall be documented during continuous operation of the system, and the UV-Oxidation Manufacturer shall submit to the Engineer five copies of a complete report containing all original test data, calculations, and descriptions of the acceptance testing procedures and results.

- f) If, in the opinion of the Engineer, the system meets the Performance Requirements, the Engineer will recommend to the city, by letter, the official acceptance of the UV-Oxidation System. If, in the opinion of the Engineer, the acceptance test results do not meet the requirements specified herein, the Engineer will notify the UV-Oxidation Manufacturer and the City in writing of the unacceptable performance.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Work covered by this section of the specifications consists of furnishing all plant, labor, equipment, materials and appliances and in performing all operations in connection with the furnishing, installation, testing and initial operation of the sample pumps, complete with all appurtenances, in strict accordance with this specification and the applicable drawings, and subject to the terms of the Contract.

1.2 RELATED SECTIONS

- A. Section 01650 - Starting of Systems
- B. Section 11000 - Equipment Erection

1.3 GENERAL

- A. Standard Products: The equipment furnished under this section of the specifications shall be standard products in regular production by the manufacturers specified herein.

1.4 SUBMITTAL

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Equipment Submittal: Within 15 days after award of contract, the Contractor shall furnish for the Engineer's approval, six copies of manufacturer's bulletins, specifications, pump curves and other data showing size, performance and mounting base dimensions. It shall be the responsibility of the contractor to verify the existing conditions for installing the pumps to assure proper alignment and fit of the total pump and piping assembly. The Contractor shall be responsible for securing the services of a competent, factory trained, field engineer from the manufacturer to supervise the installation of each item of equipment covered in this section of these specifications.

1.5 WARRANTY

- A. Materials and Workmanship: All complete pumping units shall be warranted by the Contractor against all defects in materials and workmanship for a period of one (1) year from the date of final acceptance. The Contractor shall be obligated to replace all parts and accessory construction proved defective within one (1) year at no cost to the Owner.

PART 2 PRODUCTS

2.1 SAMPLE PUMPS

- A. Sample Pumps shall be AMT Pump Company Model 489A-98, or approved equal, with 1.5 HP motor, 30 GPM @ 70 TDH. Pumps shall be horizontal close coupled electric motor driven, stainless steel pump, stainless steel impeller, Vion N seals with TEFC single phase 115/230V, 60 HZ Motor. Provide two (2) installed pumps.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pumps at the locations shown in accordance with the manufacturer instructions.

3.2 FIELD TEST

- A. After the pumping equipment and controls are installed, the Contractor shall conduct, in the presence of the Engineer, an eight-hour test run covering the full range of operating conditions as specified herein. Acceptance of the equipment shall be predicated upon satisfactory operation during this field test. The Contractor shall furnish all equipment, labor, materials, and bear all costs of the eight-hour test of each pumping unit.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this section of specifications consists of furnishing all plant, labor, supervision, equipment and materials and performing all operations in connection with furnishing and installing the chemical storage tanks and associated equipment. The work shall be in accordance with this section of these specifications and the applicable drawings, subject to the terms and conditions of the contract.

1.2 REFERENCES

- A. ASTM C581- Chemical Resistance of Thermosetting Resins Used in Glass - Fiber Reinforced Structures
- B. ASTM C582 - Reinforced Plastic Laminated for Self-Supporting Structures in a Chemical Environment.
- C. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastic and Electrical Insulating Materials.
- D. ASTM D3299 - Filament - Wound Glass - Fiber Reinforced Polyester Chemical Resistant Tanks
- E. ASTM D1784 - Rigid Polyvinyl Chloride Compounds
- F. ASTM D1998 - Polyethylene Upright Storage Tanks
- G. ARM Standards - Low Temperature Impact Resistance (Falling Dart Test Procedure)
- H. ANSI B-16.5 - Pipe Flanges and Flanged Fittings
- I. OSHA Standards - 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids
- J. ASME RTP-1 - Reinforced Thermoset Plastic Corrosion-Resistant Equipment
- K. ANSI/NSF 61 - NSF International for Drinking Water System Components

1.3 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.

- B. Detailed shop drawings, catalog data, and installation instructions for all tanks, piping and equipment shall be submitted to the Engineer for approval. Shop drawings are to include critical dimensions, fitting locations, construction materials and certification of approved chemical usage in this application. Fabrication of the tank shall not commence until shop drawings are approved. Operating and maintenance instruction bulletins for each type of equipment shall be submitted, and such bulletins shall include a parts list.

1.4 GENERAL

- A. The tanks shall be high density polyethylene or Dual-Laminate tanks as appropriate for storing hydrogen peroxide. Tanks shall be UV protected to protect hydrogen peroxide from degradation from the sun. All piping and fittings, connections, insulation, heat tracing equipment and appurtenances as hereinafter specified and/or required to assure a complete and satisfactory installation shall be provided.

1.5 SCHEDULE OF CHEMICAL STORAGE TANKS

- A. The tanks shall be vertical, flat-bottomed cylindrical tanks with a semi-flat dome top. Tank volumes of the following tabulation are minimum; tank sizes and types are as follows:

Tank Number: T1101	Volume: 8500 gal	Service: Hydrogen Peroxide (50%)		
S.G. @ 60°F: 1.2	Size: 9'-0"Ø x 18'-0" nom.	Insulation: (N)	Heat trace: (N)	
Tank Material: Dual Laminate ECTFE (Halar) lined	Fitting Material: PVC	Gasket Material: Viton	Bolt Material: Titanium	
Fittings: 1 – ½" Threaded FPNT coupling mounted in a 1" Ø Flanged nozzle with a bling flange 3 – 2" Ø flanged nozzles – one (1) with internal siphon pipe 4 – 3" Ø flanged nozzles – one (1) with a blind with one (1) 2" Ø Male addaptor 1 – 14" Ø flanged nozzle with a hinged cover with an insect screen		1 – 24" Ø Manway with a cover 2 – GCS "Trunnion" style Lifting Lugs 4 – GCS Hold Down Lugs 3 – 2" PVC Fill Pipe Clips with SST U-Bolts 3 – 3" PVC Overflow pipe clips with SST U-Bolts		
Accessories: Provide Seismic restraint system with 316 sst anchors, cables and hardware Provide FRP ladder and Safety Assist Rail System with all attachments Provide FRP Top Perimeter Handrail System with Safety Gate, toe plates and all attachment hardware				

Tank Number: T4201	Volume: 3900 gal	Service: Hydrogen Peroxide (50%)	
S.G. @ 60°F: 1.2	Size: 7'-6" Ø x 12'-3" nom.	Insulation: (N)	Heat trace: (N)
Tank Material: HDLPE-UV Stabilized	Fitting Material: PVC	Gasket Material: Viton	Bolt Material: Titanium
Fittings: 1 – 24" O.D. Polypropylene threaded top manway 1 - 3" PVC U-Vent assembly w/bulkhead fitting (vent) 1 – 14" O.D. Polypropylene hinged air-surge emergency vent (w/ insect screen) 1 – 2" PVC threaded bulkhead FNPT fitting (top-fill) 1 – 3" PVC threaded bulkhead FNPT fitting (side at top - overflow) 1 – 2" PVC threaded bulkhead FNPT fitting w/internal siphon (side-outlet) 1 – 2" PVC threaded bulkhead FNPT fitting (top – misc. connection)		1 – 3" threaded bulkhead FNPT fitting (top-reverse level) 1 – ½" PVC threaded bulkhead FNPT fitting (top – misc.) 4 – Molded-in HDPE lifting lugs (top mounted) 4 – Molded-in HDPE hold down lugs (top mounted) 3 – 2" PVC fill pipe Clips w/ bulkhead fittings (designed for schedule 80 PVC pipe) 3 – PVC overflow pipe clips w/bulkhead fitting (designed for schedule 80 PVC pipe)	
Accessories: Provide Stainless Steel Seismic/wind cable tie down assembly Provide FRP standard tank ladder & tank attachment (SII standard) Provide Shop Hydrotest and standard ASTM D-1998 Test Provide plastic shrink wrap for shipping protection			

- B. **Loading Conditions:** The tanks shall meet the following criteria: a wind load limit of 100 MPH when anchored, and a concentrated top load design for a 250 pound man on 16 sq. inches. Tank designs shall be for chemical temperatures up to 100° F. Tanks shall be securely fastened to the foundation using a stainless steel cables and hardware furnished by the tank vendor to provide the required restraint or with an equivalent approved manufacturer recommended restraint. Design for seismic zone 2A.
- C. All side wall inlet and outlet nozzles shall be double flanged bolted fittings. Top fittings shall be standard or self aligning bulkheads. Flanges shall conform to ANSI B16.5 150 lbs. for diameter and drilling. Gaskets shall be provided for all tank openings and shall be full faced and appropriate for the chemical content. Insofar as possible, the orientation of all nozzles and man-way shall be suitable for the installation as shown on the Plans.

1.6 WARRANTY

- A. The tank, equipment and piping furnished and installed by the Contractor shall be guaranteed by the Contractor against all defects in materials and workmanship for a period of one year and warranted for three years from the date of final acceptance. The Contractor shall be obligated to replace all parts and accessory construction proved defective within one year at no cost to the Owner.

PART 2 PRODUCTS

2.1 HIGH DENSITY LINEAR POLYETHYLENE TANK (CLARKS HILL PLANT QTY 1)

- A. The double wall HDLPE tank consists of one cylindrical inner primary tank and one blended form octagonal outer secondary tank. Each tank is molded in one-piece seamless construction by rotational molding (laminated or fabricated tanks will not be accepted). The assembly shall be designed to prevent rainwater from entering the containment tank. The design shall allow direct primary tank base retention for up to seismic conditions per IBC code requirements. The containment tank shall be designed to hold a minimum of 115% of the normal fill capacity of the primary tank.
- B. All polyethylene resin material shall contain a minimum of a U.V. 15 stabilizer as compounded by the resin manufacturer.
- C. Tank shall be manufactured by Snyder Industries Part Number 5190000N or approved equal.

2.2 DUAL-LAMINATE FABRICATED TANK (JIM BLANCHARD PLANT QTY 1)

- A. Description: Dual Laminate tank shall be a Derakane 411-350 FRP Resin with a 2.3mm thick fabric backed ECTFE (Halar) Thermoplastic Liner.
- B. All Nozzles shall be drilled in accordance with ANSI B 16.5 standard.
- C. Bolt Holes shall straddle major centerlines.
- D. Only flanged nozzles less than 6" diameter to be gusseted (where practical).
- E. Provide FRP encapsulated nameplate. Name plate to include manufacturer name, owners name and location, purchase order number, job number, equipment number, equipment capacity, design conditions, chemical contents, drawing number, misc. Notes and date shipped.
- F. Vessels shall have a white gel coat with a protective U.V. coating for improved weather resistance.
- G. All thermoplastic welds on dual laminate equipment shall have a layer of conductive carbon veil as a target for spark testing.
- H. All thermoplastic liner materials shall undergo a series of spark test during the fabrication procedure.
- I. Tank shall be manufactured by B&D Plastics, LLC or approved equal.

2.3 PIPING, FITTINGS, VALVES

- A. All PVC piping and fittings shall be Schedule 80 Type 1, Grade 1, polyvinyl chloride (PVC) conforming to the requirements of the Plant Piping Section of the specifications.
- B. Valves shall be thermoplastic ball valves and manufactured of the same PVC compound as the fittings to assure compatibility. All ball valves shall have Teflon ball seals and Viton stem and body seals. Ball valves shall carry a working pressure rating of 150 psi gauge at 73°F. The design of all ball valves shall be such that a union design will be incorporated into each end of the valve. Ball valves sized ½ inch through 2 inch shall be provided with socket ends and be equal to Chemtrol TU series as manufactured by Celanese Piping Systems.
- C. Fill Stations: A permanent fill station shall be constructed as shown on the drawings and shall be fitted with quick couplers. Quick Coupler Adaptors and caps for making quick connections shall be Kamlok 633A and 634B, respectively or equal. Couplers for Sodium Hypochlorite shall be titanium.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation of the tanks and appurtenances shall be in accordance with the Drawings and with the tank manufacturer's instructions and recommendations. Conflicts of information shall be called to the attention of the Engineer.
- B. Inspect all concrete pads for proper elevation, dimensions, cutouts, evenness and anchor bolt locations and correct if necessary.
- C. Support piping independent of equipment. Tanks shall be free from all loads and stresses induced by the piping.
- D. Do not install damaged tanks until repairs are made in accordance with manufacturer's written instruction and approval by the Engineer.
- E. Tie-down lugs for tanks shall be grouted or shimmed to prevent excessive loads being transferred to the tank shell.
- F. Pipe Installation: Installation practices, including support spacing and solvent welding, shall be in compliance with the manufacturer's printed recommendations. Valve stems shall be positioned up.
- G. Insulation: Exposed exterior liquid lines shall be insulated where indicated. Insulation shall be applied to the pipe with longitudinal seams and butt joints sealed with adhesive. Insulation shall be sealed vapor tight at walls and ceilings. Fittings and valves shall be insulated with fitting covers fabricated from insulation materials in accordance with recommendations and template patterns of the insulation manufacturer. All joints in the

fitting covers and joints between fitting covers and adjacent pipe insulation shall be sealed with adhesive. Insulation shall be furnished with four coats of Weatherproof Plastic reinforced with glass mesh. Glass mesh shall be embedded in the first and third coat while wet. Insulation shall be Armstrong Armaflex 22, with 520 Adhesive, and Armstrong Weatherproof Plastic, or equal.

3.2 STERILIZATION

- A. Tanks and piping installed in this contract shall be sterilized by filling the tank with water to which enough chlorine, either as high-test calcium hypochlorite or liquid chlorine, to produce a minimum concentration of 50 milligrams per liter (mg/.1) throughout the tanks. After the tank has been standing full for 24 hours, the solution shall be tested and shall show a minimum chlorine concentration of 10 mg/1 and zero coliform bacteria. The chlorinated water shall then be appropriately wasted. The tank and piping are to be sealed after meeting this requirement.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this section of specifications includes supervisory control and data acquisition system (SCADA), instrumentation, and controls with appurtenant equipment and accessories as indicated, specified, and as necessary for a complete and properly operating system. The supervisory control and data acquisition (SCADA) system shall consist of new PLC control panel, engineering design and supply of field instruments and control devices, interface with the water treatment plant HMI, and performing other work and providing other appurtenances as noted in these specifications.

1.2 RELATED SECTIONS

- A. Section 11260 - UV - Oxidation Equipment
- B. Section 16010 - Electrical - General Provisions
- C. Section 16050 - Basic Materials And Methods

1.3 GENERAL

- A. Work includes, but is not necessarily limited to, the following:
 - 1. Engineering design and selection of all components including SCADA hardware, field instruments and control devices, etc. as indicated, specified, and required by the plans, loop descriptions and other specifications sections contained herein.
 - 2. All engineering, hardware and software installation, and onsite supervision necessary.
 - 3. Testing and operational demonstrations as specified.
 - 4. Final terminations of all I/O signals and AC power wiring to equipment, instruments, and control panels specified and supplied under this section of the contract documents.
 - 5. Training programs as specified.
 - 6. Preparation of Operation and Maintenance Manuals.
 - 7. Preparation of Record Drawings.
- B. Work not included:
 - 1. Physical installation of in-line devices.
 - 2. Physical installation of control panels.
 - 3. Physical installation of field instruments and associated mounting hardware.
 - 4. Conduit and wire.

1.4 QUALITY ASSURANCE

- A. The SCADA system is an integrated system and, as such, shall be furnished by a single licensed and approved Instrumentation and Control System Integrator (ICSI) who shall

provide all of the instruments, equipment, and appurtenances regardless of manufacturer, and who shall be responsible to the Contractor for the complete and satisfactory operation of the entire SCADA system.

- B. These specifications cover the intended functionality of the equipment, but do not necessarily cover all details necessary for a complete, operable and functional system. The Instrumentation and Control System Integrator shall supply all devices and appurtenances necessary to provide a complete, operable and satisfactory system as indicated or specified.
- C. Instrumentation and Control System Integrators:
 - 1. In order to protect the integrity of and insure compatibility with Water System equipment, the services of Whitaker Electric, of Appling, Georgia shall be obtained by the Contractor to act as the Instrumentation and Control System Integrator to perform the work defined herein. No substitutions will be allowed and products or services from other sources will not be accepted without the express written consent of the Engineer.
- D. Contractor:
 - 1. Shall be fully and solely responsible for the work of the systems supplier and solely responsible to the Owner for having supplied to the Owner the complete supervisory control and data acquisition system.
 - 2. To provide personal superintendence and direction to the work, maintaining and supplying complete supervision over and coordination between all subcontractors employed by him.
 - 3. To be responsible for defining the limits of his subcontractor's work.
 - 4. Shall be responsible for physical mounting/setting of instruments, including instruments as provided under other sections of these specifications.
 - 5. Final piping and/or wiring connections to all instruments, including instruments as provided under other sections of these specifications shall be made by the Contractor and/or electrical subcontractor.
 - 6. Physical mounting/setting of all control panels shall be made by the Contractor and/or electrical subcontractor.
- E. Underwriters Laboratories, Inc. (UL) Listing of Control Panels:
 - 1. All control panels supplied for this project shall be UL 508 listed.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Product data: Within 90 calendar days after the Contractor has received the Owner's Notice to Proceed, submit electronically the following:

1. Component manufacturing data sheets indicating pertinent data and identifying each component by item number and nomenclature as indicated on the drawings and in the specifications.
 2. Component drawings showing dimensions, mounting and external connection details.
 3. System wiring schematics, each on a single drawing with full description of operation. Component identification on the schematic shall be as indicated above.
 4. A system schematic of the major in-plant SCADA system components.
 5. A system schematic of the major telemetry (remote site) SCADA system components.
 6. Component manufacturing data sheets for each SCADA system item, including all system peripherals and remote site hardware.
- C. Provide electronic copies of operation and maintenance manuals complying with the following provisions:
1. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for operation and maintenance.
 2. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. Instruction Manuals
1. Provide electronic copies of instruction manuals for approval. After approval, provide, two (2) hard copies to be kept on site (1) for Superintendent and one for Inspector. Electronic copies shall be maintained by the Instrumentation and Control System Integrator.
 2. Operating instructions to incorporate a functional description of the entire system including the "as-built" system schematics.
 3. Include and clearly define special maintenance requirements particular to the system along with special calibration and test procedures.
- E. Software Documentation
1. Provide complete documentation for operation and maintenance, covering both operating system software and application software.
 2. Furnish one (1) set of documentation for operating system software.
 - a. This to be the hardware manufacturer's standard comprehensive documentation for the operating system as supplied for this project.
 - b. Include complete user information for proper utilization of the system.
 3. Furnish electronic copies of detailed user manuals for the application software.
- F. Design manuals to permit Owner's personnel to adequately understand the operation of the system as it relates to the process being controlled.
- G. Sub-divide manuals into detailed sections describing each of the major software sub-systems provided.

- H. Each sub-section to include an overview or abstract defining in general terms the function of that particular sub-system.
- I. Following the overview include a detailed functional description of the operation of that particular sub-system including a detailed explanation of all operator inputs required, copies of typical displays involved with the function of the particular subsystem, and, where applicable, include copies of typical hardcopy printouts associated with the sub-system.
- J. Make significant use of step-by-step examples to simplify system use and operation.
 - 1. User manuals are to be sturdily bound in hardback binders.
- K. Drawings
 - 1. Provide "as-built" drawings containing all necessary information for proper maintenance and system operation.
 - 2. Interconnection information between system components; and system components and packaged equipment found in other sections of these specifications, shall be complete with all necessary interconnection information. Notes referring to equipment manufacturer's drawings for proper interconnection will not be acceptable.
 - 3. Systems manufacturer to be responsible for furnishing the drawings.

1.6 PRODUCT DELIVERY, HANDLING, AND STORAGE

- A. Schedule the delivery of the equipment to coordinate with the project completion schedule. Each item of equipment shall be tagged with identifying number shown on the Shop Drawings.
- B. Contractor's attention is directed to the fact that equipment has delicate components and extreme care shall be taken in handling to avoid internal and/or external damages. Damaged equipment will not be accepted.
- C. Equipment not for immediate use shall be stored inside a building, with enclosures under protective coverings and shall be fully protected from moisture, extreme heat and vibration.

1.7 WARRANTY

- A. Provide one (1) year warranty from project substantial completion date.
- B. The Instrumentation and Control System Integrator shall furnish a hardware maintenance contract for the computer system, providing for an 8-hour response time in normal working hours, five days per week for a period of one year after acceptance of the SCADA system. For any service visit during this period, provide the Owner and Engineer with a written report stating the reason for equipment failure and recommendations to prevent recurrence.

- C. Upon expiration of the initial one-year warranty period, the Instrumentation and Control System Integrator shall make available to the Owner a maintenance contract to cover computer/SCADA system hardware, HMI/SCADA software, PLC software, PLC hardware, radio telemetry equipment, field instruments, and instrumentation repair and calibration services.

1.8 CONTROL LOOP DESCRIPTIONS

A. Hydrogen Peroxide Metering

1. The Jim Blanchard Water Treatment Plant has two distinct sides for filtering water and UV/AOP treatment. The sides will be defined as Side A and Side B. A new PLC cabinet will be installed in filter gallery where shown on the plans. All inputs/outputs from the hydrogen peroxide chemical feed system will be connected to this PLC. PLC-WPPCUV will be connected to the local plant network and will communicate to the UV factory control panels (1 on Side A (FCP-UVA) and 1 on Side B (FCP-UVB)). The PLC will receive flow and dosage information from the UV factory control panels as required for the treatment process.
2. The Clarks Hill Water Treatment Plant will utilize the UV factory control panel for I/O and control of the UV/AOP process. This panel will be connected to the SCADA network to provide a readout on the HMI. A new PLC cabinet will be installed in the UV Electrical Room where shown on the plans. All inputs/outputs from the hydrogen peroxide chemical feed system will be connected to this PLC. PLC-WPCHUV will be connected to the local plant network and will communicate to the UV Factory Control Panel FCP-UVC. The PLC will receive flow and dosage information from the UV factory control panel as required for the treatment process.

1.9 SCADA SYSTEM

A. SCADA Functional Descriptions

1. See Contract Drawings for Control System Architecture and Process and Instrumentation Diagrams.
2. The SCADA system shall include all the hardware described herein with PLC.
3. The SCADA system shall be configured for the inputs/outputs as defined on the Process and Instrumentation Drawings. Additional functionality shall be provided as described below.
4. The Instrumentation and Control System integrator shall meet with Owner and Engineer to establish the control strategies required to be implemented on the SCADA System.

C. GRAPHICS

1. All graphics to be updated on three (3) servers at the Blanchard Plant, two (2) work stations at the Blanchard plant, one (1) server at Clark Hill Plans, and one (1) work station at the Clarks Hill Water Treatment Plant.
2. All graphics to match the existing Emerson Open Enterprise Graphics.

PART 2 PRODUCTS

2.1 CONTROL PANELS

A. Panel Enclosures

1. It is the intent of these specifications to establish minimum requirements for all control panels to be supplied under this contract.
2. All control panels shall be UL Listed.
3. To match existing equipment and to allow for future connectivity to an Ethernet data highway, programmable logic controllers (PLCs) shall be Control Wave Micro by Emerson.

B. Control panels shall be supplied for locations and functions as noted in the contract specifications and as shown on the contract plans.

C. Cabinets and enclosures:

1. Provide cabinets with hinged doors for easy access.
2. Cooling fans and inlet louvers with replaceable filters shall be used to provide proper cooling where required.
3. PLC enclosure shall be a NEMA 12 Carbon Steel oversized enclosure, door stop, hinged exterior door, easy open latches (no tools required) and padlocking provisions. Panel shall be provided with a hinged interior panel. All breakers, lights, pushbuttons, switches, and accessories shall be visible and operable without opening the hinged interior panel.
4. Anti-corrosion inhibitor blocks shall be mounted inside each PLC enclosure to reduce corrosion. Corrosion inhibitors shall be Hoffman Model A-HcI10E.

D. PLC-WPPCUV:

1. The Instrumentation and Control system Integrator shall make use of readily available products with a proven history of reliable service when used in municipal water and wastewater applications.
2. The PLC shall be comprised of a Control Wave Micro by Emerson with surge arrestors, relays, power supplies, terminal strips, heater and thermostat, circuit breakers, utility light, enclosure, and other appurtenances as required for a fully functioning and fully operational system.

3. As a minimum, the PLC shall be capable of supporting the following I/O complement with 25% spare capacity:

I/O Requirements - Analog In:

Tank Level
Side A – Chemical Metering Flow Indicate
Side B – Chemical Metering Flow Indicate
SPARE – Chemical Metering Flow Indicate

I/O Requirements - Analog Out:

Side A – Chemical Metering Flow Control
Side B – Chemical Metering Flow Control
SPARE – Chemical Metering Flow Control

I/O Requirements – Digital in:

RTU Power
Tank overflow Alarm
Tank Low Level Alarm
Metering Pump No. 1 Run
Metering Pump No. 1 Auto
Metering Pump No. 1 Fail
Metering Pump No. 2 Run
Metering Pump No. 2 Auto
Metering Pump No. 2 Fail
Metering Pump No. 3 Run
Metering Pump No. 3 Auto
Metering Pump No. 3 Fail

I/O Requirements – Digital Out:

Metering Pump No. 1 Start
Metering Pump No. 2 Start
Metering Pump No. 3 Start

E. PLC-WPCHUV

1. The Instrumentation and Control system Integrator shall make use of readily available products with a proven history of reliable service when used in municipal water and wastewater applications.
2. The PLC shall be comprised of a Control Wave Micro by Emerson with surge arrestors, relays, power supplies, terminal strips, heater and thermostat, circuit breakers, utility light, enclosure, and other appurtenances as required for a fully functioning and fully operational system.

3. As a minimum, the PLC shall be capable of supporting the following I/O complement with 25% spare capacity:

I/O Requirements – Analog In

Tank Level

1. Chemical Metering Flow Indicate
2. Chemical Metering Flow Indicate

I/O Requirements – Analog Out

1. Chemical Metering Flow Control
2. Chemical Metering Flow Control

I/O Requirements – Digital In

RTU – Power

Tank Overflow Alarm

Tank Low Level Alarm

Metering Pump No 1 Run

Metering Pump No 1 Auto

Metering Pump No 1 Fail

Metering Pump No 2 Run

Metering Pump No 2 Auto

Metering Pump No 2 Fail

I/O Requirements – Digital Out

Metering Pump No 1 Start

Metering Pump No 2 Start

2.2 PLC ENCLOSURE INTERNAL PANEL WIRING AND GENERAL CONSTRUCTION

- A. All PLC equipment shall be supplied with power supplies suitable for operation on 120 Volt, 60 Hertz, single-phase, AC power.
- B. Receptacles with isolated ground shall be supplied for computer devices in the control room and internal to the PLC enclosures.
- C. All field wiring terminations shall be made to terminal strips capable of accommodating up to #12 AWG wire. Terminal strips shall be mounted using DIN rails. Terminal strips shall be as manufactured by Weidmuller, Phoenix Contact, Square D, or approved equal.
- D. All analog inputs and outputs, including all spare analog inputs and outputs, shall be protected from surges using three separate levels of surge/transient suppression. The first level of protection shall be via a 1/4 Amp 3AG size fast acting fuse. Secondary and tertiary protection shall be fulfilled using combination gas discharge and metallic oxide varistor (MOV) surge protection with current limiting resistors. Terminals shall be installed to allow each of the four analog inputs to be configured for 2-wire or 4-wire process transmitters and to produce either 4 to 20 mA or 1 to 5 VDC outputs to the PLC

and any future display or signal conversion devices. Terminals shall be installed adjacent to each spare analog surge protector to provide 24 VDC for connections of future 2-wire transmitters. Spare analog inputs and outputs shall be wired to analog surge protection, fuses, etc. and shall be ready to accommodate future field signals.

- E. All digital inputs, including spare digital inputs, shall be isolated via indicating electro-mechanical relays. Minimum contact rating for relays shall be 10 Amps at 250 VAC, minimum. Digital inputs shall be connected to field wiring via DIN rail mounted terminal strips. A 2 Amp 3AG size fuse shall protect digital inputs. Spare digital inputs shall be fully wired complete with relay isolation and terminal strips to accommodate future field signals.
- F. All digital outputs, including spare digital outputs, shall be isolated from field wiring through terminal strips and indicating electro-mechanical relays with contact ratings of 10 Amps at 250 VAC, minimum. Spare digital outputs shall be fully wired complete with relay isolation and terminal strips to accommodate future field signals.
- G. As a minimum, separate DC power supplies shall be provided for the PLC rack, analog I/O field supply, and digital I/O field supply. All DC power supplies shall be UL Listed and shall be protected via indicating 3AG size fast acting fuses. Indicating fuse holders shall be DIN rail mounted.
- H. A fluorescent light (24" minimum) shall be mounted in the top of each PLC enclosure. The light shall be wired to a limit switch that shall be mounted on the door of the PLC enclosure. When the door is opened, the light will automatically be turned on. When the door is closed, the light will automatically be turned off.
- I. Surge protectors shall be provided internal to the PLC enclosure to provide communications signal transient and surge protection.
- J. Uninterruptible power supplies shall be furnished and installed inside each PLC enclosure and shall be sized to provide at least 30 minutes of backup power for the entire PLC enclosure. UPS systems shall be designed to provide transfer to backup power in the event of AC power failure without interrupting or halting the PLC processor. Provide 1500 VA minimum UPS systems for each PLC enclosure. UPS systems for PLC enclosures shall be APC Model SMT1500 with Ethernet option card and Ethernet software driver.
- K. A minimum of two (2) circuit breakers shall be provided integral to the PLC enclosure. One circuit breaker shall provide protection to the PLC's internal power supplies and the other circuit breaker shall provide power for an internal light.
- L. An AC power surge protector shall be installed integral to the PLC to provide transient and surge protection for incoming AC power. A separate 20 amp GFI duplex utility outlet shall be protected by the surge protector and shall be used only for the UPS system.

- M. For power with 120 VAC supplied from a foreign source, provide an engraved nameplate (white letters, red background) to read “WARNING - This panel energized by foreign control power sources. Equipment will be live with panel disconnect in either on or off position.”

2.3 COMMUNICATION

- A. Each new PLC panel shall be connected to the plant network. Jim Blanchard WTP shall have FCP-UVA, FCP-UVB, and PLC-WPPCPS added to its SCADA network. The Clarks Hill WTP shall have FCP-UVC added to its SCADA network.
- B. Fiber Optics Cable
 - 1. Fiber optics cable shall be supplied and installed by the Electrical Contractor.
 - 2. All fiber optics terminations shall be the responsibility of the Instrumentation and Control System Integrator.
 - 3. Fiber optics cables shall be provided for the following communications runs:
 - a. FCP-UVA to PLC-WPPCUV
 - b. FCP-UVB to NETWORK CONTROL SWITCH
 - c. PLC-WPCHUV to NETWORK CONTROL SWITCH

2.4 PROCESS INSTRUMENTATION

- A. General
 - 1. The Instrumentation and Control System Integrator shall supply all equipment specified under this section.
 - 2. The intent of this specification is that all systems form a completely integrated system without the addition of any other equipment than that specified herein.

- B. Flow Meters

- 1. Flow Meters shall be supplied for the following applications:

Tag	Service	Range
FIT-2101	Magnetic Flow Meter	0 to 9900 gpm
FIT-2102	Magnetic Flow Meter	0 to 9900 gpm
FIT-3104	Magnetic Flow Meter	0 to 8000 gpm
FIT-3105	Magnetic Flow Meter	0 to 8000 gpm
FIT-4104	Magnetic Flow Meter	0 to 4200 gpm
FIT-4105	Magnetic Flow Meter	0 to 4200 gpm

- 2. The flow meters shall operate on electromagnetic induction principle and give and output signal directly proportional to the liquid rate of flow.
 - 3. Each meter shall have a stainless steel metering tube and a non-conductive liner suitable for the liquid being metered. End connections shall be steel flanged. ANSI Class 150#. The housing shall be epoxy coated steel and welded at all joints. Bolted coil enclosures shall not be acceptable.

4. The field coils of the meter shall be supplied with a precisely adjusted bi-polar direct current.
5. There shall be no electronic components on the primary flow head. Coil drive power shall be supplied by an integral or remote signal converter. Output signal from the primary shall be fed through 'DS' proprietary cable supplied with the meter to the signal converter.
6. The meter body shall have a housing rated IP68 for constant submersion in water.
7. Electrode material shall be compatible with the process fluid.
8. Liner material will be hard rubber.
9. Meter will have field replaceable electrodes with access parts.
10. The instrument shall be manufactured in an ISO 9001 approved facility.
11. The meter shall be provided with corrosion resistant grounding rings.
12. Meter calibration shall be performed by a direct volumetric comparison method. A calibration certificate shall accompany each meter. Calibration facility shall be certified to 0.03% accuracy and be traceable to national standards.
13. The meters shall be Rosemount 8750WA.
14. The magnetic inductive flow converters shall be remote mounted in a NEMA 4X panel at the equipment rack and provide precisely controlled and regulated, bi-polar DC primary field excitation pulses at a keyed frequency which is user configurable. It shall convert the primary flow meter signal into a standard linear analog output directly proportional to the flow rate of flow total. The converter shall be capable of up to (4) inputs. Outputs to be 4-20 mA DC with HART superimposed digital signal.
15. Cables as recommended by Rosemount and as shown on the drawings shall be installed to connect the flow meters and converters. The converter shall display flow in GPM and shall have non-resettable totalizers to display total flow on demand. The converters shall have a 4-20MA output for connection to the SCADA system.

C. Hydrogen Peroxide (H₂O₂) Monitor

1. On-line Monitors shall be provided to continuously measure Hydrogen Peroxide concentration at the locations shown on the drawings and specified herein. Each Hydrogen Peroxide Monitor shall consist of a direct measuring hydrogen peroxide sensor, a clear constant-head flowcell, 25 feet of sensor interconnect cable with quick disconnect plug, and an electronic monitor housed in a NEMA 4X enclosure suitable for wall, pipe, or panel mounting.
2. The hydrogen peroxide sensor shall be a direct measuring polarographic sensor utilizing a special polymeric membrane to isolate the sensing electrodes from the sample and eliminate the potential for electrode contamination. The membrane shall allow hydrogen peroxide to diffuse into the sensor where it shall react with the sensing electrode, generating a signal that is linearly proportional to hydrogen peroxide concentration. The sensor assembly shall also contain a precision RTD temperature sensor to continuously measure sample temperature to allow temperature compensation of the measured hydrogen peroxide value. The hydrogen peroxide sensor shall be constructed with a quick disconnect receptacle to allow easy sensor servicing or exchange. Hydrogen peroxide sensors shall be supplied

- complete with at least 10 spare membranes, electrolyte, and a spare parts kit that includes all o-rings and special hardware.
3. The flowcell assembly supplied with the monitor shall be constructed of clear material allowing the condition of the sensor membrane to be inspected without removal of the sensor. The sensor shall slide easily into the side of the flowcell, with a double o-ring seal to prevent water leakage. Flow to the sensor shall be regulated automatically through a constant-head overflow arrangement. Hose barbs for sample inlet (1/4" I.D. tubing) and drain (1/2" I.D. tubing) shall be supplied as part of the flowcell.
 4. Monitors shall be powered by either 90-260 VAC single-phase line power, or 12-24 VDC. Either version of the monitor shall provide two isolated 4-20 mA outputs as standard, with an option for a third 4- 20 mA output. Outputs shall be configurable for hydrogen peroxide, temperature, or PID control. Analog outputs shall be both ground isolated and isolated from each other.
 5. For alarm purposes, monitors shall contain three SPDT relays. Relay functions shall be programmable for control, alarm, or fail functions, and may be designed for either normal or failsafe operation. For monitors supplied with only 2 analog outputs, monitors shall have the option of an additional 3 low-power relays to allow for additional external alarm functions.
 6. The hydrogen peroxide monitor electronic assembly shall provide a variety of functions as follows:
 - a. Provide user selectable display of PPM hydrogen peroxide, process temperature, or PID % output on the main display. Main display variable shall be indicated with a minimum character height of 0.75" to allow easy readability up to 20 feet away.
 - b. Allow selection of operating ranges of 0-200 PPB, 0-2 PPM, 0-20 PPM, or 0-200 PPM. Display ranges shall be configurable by operators, or the monitor may be configured for Auto-Ranging. The auto-ranging function shall automatically switch to the display range that provides the best resolution for any given operating level.
 - c. Provide the ability to use the 4-20 mA output for PID control. Proportional, Integral, and Derivative functions shall be user adjustable, and also provide for output hold when needed.
 - d. Provide two isolated 4-20 mA outputs, with output spans programmable by the user for any segment of a display range. An optional third analog output is available, providing separate outputs for hydrogen peroxide and temperature.
 - e. Provide output hold and output simulate functions to allow for testing or remote receiving devices or to allow maintenance without disturbing control systems.
 - f. Provide three 6 amp SPDT relay outputs in standard unit. Software settings for relay control include setpoint, deadband, phase, delay, and failsafe. Provide an optional 3-relay card, for 0-30 V signals, to bring the total to 6 relays. Relays shall be programmable for either control or alarm function, or relays may be assigned to diagnostic functions for use in indicating trouble conditions at a remote location.

- g. Diagnostic functions shall be incorporated into the transmitter. The 4-20 mA output shall be capable of being assigned to safely rise to 20 mA, fall to 4 mA, or be left alone, during diagnostic failures. Diagnostic error messages shall be displayed in clear language; no confusing error codes shall be displayed.
- 7. The complete hydrogen peroxide monitor shall be supplied with spare parts and accessories for up to 2 years of operation. A minimum of 10 replacement membranes shall be supplied for the sensor.
- 8. The complete Hydrogen Peroxide Monitor shall be Series Q46/84 as manufactured by Analytical Technology, Inc. or approved equal.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 FACTORY TESTING

- A. The Instrumentation and Control System Integrator shall provide a factory software demonstration to verify operation of all functional features of the system. This testing shall be witnessed by representatives of the Owner and the Consulting Engineer.
- B. Software testing shall be conducted on the target computer systems at the supplier's facility.

3.3 FIELD EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings and as instructed by manufacturer.
- B. Verify that the instrumentation is of the correct size and voltage in accordance with the manufacturer's approved shop drawings.
- C. Verify that the location is suitable for instrumentation installation.

3.4 PREPARATION

- A. Verify that the location is ready to receive work and the dimensions are as indicated.
- B. Do not install any instrument until the building environment or power requirement can be maintained within the service conditions required by the manufacturer.
- C. Provide Type 316 Stainless Steel stands as necessary for mounting of the instrumentation and other equipment.

3.5 INSTALLATION

- A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.
- B. Install the work of this Section in strict accordance with the original design and the manufacturer's recommended installation procedures as approved by the Engineer, anchoring all components firmly into position for long life under hard use.
- C. Perform all wiring in compliance with NEC.
- D. Before and during the installation, the instrumentation shall be protected from site contaminants.
- E. Installation shall be where indicated, in compliance with manufacturer's instructions, drawings and recommendations NEMA ICS 3.1.
- F. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance.
- G. Mount control equipment securely on wall or equipment rack at a location 48 inches above the finished floor as shown on drawings using type 316 Stainless steel hardware.
- H. Mount Transmitters with isolation valves for servicing or replacement without taking line out of service. All mounting frames and hardware shall be #316 stainless steel.
- I. Properly connect the transmitters to the PLC inputs and power supply to obtain a current loop.
- J. Tighten accessible connections and mechanical fasteners after placing instrumentation.
- K. Coordinate with Manufacturer for Startup Services as specified.
- L. Provide engraved plastic nameplates under the provisions of Division 16 - ELECTRICAL.

3.6 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.
- B. All panels shall be thoroughly vacuumed to remove all trash and other debris.

3.7 FIELD SERVICES

- A. Manufacturer's field representative shall inspect completed installation of all instrumentation for physical damage, proper alignment, anchorage, and grounding.

- B. The manufacturer field representative shall be a factory certified technical representative to supervise the contractor's installation, testing and start-up of the instrumentation furnished under this specification as specified herein.

3.8 CALIBRATION AND START-UP SERVICES

- A. The Instrumentation and Control System Integrator's (ICSI) on-site field service technician shall be responsible for the startup and field calibration of all instrumentation and equipment supplied herein.
- B. The ICSI shall supply a trained technician for a minimum of one (1) day in order to place the equipment in operation, calibrate the equipment, and provide training for the Owner in the equipment's proper operation and maintenance. Additional days shall be provided as necessary to insure that the equipment is operating properly.
- C. The ICSI shall provide a certification letter that all equipment has been installed in accordance with their recommendations and has been calibrated to their published accuracy. Any deviations shall be promptly reported to the Engineer.
- D. Upon completion of field calibration of instrumentation the technician shall place labeling inside of the equipment stating the date, name of certified calibrator, and the calibration range of each item of equipment.
- E. ISA style calibration data sheets shall be provided to document calibration of each instrument. These data sheets shall be included with the O&M Manuals.

3.9 TECHNICAL SERVICES

- A. Provide supervisory service of a factory trained service engineer, specifically trained on the type of equipment herein specified, for a period of not less than two (2) 8-hour days during construction to assist the Contractor in the location of sleeves, methods of installing conduit and special cable, mounting, piping, and wiring of one of each type of service, and the methods of protecting all of the equipment prior to placing it into service.
- B. Upon completion of equipment installation, provide services of the above service engineer for a period of not less than one (1) 8-hour day for calibration and start-up of the equipment and instructing the operating personnel.
- C. The number of days specified above does not relieve the system manufacturer of providing sufficient service to place the system in complete and satisfactory operation.
- D. System supplier to provide operation and maintenance training for Owner's personnel to ensure their adequate knowledge of use of the system.
- E. Training to be conducted on-site by instructors thoroughly familiar with operation of the system, with training divided into three general areas as follows:

- F. Analog and digital hardware maintenance training:
1. Instruct Owner's maintenance personnel in the proper preventative maintenance and repair tasks associated with system maintenance.
 2. For analog instrumentation, include detailed instruction of calibration and checking along with familiarization training for basic repair and maintenance tasks that are expected to be encountered.
 3. For computer hardware maintenance, include general familiarization with computer hardware and peripheral devices with instruction in preventative maintenance tasks associated primarily with peripheral devices. It is not intended that this course will produce trained computer maintenance technicians.
 4. Include detailed instruction in maintenance and repair work associated with the computer process I/O sub-system.
 5. Minimum training time for this material to be four (4) hours.
- G. Operator familiarization training:
1. Instruct Owner's operating personnel in the proper use of the analog and digital process control system.
 2. Include instruction in the system control steps and basic interface with the computer system.
 3. Provide sufficient training to Owner's operating personnel so they can respond to the normal tasks required for operation of the plant.
 4. Minimum training time for this material to be four (4) hours.
- H. Supervisor and application software training:
1. Provide supervisory personnel with a working knowledge of all application software supplied.
 2. Include basic digital and computer concepts, process control concepts, database configuration, report configuration, graphic display configuration, and control strategy development.

END OF SECTION

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. Furnish, install and test Single Girder Crane Systems with an Electric Wire Rope Hoist, Runway Rail and Runway Electrification, in accordance with the contract drawings and specifications herewith. The crane systems are to be designed and fabricated by a single source having total system responsibility.

1.2 QUALITY ASSURANCE

- A. Quality Control: All equipment and appurtenances provided under this section shall be the named products and shall conform to the applicable requirements listed below.
 - 1. ASME B30.17 Overhead and Gantry Cranes (Top Running, Single Girder)
 - 2. ASME B30.16 Overhead Hoists- Underhung
 - 3. ASME HST-4 Performance Standard for Overhead Hoists
 - 4. AWS D14.1 Welding of Material Handling Equipment
 - 5. NFPA 70 National Electric Code
- B. Qualification of Manufacturer: Products used in the work of this section shall be produced by manufactures regularly engaged in this type of work for a minimum 20 years, and with a history of successful production acceptable to the Approval Engineer.
- C. Qualification of Installer: Use adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
- D. Basis of Acceptance: The manufactures recommended installation procedures, when approved by the Engineer, will become the basis for inspecting and accepting or rejecting actual installation procedures used in this work.

1.3 SUBMITTALS

- A. Shop Drawings: Before any of the materials of this section are ordered or delivered to the job site, submit complete shop drawings to the Engineer in accordance with the applicable sections of these Specifications.
- B. Material List: Submit a complete list of all materials and components proposed to be furnished and installed under this portion of work, giving manufactures name, catalog number and catalog cut sheets for each item where applicable.
- C. Electrical Package: Before any of the materials of this section are ordered or delivered to the job site, submit complete electrical drawings to the Engineer in accordance with the applicable sections of these Specifications. Include schematics and bill of materials.

- D. O&M Manual: Submit a complete Operation & Maintenance Manual to the Engineer in accordance with the applicable Section 01730 Operation and Manual Data of these Specifications.
- E. Equipment suppliers written report certifying that the equipment:
 - 1. Has been properly installed and lubricated.
 - 2. Is in accurate alignment
 - 3. System is free from undue stress imposed by piping and or mounting bolts

1.4 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect the materials of this section before, during and after installation and to protect the installed work and material of all other trades.
- B. Replacement: In the event of damage, immediately make all repairs and replacements to the original condition of the equipment.
- C. Storage: Store and handle materials in such a manner as to avoid damage. All equipment should be stored and protected in accordance with manufacturer's short term and long-term storage procedures.

1.5 JOB CONDITIONS

- A. Protection: Use all means necessary to protect the materials of the section before, during and after the installation and to protect the installed work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer

PART 2 - PRODUCTS

2.1 GENERAL

- A. Proprietary Products: References to the specified proprietary products are used to establish minimum standards of utility and quality. Unless otherwise approved by the Engineer, provide only the specific products as system design is based on these materials. Other materials may be considered by the Engineer in accordance with the provisions stated in "Substitutions" of the contract documents.

SINGLE GIRDER CRANE SYSTEMS

2.2 ELECTRIC WIRE ROPE HOIST WITH MOTORIZED TROLLEY

- A. Provide Cordell WWTP Hoists specifically designed and built for wastewater treatment plant environments. D.R. Cordell & Associates. Inc. 95 West Butler Ave, Chalfont, PA. 18914. Phone# (215) 822-9345. Email steve@cordellmfg.com

Hoist Schedule:

Feature	System #1	System #2	System #3	System #4
Equipment ID#:				
Location:	Blanchard A-UV	Blanchard B-UV	Clarks Hill-UV-B	Clarks Hill-UV-2
Area Classification:	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X
Spark Resistant:	No	No	No	No
# of units:	1	1	1	1
Capacity (tons):	2	2	2	2
Model #	CWWD-044915	CWWD-044915	CWWD-044915	CWWD-044915
Speed	15 FPM VFD	15 FPM VFD	15 FPM VFD	15 FPM VFD
Lift:	18'	18'	18'	39'
Reeving:	single	single	single	single
Hoist HP:	3	3	3	3
Control type:	Inverter	Inverter	Inverter	Inverter
Trolley type:	motorized	motorized	motorized	motorized
Speed:	35 FPM VFD	35 FPM VFD	35 FPM VFD	35 FPM VFD
Trolley HP:	1/2	1/2	1/2	1/2
Control type:	Inverter	Inverter	Inverter	Inverter
Motors:	Wash Down Duty	Wash Down Duty	Wash Down Duty	Wash Down Duty
Enclosures:	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X
Push Button Location:	Festooned on bridge	Festooned on bridge	Festooned on bridge	3' outrigger with 180 Deg. rotation on hoist
Hoist Headroom*:	2'-4"	2'-4"	2'-4"	2'-4"
Hook end approach L*:	3'-8" from CL of runway	3'-8" from CL of runway	3'-8" from CL of runway	2'-6" from end of monorail
Hook end approach R*:	1'-8" from CL of runway	1'-8" from CL of runway	1'-8" from CL of runway	1'-8" from end of monorail

*See contract drawings for detailed information on high hook, hook end approach and other critical dimensional information

- B. Hoist General Specifications: Electric wire rope hoist with motorized trolley designed for maintenance service and able to withstand long periods of inactivity. A stainless steel parallel mounted drum shall be reeved as specified in the above chart. Double reeved units shall be designed for true vertical lift with a drum having left hand and right-hand grooving. Single reeved units shall be designed for 2-part or 4-part single reeving with single direction grooving. Stainless steel wire rope shall lay in deep machined grooves equal to 50% of the depth of the wire rope. Hoist to include adjustable upper and lower

SINGLE GIRDER CRANE SYSTEMS

adjustable geared limit switch, upper reverse plugging paddle limit switch and electro-mechanical disc hoist motor brake.

1. Motorized Trolley: Hoist shall include a motor driven trolley for operation on the monorail beam shown on the contract drawings. The trolley shall include a worm drive gear reducer for its inherent braking characteristics, trolley side plates, safety drop lugs and rubber bumpers. The final reduction shall be achieved with a pinion gear with grease lubrication.
2. Service: Hoist shall be rated H3 minimum meeting service classification as defined in ASME HST-4M.
3. Capacity: Rated capacity for each hoist shall be clearly labeled and readable from the operator's level and shown on the hook block.
4. Hoist Brake: Hoists are to be supplied with a 3 phase electro-mechanical spring set magnetically opened multiple disc motor brake for precise load positioning.
5. Hoist Motor: The hoist motor shall be an AC squirrel cage motor especially designed for hoisting service rated for 30 MIN duty cycle. The C Face motors shall be externally mounted for superior cooling characteristics, operate at 1800 RPM and include class F motor insulation and thermal detectors imbedded in windings. All motors shall be commercially available provided by a domestic manufacturer and not a propriety product of the hoist manufacturer.
6. Gear Train: Gearing shall include a cast high quality, bronze wheel and hardened ground and polished steel worm. Gears shall be mounted between tapered roller bearings and operate in an oil bath for efficiency and quiet operation. The inherent self-locking features of the gearing provides a safe mechanical load braking means.
7. Controls: All Controls shall be mounted in NEMA rated control enclosures as specified in the above chart, and designed for service a corrosive, wet and/or hazardous environment as specified above. Magnetic contactors shall be used for single speed operations, and VFD's for all multiple speed operations. Enclosure shall include a through the door manual disconnect, a magnetic mainline disconnect (if not provided in the bridge panel) operated from the push button station and an external green light indicating power to the panel is on.
8. AEM (Automatic Exerciser Module): The AEM will automatically cycle the hoist and trolley on a weekly basis to keep motors and controls exercised to prevent seizing, corrosion and malfunctions. The hoist needs to be positioned in a "home" position detected by sensors mounted on the system. If positioned "Home", the AEM will automatically operate the trolley FWD and REV for short timed distances, and then automatically operate the hoist UP and DN for short timed distances. The AEM will provide the ability to **field adjust the timed** distances of operation from 5 seconds up to 60 seconds. The cycles shall also be adjustable from 1 to 10.
9. Push Button Station – Primary Control: The 8 Button Push Button Station shall be rated as specified on the above chart and include a pedant cable long enough to allow the station to hang 3'-0" above the operator floor. It shall be suspended from the hoist or festooned across the full bridge span as specified in the above chart.
10. Space Heaters: Shall be included in hoist motors, trolley motors and control enclosures. Space heaters for the motors shall be anti-condensation type with a fixed temp setting. Space heaters for the panels shall be thermostatically controlled. Power to system shall be left on position when system is not in use in order for the space

SINGLE GIRDER CRANE SYSTEMS

heaters to be effective. When system is in use the space heaters will turn off during use of system.

11. Corrosion Resistant Features: Shall be provided with the hoist and trolley and includes; epoxy painted hoist, non-metallic conduit and fittings, stainless steel rope drum, stainless steel wire rope, stainless steel trolley pinions, stainless steel wheel pins and stainless wheels. All conduit fitting openings shall be located on the bottom of the enclosures and panels.
12. Epoxy Paint: Shall be applied to hoist including all motors, reducers and motor brake enclosures. The stainless-steel rope drum and wire rope shall not be painted. Epoxy paint shall be submitted for review and approval with the equipment specifications.

2.3 BRIDGE CRANE SYSTEM

- A. Provide Cordell WWTP Bridge Crane Systems specifically designed and built for wastewater treatment plant environments. D.R. Cordell & Associates. Inc. 95 West Butler Ave, Chalfont, PA. 18914. Phone# (215) 822-9345. Email jim@cordellmfg.com

Bridge Crane Schedule

Feature	System #1	System #2	System #3	System #4
Equipment ID#:				
Location:	Blanchard A-UV	Blanchard B-UV	Clarks Hill-UV-B	Clarks Hill-UV-2
Area Classification:	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X
Spark Resistant:	No	No	No	No
# of units:	1	1	1	1
Capacity (tons):	2	2	2	2
Type:	Top Running Single Girder	Top Running Single Girder	Top Running Single Girder	Free standing monorail
Model #	TRSGDM2T-35.08	TRSGDM2T- 35.08	TRSGDM3T- 24.08	S12x40
Speed	90 FPM VFD	90 FPM VFD	90 FPM VFD	35 FPM Trolley
Span	35'-1"	35'-1"	24'-1"	38'-6" OAL
Hoist HP:	2@1/3	2@1/3	2@1/3	¼ trolley HP
Wheelbase:	6'-0"	6'-0"	6'-0"	2'-3"
#of Wheels / Dia:	4/4.25"	4/4.25"	4/4.25"	6/6"
Wheel Material:	Stainless	Stainless	Stainless	Stainless
Control type:	Inverter	Inverter	Inverter	Inverter
Trolley type:	motorized	motorized	motorized	motorized
Speed:	35 FPM VFD	35 FMP VFD	35 FMP VFD	TBD upon submittal
HP:	2 @ 1/3 hp	2 @ 1/3 hp	2 @ 1/3 hp	TBD upon submittal
Control type:	Inverter	Inverter	Inverter	Inverter
Motors:	Wash Down Duty	Wash Down Duty	Wash Down Duty	Wash Down Duty
Enclosures:	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X
Push Button Location:	Festooned on bridge	Festooned on bridge	Festooned on bridge	Hoist
Hoist Headroom*:	2'-4"	2'-4"	2'-4"	2'-4"
Hook end approach L*:	2'-4" from wall	2'-4" from wall	2'-4" from wall	2'-4" from wall
Hook end approach R*:	5'-0" from wall	5'-0" from wall	5'-0" from wall	5'-0" from wall
Runway Rail	S15x42	S15x42	S15x42	TBD upon submittal
ASCE Rail	--	--	--	TBD upon submittal

*See contract drawings for detailed information on high hook, hook end approach and other critical dimensional information.

- B. Bridge Crane Girders: Crane girders shall be structural shape sections, combination sections or structural box girder sections fabricated from steel plate. Operating treads subject to wheel load shall be designed to resist bending or peening from loads imposed

SINGLE GIRDER CRANE SYSTEMS

by the trolley wheels, taking live load, hoist weight and impact into consideration. Impact factor due to the lifting forces shall be 0.5 percent of the hoisting speed in feet per minute, but not less than 15 percent or more than 50 percent. The maximum allowable deflection of the crane girder at rated capacity shall not exceed $L/800$.

1. Structural shapes shall be selected based on maximum center loading and wheel loads imposed by the hoist, live load and impact, while limiting deflection to specified limits. All structural shape material shall be new, free from defects, excessive twist and sweep.
 2. Box girders shall include diaphragms designed to resist all vertical, horizontal and torsional forces. Girders may be of symmetrical or asymmetrical design with different plate thickness for top, bottom and web plates. For double girder cranes, trolley sections may be welded to the top plate directly over the inside web. For single girder cranes, the bottom flange shall be designed and selected to resist the maximum wheel load imposed by the monorail style hoist.
 3. Girder end truck connections shall be bolt together to form a rigid connection. Bolts in shear or welded connections shall not be permitted.
 4. A minimum clearance of 3 inches between the highest point of the crane and the lowest overhead obstruction shall be provided. For buildings where truss sag becomes a factor, this clearance should be increased.
- C. End Truck Assemblies: The crane girder(s) shall be carried on End Trucks designed to resist the maximum loading imposed by the girder, hoist, live load and impact when lifted at one end of the bridge crane. The wheelbase to crane span ratio shall be 1:7 or greater. Rotating axle or fixed axle design is acceptable and will be based on application and duty cycle.
1. Provision shall be made to prevent a drop of the crane not more the one inch in case of axle failure. Guards shall be provided in front of each outside wheel and shall project below the top of the runway rail.
 2. Flanged stainless-steel or bronze wheels shall be provided for accurate tracking of the traveling bridge crane. Wheels shall be easily removable and operate on dual anti friction bearings with a minimum B-10 bearing life. Wheels shall be designed to carry the maximum wheel loads without premature wear.
 3. Cranes shall be driven by individual motorized drives mounted on end trucks, which provide traction dependent upon wheel loads. All single and two speed motors shall be squirrel cage type, totally enclosed. Motor shall be provided with electro-mechanical motor brakes, motor heaters and lifetime lubricated anti-friction bearings. Cranes operating in classified areas shall be rated NEMA 7 for explosion proof operations.
 4. Gearing shall be totally enclosed operating in oil bath. Final reduction at the crane wheel can be by internal splined shaft or open pinion gear.
 5. The clearance between the ends of the crane (end truck) and the building columns / wall / obstruction shall not be less than 2 inches with the crane centered on the runway rails. Pipes, conduits and similar other equipment or utilities must not reduce this clearance.
 6. The End Truck structure shall be epoxy painted and include rubber bumpers. Epoxy paint shall be applied to the end truck and all motors, reducers and motor brake

enclosures. Epoxy paint shall be submitted for review and approval with the equipment specifications.

- D. Bridge Crane Electrification: A 14 Gage Stainless Steel Festooned system consisting of multi-conductor flat cables suspended at regular intervals from stainless steel trolleys operating on a rigid stainless-steel track mounted parallel to the bridge girder shall be provided. Trolleys are to be equipped with cable saddles and clamps. The ends of each wire are to be prepared and tagged for field connection to the bridge crane and shall include a flat cable connector for adapting to the control panel. Stainless steel carrier chain shall be festooned between trolleys and be shorter than the flat cable to ensure that chains are pulling the trolleys and not the cable.
- E. Painting: All steel surfaces on the crane girder shall be sand blasted and epoxy painted. End truck gear motors shall be finished with the same paint applied to the bridge crane assembly. Stainless-steel surfaces shall not be painted.
- F. Crane Controls: Controls shall be mounted in a NEMA 4X 316 stainless steel, or NEMA 7 control enclosure (crane schedule) designed for a corrosive service environment. Magnetic contactors with electronic soft start control shall be used for single speed operations, and VFD's for all multiple speed operations. Reversing contactors shall be mechanically and electrically interlocked and operated by a fused 115VAC control circuit. All wiring shall be terminated on terminal strips and run via raceways in the control enclosure. Devices shall be mounted to the enclosure backing panel and secured via DIN rail when applicable.
1. Enclosure shall include a through the door manual disconnect, a magnetic mainline disconnect operated from the push button station and an external green light indicating power to the panel is on. Stepdown transformers are to be sized accordingly and fused providing 115VAC control voltage.
 2. AEM (Automatic Exerciser Module): The AEM will automatically cycle the bridge crane on a weekly basis to keep motors and controls exercised to prevent seizing, corrosion and malfunctions. The bridge crane needs to be positioned in a "home" position detected by sensors mounted on the system. If positioned "Home", the AEM will automatically operate the bridge crane FWD and REV for short timed distances, and then automatically operate the hoist and trolley short timed distances. The AEM will provide the ability to field adjust the timed distances of operation from 5 seconds up to 60 seconds. The cycles shall also be adjustable from 1 to 10.
 3. Push Button Station – Primary Control: The 8 Button Push Button Station shall be rated for NEMA 4X , with intrinsically safe circuits for NEMA 7 environments, and include a pedant cable allowing the station to hang 3'-0" above the operator floor. See Bridge Crane Schedule for push button location. Festooned push button stations shall be festooned across the full bridge span allowing the operator the freedom to move independent of the trolley travel. A 14 Gage Stainless Steel Festooned system consisting of multi-conductor flat cables suspended at regular intervals from stainless steel trolleys operating on a rigid stainless steel track mounted parallel to the bridge girder shall be provided. Trolleys are to be equipped with cable saddles and clamps. Stainless steel carrier chain shall be festooned between trolleys and be shorter than the flat cable to ensure that chains are pulling the trolleys and not the cable. Hoist

suspended push button stations shall hang from a fixed location on the hoist, and travel with the hoist trolley movement.

4. Space Heaters: Shall be included in bridge motors and control enclosures. Space heater for the motors shall be anti-condensation type with a fixed temp setting. Space heaters for the panels shall be thermostatically controlled. Power to system shall be left on position when system is not in use in order for the space heaters to be effective. When system is in use the space heaters will turn off during use of system.
5. All wiring shall be in "EMT" (Electrical Metallic Tubing) conduit wherever possible. Flexible cable may be used on short runs where "EMT" conduit is not practical.

2.4 RUNWAY ELECTRIFICATION

- A. Runway electrification shall be provided for the lengths of the runways shown on the contract drawings. Electrification shall be festoon type and sized based on the maximum system(s) amp draw and calculated voltage loss based on system length. Maximum voltage loss shall not exceed 3% from the power taps to the load at the farthest point on the conductor run.
 1. Festoon electrification shall be A 14 Gage Stainless Steel Festooned system consisting of multi-conductor flat cables suspended at regular intervals from stainless steel trolleys operating on a rigid stainless-steel track mounted parallel to the bridge girder shall be provided. Trolleys are to be equipped with cable saddles and clamps. The ends of each wire are to be prepared and tagged for field connection to the bridge crane and shall include a flat cable connector for adapting to the control panel. Stainless steel carrier chain shall be festooned between trolleys and be shorter than the flat cable to ensure that chains are pulling the trolleys and not the cable.

2.5 FREE STANDING RUNWAY SYSTEM

- A. Provide semi-free-standing runway systems for both Blanchard crane systems, a building supported runway system for the Clark Hill crane system and the building supported monorail beam for the Clark Hill monorail. The runway systems and monorail are considered an integral part of the hoisting system and provided as part of a complete system by a single source.
 1. Connections: All field connections and bracing are to be bolted and not require welding. Any field corrections required will include best practices in accordance with AISC. All marred and damages surfaces shall be repaired. All connection hardware shall be galvanize including anchor bolts. The semi-free-standing runway systems shall be braced to itself in the longitudinal direction and tied back to the building structure for lateral stability. The building supported crane runway shall be bolted to anchors in the corbels and tied laterally to the building structure.
 2. Anchoring: Epoxy anchors with non-shrink grout shall be used to secure columns to the concrete surface and bracing where applicable. The anchor system shall be included with the submittal, showing anchor pullout and minimum embedment. Shimming and or leveling nuts will be used as necessary to ensure the monorail beam is installed to within ¼" of level in its length. Monorail beams shall include a joint splice that aligns the bottom flange treads incorporating a "tongue and groove" splice joint factory welded to the bottom flange.

SINGLE GIRDER CRANE SYSTEMS

3. Finish: The complete runway and monorail systems shall be galvanized to withstand the corrosive environment. Galvanized members shall be designed to withstand galvanizing temperatures and be free from warping and distortion at delivery.
4. Design: All members used to construct the monorail shall be designed with a 5:1 factor of safety. Deflection between spans shall not exceed $L/450$, cantilever spans shall not exceed $L/400$. The system shall be designed to be free standing in both the lateral and longitudinal directions.
5. Systems Markings: The free-standing system shall be provided with system capacity labels, serial numbers and manufacturer's identification. Capacity labels shall be affixed to the system and readable from the floor. A stainless-steel ID Plate will be affixed to one of the system columns, be readable from the floor and include system capacity, serial number, Manufacturer's name and address and date of manufacture.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

- A. Inspection:
 1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
 2. Verify that the work of this section may be installed in accordance with all pertinent codes and regulations, the original design and the referenced standards.
- B. Discrepancies:
 1. In the Event of a Discrepancy, immediately notify the ENGINEER.
 2. Do not proceed with installation in areas of discrepancy until all such have been fully resolved.

3.2 INSTALLATION

- A. General: Install the work of this section in strict accordance with the manufacture's recommendations as approved by the Engineer.
- B. Touch up paint: Marred or abraded surfaces shall be cleaned and refinished in accordance the manufactures recommendations.

3.3 TESTING

- A. Upon completion of this portion of work, and prior to its acceptance by the OWNER, make all required tests and adjustments for free and smooth operation. Tests shall include a minimum 100% load test, system operational test and demonstration of the AEM. Testing shall include system inspection and a load test certificate.

3.4 INSTRUCTIONS

- A. When all required work approvals of this portion of work have been obtained, and at a time designated by the OWNER, thoroughly demonstrate to the Owner's operation and

maintenance personnel, the operation and maintenance of all items installed under the work of this section.

3.5 CLEANING

- A. Clean all exposed surfaces of all grease, dirt, and other foreign materials.
- B. Touch up all marred or abraded surfaces as specified herein.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping complete with all fittings, jointing materials, hangers, supports, anchors and necessary appurtenances for:
 - 1. Wrought metal piping
 - 2. Drainage piping
 - 3. Waste and vent piping
 - 4. Hot and cold building water supply piping
 - 5. Natural gas piping
 - 6. Fuel oil piping
 - 7. Compressed air piping
 - 8. Other miscellaneous piping

1.2 RELATED SECTIONS

- A. Section 02200 - Excavation, Filling And Backfilling
- B. Section 15062 - Ductile Iron Pipe
- C. Section 15100 - Valves, Cocks and Hydrants
- D. Section 15140 - Supports and Anchors

1.3 REFERENCES

- A. ANSI B16.1 - Cast Iron Pipe and Flanges and Flanged Fittings
- B. ANSI B16.3 - Malleable Iron Threaded Fittings
- C. ANSI B16.5 - Pipe Flanges and Flanged Fittings
- D. ANSI B16.9 - Factory-Made Wrought Steel Buttwelding Fittings
- E. ANSI B16.11 - Forged Steel Fittings, Socket-Welding and Threaded
- F. ANSI B16.12 - Cast Iron Threaded Drainage Fittings
- G. ANSI B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
- H. ANSI B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- I. ANSI B16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings
- J. ANSI B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes

- K. ANSI B1.20.1 - Pipe Threads, General Purpose, Inch
- L. ANSI B31.1.1 - Power and Process Piping Package
- M. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- N. ASTM A74 - Cast Iron Soil Pipe and Fittings
- O. ASTM A139 -Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
- P. ASTM A307 - Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
- Q. ASTM A312 - Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- R. ASTM B32 - Solder Metal
- S. ASTM B75 - Seamless Copper Tube
- T. ASTM B88 - Seamless Copper Water Tube
- U. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- V. ASTM B813 - Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
- W. ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- X. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- Y. ASTM D1330 - Rubber Sheet Gaskets
- Z. ASTM D1785 - Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- AA. ASTM D2464 - Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- BB. ASTM D2467 - Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- CC. AWWA C200 - 12 Steel Water Pipe 6 Inch (150 Mm) and Larger
- DD. CISPI 301 - Hubless cast iron soil pipe and fittings for sanitary and storm drain, waste, and vent piping applications
- EE. FS WW-U-531 - Unions, Malleable Iron or Steel

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Shop Drawings:
 - 1. Fabrication and/or layout drawings:
 - a. Exterior yard piping drawings (minimum scale 1 inch equals 10 feet) with information including:
 - 1) Dimensions of piping lengths
 - 2) Invert or centerline elevations of piping crossings
 - 3) Bury depth requirements
 - 4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances
 - 5) Designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers
 - 6) Line slopes and vents
 - b. Interior piping drawings (minimum scale 1/8 inch equals 1 foot) with information including:
 - 1) Dimensions of piping and end connections
 - 2) Invert or centerline dimensions
 - 3) Location and type of pipe supports and anchors
 - 4) Locations of valves and valve operator type
 - 5) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment and related appurtenances
 - 6) Valve and equipment tag numbers and instrument tag numbers
 - c. Schedule of interconnections to existing piping
- C. Product Data: Sufficient data to verify compliance with the specifications:
 - 1. Technical product data on piping and piping appurtenances
- D. Test Reports:
 - 1. Copies of pressure test results on all piping systems
 - 2. Notification of time and date of piping pressure tests

1.5 REGULATORY REQUIREMENTS

- A. In accordance with all municipal codes and ordinances, laws and regulations of the state.
- B. In case of apparent conflict, state and local requirements govern over these specifications.
- C. In absence of state and local regulations, National Plumbing Code applies.
- D. Gas and fuel oil piping: Per National Fire Protection Association.

PART 2 PRODUCTS

2.1 STEEL PIPE: GALVANIZED OR BLACK AS SCHEDULED

- A. Standard weight: ASTM A53, standard weight (Schedule 40)
- B. Extra strong pipe: Seamless ASTM A53 Types, Grade A extra strong (Schedule 80)
- C. Lightweight: ASTM A139, AWWA C200:
 - 1. Wall thickness: 10 gage, 0.135 inch
 - 2. Outside diameter
 - a. 6 inch size: 6-5/8 inch
 - b. 8 inch size: 8-5/8 inch
 - 1) Flanges: Steel plate at least 1/4 inch thick, ANSI B16.1 125 lb drilling and diam
- D. Nipples: CS5, extra strong (Schedule 80); close nipples permitted only by special authorization in each case.
- E. Fittings:
 - 1. Malleable iron: ANSI B16.3:
 - a. Ungalvanized pipe: Type I, ungalvanized
 - b. Galvanized pipe: Type II, galvanized
 - 2. Drainage: ANSI B16.12
 - 3. Forged Steel: Schedule 40, 2,000 lb for standard weight pipe; Schedule 80, 3,000 lb for extra strong pipe:
 - a. Socket welding: ANSI B16.11; Bonney, Crane, Porter, or equal
 - b. Threaded: Bonney, Crane, Porter, or equal
 - 4. Flanged: Cast iron, 125 lb, ANSI B16.1
 - 5. Welding: ANSI B16.9
 - 6. Compression: Dresser "165 Plus-temp Couplings," with restraining rings, Telsco "Series 700 Clamp Style Fittings," with stainless steel clamp rings, or equal
 - 7. Unions:
 - a. Malleable iron: FS WW-U-531, Class 2:
 - 1) Ungalvanized pipe: Type A, ungalvanized
 - 2) Galvanized pipe: Type B, galvanized
 - b. Forged steel: Tongue and groove flange type with non-metallic gaskets
 - 8. Lightweight: To match pipe with flange diameter and drilling to match ANSI B16.1 125 lb
 - 9. Flanges: ANSI B16.1, 125 lb or ANSI B16.5, 150 lb
 - 10. Flange bolts and nuts: ASTM A307, length such that after installation bolts will project 1/8 to 3/8 inch beyond outer face of nut
 - 11. Flange gaskets: ASTM D1330, Grade I; red rubber, ring type, 1/8 inch thick
 - 12. Mechanical couplings: Dresser "Style 38," Smith- Blair "Type 411," or equal
 - 13. Grooved couplings: Mil-C-10387; Gustin-Bacon "Gruvagrip Series 100," Victaulic "Style 77," or equal

- 14. Expansion joints:
 - a. 2-1/2 inch and smaller: Flexonics "Model H Expansion Compensation," or equal
 - b. 3 inch and larger: Flanged and with stainless steel bellows, "Flexonics Free Flexing Expansion Joint," or equal

2.2 COPPER TUBING

- A. Water tubing: ASTM B88
- B. Instrument tubing:
 - 1. Material: ASTM B75 or B280, hard-drawn, with polyethylene or PVC jacket except where buried
 - 2. Minimum wall thickness:
 - a. 1/4 inch O.D.: 0.030 inch
 - b. 3/8 inch O.D.: 0.032 inch
 - c. 1/2 inch O.D.: 0.032 inch
 - d. 3/4 inch O.D.: 0.040 inch
 - e. Minimum PVC jacket thickness: 0.032 inch
- C. Fittings:
 - 1. Flared: ANSI B16.26
 - 2. Solder: ANSI B16.18 or B16.22
 - 3. Compression: Crawford "Swagelok," Hoke "Gryolok," Imperial "Hi-Seal," Parker-Hannifin "CPI," Weatherhead "Self Align," or equal
 - 4. Insulating:
 - a. Threaded: PSI "Delrin Insulating Couplings," Vallet "V-Line Insulating Couplings," or equal
 - b. Flanged: Epco "Dielectric Flange Unions," PSI Type E Flange Insulation," or equal
- D. Solder: Solid wire, ASTM B32, Alloy Grade 50A (50-50)
- E. Soldering flux: Paste Type, ASTM B32, Type I, Form A
- F. Brazing filler metal: BCuP-5; Engelhard "Silvaloy 15," Goldsmith "gb-15," Handy and Hardman "Sil- Foss," or equal
- G. Brazing flux: Paste Type, ASTM B813, Type B
- H. Flanges: Cast bronze, 150 lb, brazed joints, ANSI B16.24
- I. Flange bolts and nuts: As specified for steel pipe
- J. Flange gaskets: As specified for steel pipe, except full face
- K. Expansion joints: Flexonics "Model HB Expansion Compensators," Mercer, or equal

2.3 PVC PIPE

- A. Water service: Ethyl "VisQueen Bell: Ring PBC Pipe," Johns-Manville "Ring-Tite PVC Pipe," or equal; 160 psi pressure rating, SDR26, with NSF International Seal
- B. Chemical service:
 - 1. Pipe: ASTM D1785, Schedule 80, PVC 1120, with NSF International Seal
 - 2. Fittings: ASTM D2464 or D2467, PVC I; by pipe manufacturer or by Celanese, Chemtrol, or equal
 - 3. Flanges: Diameter and drilling per ANSI B16.5, 150 lb
 - 4. Flange bolts and nuts: ASTM A307, Grade B, galvanized, install such that bolts project 1/8 to 3/8 inch beyond the outer face of the nut
 - 5. Flange gaskets: Full face, 1/8 inch thick, neoprene or plasticized PVC
 - 6. Expansion joints: Belmont "Style 3915," Resistoflex "Style R6905" molded expansion joint, or equal
 - 7. Grooved couplings: Gustin-Bacon "Gruvagrip Series 100," Victaulic "Style 78," or equal

2.4 REINFORCED PLASTIC TUBING

- A. Wire reinforced plasticized PVC; Cobon "Cobovin Type S," or Newage "Vardex"

2.5 STAINLESS STEEL PIPE

- A. Pipe: ASTM A312, Grade TP 304, Grade TTP 316, Schedule 40S
- B. Fittings: AISI Type 304, 316 (18-8 Mo)

2.6 STAINLESS STEEL TUBING

- A. Tubing: AISI Type 304, 316 (18-8 Mo), Schedule 10
- B. Fittings: Parker-Hannifin "Stainless Steel Ferulok," Tube Turns "Sokend Fittings," Potts "Speedline T/D Insert Flange, or equal
- C. Joint adhesive: Tube Turns "224 Epoxy Adhesive," Parker- Hannifin, or equal

2.7 CAST IRON SOIL PIPE

- A. Where permitted by local codes, provide either hubless cast iron soil pipe or centrifugally cast service weight soil pipe, Contractor's option
- B. Extra heavy: ASTM A74, extra-heavy
- C. Service weight: ASTM A74, service weight
- D. Hubless: CISPI 301

- E. Jointing material:
 - 1. Packing: Hooven & Allison "Sure Seal White Oakum," Sealite "White Oakum Caulking Yarn 110," or equal
 - 2. Rubber gaskets, where permitted by local codes: ASTM C564

2.8 PIPE INSULATION AND ACCESSORIES

- A. Piping: ASTM C553, 1 inch thick; glass fiber, with flame retardant vapor barrier jacket
- B. Watertight and dust-tight pipe sleeves: O-Z Electrical Manufacturing Company, Incorporated
- C. Modular, rubber, sealing elements: Thunder Line Corporation, "Link Seal," or equal
- D. Thread tape: Teflon; John Crane "Thread Tape," Garlock "Plasti-Thread," Hoke "EZ Seal," or equal
- E. Sealant: Thiokol or urethane as specified in caulking section
- F. Snubbers: Operating and Maintenance Specialties "Ray Snubbers," Ashcroft "Series 1112" or equal
- G. Gauge cocks: Bronze, tee handle; Lunkenheimer 1178, Powell 915, or equal
- H. Protective coatings:
 - 1. Plastic-coated pipe: 3M "Scotchkote," Republic "X- Tru-Coat," or equal
 - 2. Tape wrap: Protector Wrap "200," Tapecoat "CT," or equal
 - 3. Coal tar coating: MIL-C-18480; Koppers "50 Bitumastic," Porter "Tarmastic 101," Tnemec "476 Super Tnemecol," or equal
- I. Chlorine Tank Car Unloading Connection: Special flanged tubing assembly conforming to materials and details on Drawing No. 118, the Chlorine Institute, Inc.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install as specified and indicated on Drawing.
- B. Provide a shutoff valve and union at the water, gas, and air supply connections to each fixture and unit of equipment, whether shown on the Drawings or not.
- C. Provide a union within 2 feet of each threaded end valve unless other means for easy removal of the valve are available.
- D. Provide unions where required for equipment removal, indicated on the Drawing or specified.

- E. Do not install piping to obstruct openings and passageways.
- F. Cut pipe to measurement taken at the site, not from the Drawings.
- G. Layout piping to provide for expansion and contraction.
- H. Provide taps for pressure gauge connections with a nipple, snubber, and gauge cock.
- I. Provide expansion joints at not greater than 60 feet intervals in exposed or submerged PVC piping.
- J. Securely anchor piping at the midpoints between expansion joints.
- K. "Snake" buried PVC into trench and keep as cool as possible during installation.
- L. Keep shaded and cover with backfill immediately after installation.
- M. Provide a shutoff valve and union on gas supply lines immediately inside each building.
- N. Hold pipes free of contact with building construction so that noise will not be transmitted after pipe expansion.
- O. Provide air supply piping with sectionalizing valves and valved air inlet connections to isolate portions of system for periodic testing.
- P. Grade all air piping to points of drainage; provide driplegs on drain valves at drainage points.
- Q. Size air piping as follows:

<u>Service</u>	<u>Min. Size</u>
Air Signal	1/4 inch OD
Power Air	1/2 inch OD
Air Supply	1/2 inch OD
Bubbler Droplines	3/4 inch
Buried Piping	3/4 inch

- R. Arrange water supply piping (within buildings) and hot water heating system piping for complete drainage.
- S. Uniformly grade all piping serving metering equipment and provide complete venting to eliminate air traps.
- T. Properly grade steam and condensate piping to drip pockets, traps, and blowoff valves, and other points of drainage collection.
- U. Pipe stuffing box leakage from water sealed pumps to nearest point of drainage.

- V. Provide insulating fittings in all piping except air and gas piping wherever copper tubing or fittings are connected to iron or steel pipe or fittings.

- W. Drainage piping:
 - 1. Conform, in general, to locations indicated on Drawings
 - 2. Slope horizontal soil and waste pipes at 1/4 inch per foot where possible, but never less than 1/8 inch per foot
 - 3. Provide cleanouts in finished floors or in partition walls with a nickel-bronze access cover and frame, with securing screw
 - 4. Install bell-ups flush with floor surface
 - 5. Lay on uniformly descending grades
 - 6. Handle and store properly pipe with premolded joints
 - 7. Properly lubricated joints before installation

3.2 JOINTS

- A. Make pipe joints carefully and neatly

- B. Threaded:
 - 1. ANSI B1.20.1, NPT fully and cleanly cut with sharp dies
 - 2. No more than 3 threads exposed after installation
 - 3. Ream pipe ends after threading to remove burrs
 - 4. Apply thread tape to joints in all plastic and stainless steel piping
 - 5. Apply thread tape or joint compound to joints in other piping
 - 6. Apply teflon thread tape or litharge and glycerin paste to joints in steel piping for chlorine service

- C. Compression:
 - 1. Cut pipe ends squarely, remove burrs
 - 2. Clean contact surfaces with steel wool

- D. Flared:
 - 1. Cut tubing ends squarely, remove burrs
 - 2. Scratches or grooves in flared ends are not allowed

- E. Soldered and brazed:
 - 1. Braze joints in 2 inch or larger copper tubing
 - 2. Solder or braze lines smaller than 2 inch where solder fittings are specified, except for aluminum pipe or fittings
 - 3. Thoroughly clean joint surfaces with flint paper and coat with thin film of flux
 - 4. Install tubing to full depth of socket
 - 5. Do not overheat metal or flux
 - 6. Uniformly heat joint to melt filler metal on contact
 - 7. Remove surplus filler metal and flux while joint is still hot

- F. Solvent welded:
 - 1. Cut PVC pipe ends square and smooth and wipe clean

2. Apply solvent cement to outside of the pipe and the inside of the fitting socket with a small brush.
 3. Push the coated surface snugly together and rotate approx 1/2 turn to insure uniform cement distribution.
 4. Remove excess cement by wiping.
- G. Welded: ANSI B31.1, and per "Code for Pressure Piping"
- H. Grooved couplings
1. Cut grooves with grooving tool
 2. Groove to rigid grooving dimensions
 3. Groove cleanly and sharply without burrs or check marks
 4. Form rounded bottom "radius grooves" in plastic piping
- I. Push on
1. Per recommendations of pipe manufacturer
 2. Bevel each spigot end to facilitate assembly
 3. Lubricate with a heavy vegetable soap solution immediately before joint is completed
 4. Store lubricant in closed containers, keep clean, suitable for use in potable waters
- ### 3.3 PIPE SLEEVES
- A. Provide for pipes passing through concrete or masonry.
- B. Install before concrete is placed.
- C. Through ceramic or vinyl floors, install sleeves flush with finished floor and provide nickel or chromium plated floor plates.
- D. Where passing through all other floors, install so the sleeve projects between 1 and 2 inches above the floor.
- E. Seal sleeves passing through slabs with 1 side against soil with a modular sealing element or a watertight pipe sleeve.
- F. If insulated, extend insulation through sleeves.
- G. For future pipe installation, provide sleeves and seal ends with plastic caps or plugs.
- H. For piping through interior walls and floors with special finish provide pipe sleeves or holes drilled with rotary drill.
- I. Make dust and gas tight through room walls and floor.
- J. Six inch or smaller; special dusttight sleeves.

- K. Greater than 6 inch seal with modular sealing elements or caulk with oakum and seal both sides with Thiokol or urethane sealant.

3.4 CHEMICAL PIPING

- A. Install so that the lines are readily accessible for cleaning.
- B. At each point where flexible tubing is connected to rigid piping, provide a quick disconnect coupling.
- C. Install chlorine gas and vent piping without liquid traps.
- D. Install an elbow and corrosion-resistant insect screen on the open end of each vent.
- E. Provide crosses with plugged openings at changes in direction, except for chlorine piping.

3.5 INSULATION

- A. Install neatly
- B. Clean, dry and test pipe before applying
- C. Tightly butt end joints
- D. Hold seams and joints with manufacturer's standard adhesive
- E. Paste jacket laps neatly
- F. Point joints with insulating cement
- G. For flanges, fittings and valves use molded insulation or insulating cement of same thickness as insulation
- H. Pass through hangers
- I. Provide saddles to prevent pipe support by insulation

3.6 FINISHES

- A. Tape wrap buried black steel pipe including joints
- B. Thoroughly clean surfaces immediately before wrapping
- C. Half-lap tape wrapping
- D. Apply 1 coat of coal tar paint to joints in buried galvanized steel piping.
- E. Paint exposed threads of submerged galvanized piping with zinc rich paint.

3.7 CLEANING

A. General

1. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when erected
2. Blow all lines thoroughly before placing in service

B. Chlorine Piping

1. Clean by pulling a cloth saturated with trichlorethylene or other suitable chlorinated solvent through each length of pipe
2. Disassemble valves and clean with a suitable solvent
3. All surfaces which may come in contact with chlorine gas shall be thoroughly dry and free of oil or grease before placing in service

3.8 FIELD QUALITY CONTROL

- A. Test each line at the Contractor's expense in the presence and to the satisfaction of Engineer.
- B. Provide all testing equipment materials, tools, appliances, devices, and labor.
- C. Test Conditions

Service	Test Pressure	Test Medium
Gas supply	15 inch	compressed air
Chemical piping	30 psi	suitable fluid

D. Procedure

1. Disconnect all fixture devices and other accessories which may be damaged by the specified test pressure
2. Plug or cap ends as required
3. Test for 1 hr with a loss of less than 5 percent of test pressure in air piping, and no loss in pressure in other piping
4. Determine leakage by loss of pressure, soap solution, chemical indicator or other positive method
5. After pressure testing, test all gas piping for leakage with gas at operating pressure:
 - a. Clean and dry piping before admitting chlorine gas
 - b. Admit gas slowly
 - c. Check for leakage with a swab soaked in ammonia solution and waved near each fitting
 - d. Do not apply ammonia solution to fittings
 - e. White fumes are evidence of leakage
 - f. Purge all chlorine gas from lines before repairing
6. All joints shall be tight:
 - a. Repair leaking joints

- b. Repeat tests on repaired lines
- 7. Test drainage and venting systems by filling with water to level of highest vent stack:
 - a. Plug openings as necessary
 - b. Test for drop in water level after 30 minutes

3.9 PIPING SCHEDULE

A. Standard Weight Galvanized Steel Pipe:

- 1. With threaded drainage fittings (galvanized or black):
 - a. Equipment drain piping
 - b. Three inches and smaller drainage and waste piping inside buildings
 - c. 4 inch and 6 inch drainage and waste piping inside structures (or cast iron soil pipe)
 - d. Roof drain piping
 - e. Floor drain piping, except where cast iron soil specified
 - f. Plumbing vent piping
- 2. With threaded malleable iron fittings (2-1/2 inch or smaller):
 - a. 1 to 2-1/2 inch high pressure air piping in interior locations
 - b. Grease piping for pumps
 - c. Drainage pump discharge piping
 - d. Gasoline piping
 - e. Filtrate piping
 - f. Submerged surface wash supply piping
 - g. All pipe sleeves except where plastic-lined or watertight/dusttight sleeves are required
 - h. All piping not otherwise specified
- 3. With flanged fittings (3 inch or larger):
 - a. Air supply piping
 - b. All piping not otherwise specified

B. Black Steel Pipe:

- 1. Standard weight with threaded malleable iron fittings (2-1/2 inch and smaller):
 - a. Natural gas where 2 inch or smaller buried, 2-1/2 inch and smaller other locations
 - b. Buried LP gas where 2 inch or smaller, 2-1/2 inch and smaller other locations
- 2. Standard weight with forged steel fittings (2-1/2 inch or smaller):
 - a. Fuel oil piping (seal weld joints in pump suction piping)
- 3. Standard weight with welded fittings (3 inch or larger):
 - a. Natural gas and LP gas piping, (2-1/2 inch and larger) where buried, 3 inch and larger other locations
 - b. Engine exhaust piping

C. Cast Iron Water Pipe: 8 inch and larger drainage and waste fittings

- D. Cast Iron Soil Pipe:
 - 1. 6 inch and smaller drainage piping buried beneath floors or underground
 - 2. 4 inch and 6 inch drainage and waste piping inside structures (or galvanized steel)

- E. Iron-Pipe-Size Brass Pipe:
 - 1. Gauge piping on pumps, standard weight

- F. Copper Water Tubing:
 - 1. Soft annealed with flared fittings (1-1/4 inch or smaller) submerged or in contact with earth
 - 2. Hard drawn with flanges and flanged fittings:
 - a. Per Drawings
 - 3. Hard drawn with solder fittings (3 inch or smaller) inside buildings or structures:
 - a. Cold water supply piping
 - b. Hot water supply piping
 - c. Differential pressure lines from flow meters to transmitters
 - d. Seal water piping
 - e. Chilled water piping
 - f. Refrigerant piping
 - g. Sampling lines

- G. Copper Instrument Tubing With Compression Fittings:
 - 1. 3/4 inch or smaller air supply piping and pneumatic signal piping
 - 2. All other instrument piping

- H. Chromium Plated Copper or Brass: Exposed Plumbing Fixture Supply Piping

- I. PVC Water Service Pipe with Push-On Joints (1-1/2 to 4 inch buried):
 - 1. Domestic water piping 1-1/2 inch and larger, buried

- J. Pipe, Fitting, Flange, Valve Insulation:
 - 1. Domestic hot water piping
 - 2. Cold water lines above suspended ceilings
 - 3. Roof drain lines above suspended ceilings
 - 4. Refrigerated water piping
 - 5. Hot water heating piping

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide ductile iron piping, 3-inches and larger, complete with all fittings, jointing materials, pipe hangers and supports, anchors, blocking, encasement, and other necessary appurtenances.

1.2 RELATED SECTIONS

- A. Section 02200 - Excavation, Filling and Backfilling
- B. Section 03000 - Concrete
- C. Section 09900 - Painting
- D. Section 15060 - Pipe and Pipe Fittings
- E. Section 15100 - Valves, Cocks, and Hydrants
- F. Section 15140 - Supports and Anchors

1.3 REFERENCES

- A. ANSI B16.1 - Cast Iron Pipe and Flanges and Flanged Fittings, Class 25, 125, 250, and 800
- B. AWWA C104 - Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water
- C. AWWA C105 - Polyethylene Encasement for Ductile Iron Pipe Systems
- D. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 Inch through 48 Inch, for Water and Other Liquids
- E. AWWA C111 - Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
- F. AWWA C115 - Flanged Ductile-Iron Pipe with Threaded Flanges
- G. AWWA C150 - Thickness Design of Ductile-Iron Pipe
- H. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
- I. AWWA C153 - Ductile-Iron Compact Fittings, 3 Inch through 24 Inch and 54 Inch through 64 Inch, for Water and Other Liquids
- J. AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances
- K. AWWA C606 - Grooved and Shouldered Joints

- L. AWWA C651 - Disinfection Water Mains (See Procedure)
- M. ANSI/AWS D11.2 - Guide for Welding Iron Casting
- N. NSF 61 - Drinking Water System Components – Health Effects

1.4 SYSTEM DESCRIPTION

- A. Provide piping complete with all fittings, jointing materials, supports, anchors and accessories as necessary.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these Specifications.
- B. Shop Drawings: Provide piping layout fabrication and assembly drawings with fittings and dimensions in reference to structures. Provide sufficient information to verify compliance with structures and these specifications.
- C. Product Data: Provide data on pipe materials, pipe fittings, and accessories. Provide manufacturer's catalog information with dimensions, material and assembled weight. Indicate pressure ratings for pipe and appurtenances.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Test Reports: Submit proposed method and reports of field pressure tests under provisions of Section 01400, Quality Control of these Specifications.

1.6 REGULATORY REQUIREMENTS

- A. Conform to all municipal codes and ordinances, laws and regulations of the State.
- B. In case of apparent conflict, State and local requirements govern over these specifications.
- C. In absence of State and local regulations, National Plumbing Code applies.

1.7 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01720, Project Record Documents of these Specifications.
- B. Accurately record actual locations of piping, fittings, valves, connections, and top of pipe (or centerline) elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

- A. Manufacturer's name and pressure rating marked on piping and fittings.
- B. Same manufacturer to provide all piping, fittings, jointing materials and accessories.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600, Materials and Equipment of these Specifications.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. During loading, transporting, unloading and installation, exercise care to prevent damage to material:
 - 1. Use nylon slings only
 - 2. Do not drop pipe or fittings
 - 3. Do not roll or skid against pipe already on ground
 - 4. Repair any damage done to coating or lining
 - 5. Handle per manufacturer's instructions
 - 6. Store rubber gaskets in cool dark location
 - 7. Store all material on wood pallets or timbers
- D. Adequately tag or otherwise mark all piping and fittings as to size

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Ductile Iron Pipe
 - 1. U.S. Pipe and Foundry
 - 2. American Cast Iron Pipe
 - 3. Griffin Pipe Products Company
 - 4. McWane Cast Iron Pipe
- B. Ductile Iron Fittings
 - 1. American Cast Iron Pipe
 - 2. Union Tyler Foundry Company
 - 3. Clow
 - 4. U.S. Pipe and Foundry
 - 5. Sigma

2.2 DUCTILE IRON PIPE

- A. Pipe, As listed below except as otherwise specified or indicated on the Drawings:
 - 1. AWWA C150, AWWA C151:
 - a. 3 inches to 12 inches Pressure Class 350

- b. 14 inches to 36 inches Pressure Class 250
 - c. 42 inches to 64 inches Pressure Class 150, 200, 250, 300, 350
 - d. Pressure Class (PC) determined by Section 01601, Piping Schedule.
2. Where fitted with flanged or grooved, 4 inches to 54 inches Special Thickness Class 53

B. Fittings:

- 1. Ductile iron standard fittings, ANSI A21.10/AWWA C110, ASTM A536:
 - a. Flanged joints, 4 inch to 48 inch: 250 psi rating
 - b. Mechanical joints, 4 inch to 12 inch: 350 psi rating
 - c. Mechanical joints, 14 inch to 48 inch: 250 psi rating
- 2. Ductile iron compact fittings: ANSI A21.53/AWWA C153:
 - a. Flanged joints, 4 inch to 48 inch: 250 psi rating
 - b. Flanged joints, 54 inch to 64 inch: 150 psi rating
 - c. Mechanical joints, 4 inch to 24 inch: 350 psi rating
- 3. Ductile iron grooved fittings: ANSI/AWWA C606, AWWA C110 for center-to-center dimensions, AWWA C153 or C110 for wall thickness:
 - a. 3 inch to 12 inch: 350 psi rating
 - b. 14 inch to 36 inch: 250 psi rating

C. Joints:

- 1. Mechanical joints: ANSI A21.11/AWWA C111:
 - a. Bolts and nuts: High strength, low alloy steel, “Cor-Ten” or approved equal
- 2. Mechanical joints with tie rods:
 - a. Tie rods: ASTM A307, galvanized entire length
 - b. Steel pipe spacers: ASTM A120, standard weight galvanized
 - c. Washers: ANSI A27.2 plain steel, galvanized
- 3. Flanged joints:
 - a. General use: ANSI A21.15/AWWA C115 and ANSI B16.1, Class 125
 - b. Where 250 psi working pressure indicated on Drawings or specified: ANSI 21.15/AWWA C115
 - c. Where Class 250 indicated on Drawings or specified: ANSI B16.1, Class 250, flat faced
 - d. Flange bolting:
 - 1) Material: ASTM A307
 - 2) Type: Bolt and nut, bolt-stud and 2 nuts permitted for 1 inch and larger
 - 3) Bolts and bolt-studs:
 - a) Length: Ends project 1/4 inch to 1/2 inch beyond nuts
 - b) Ends: Chamfered or rounded
 - c) Threading: ANSI B1.1, coarse thread series, Class 2A fit. Bolt studs may be threaded full length. Studs for tapped holes threaded to match holes

- 4) Bolt heads:
 - a) Shape: Hexagonal or square
 - b) Dimensions: ANSI B18.2 regular pattern for square, heavy pattern for hexagonal
 - 5) Nuts:
 - a) Dimensions: ANSI B18.2 heavy, semi-finished pattern
 - b) Threading: ANSI B1.1 coarse thread series, Class 1B fit
 4. Push-on joints: ANSI A21.11/AWWA C111, except gaskets shall be neoprene or other synthetic rubber. Natural rubber is not acceptable:
 - a. Lubricant: Heavy vegetable soap solution suitable for potable water contact
 - b. Pressure rated 350 psi
 5. Restrained Joints: All joint restraint for underground ductile iron pipe and fittings shall be rated for a minimum of 250 psi. Restraining gaskets shall be clearly marked 6" thru 24" pipe and shall utilize "Fast Grip" restraining gaskets for ACIPCO (American) Pipe only or "Field Lok" restraining gaskets for U.S. Pipe, Griffin Pipe and McWane Pipe only. Restrained Joints for pipe 36" and larger shall be ACIPCO "Flex Ring", U. S. Pipe "TR Flex" or comparable product which utilizes a positive restraining joint. Megalug® series 1100 and 1700 may also be used as restraint for ductile iron pipe 6" to 36". All tie rod assemblies added to joint restraint shall receive a coal tar bitumastic coat to prevent corrosion. All horizontal bend fittings and connecting pipe shall be restrained as shown on drawings. For number of lengths to be installed, refer to drawings.
 6. Threaded connections: ANSI B2.1.NPT: Provide boss or tapping saddle at all tapped connections
 7. Mechanical couplings:
 - a. Mechanical Joint Sleeve
 8. Grooved couplings:
 - a. Standard groove/rigid groove
 - b. Pipe ends: Grooved with "radius cut groove"
 - c. Couplings: Victaulic "Style 31", Gustin-Bacon "Series 100 Gruvagrip", or approved equal
 - d. Gaskets: Compatible with pipe material
 - e. Vic-Flange Adapters: Victaulic "Style 341", "Style 342", or approved equal
 9. Flanged coupling adapters:
 - a. 48 inch and under: Ebba Iron Series 2100 Megaflange or approved equal
 - b. Uniflange is not acceptable
- D. Wall Sleeves and Wall Pipes
1. The penetration of pipes passing through concrete walls shall be made watertight. Pipes 4" and larger shall have or ductile iron wall pipes. Wall pipes shall have a dam inside the wall and shall have the proper joint to connect with the pipe on each side of the wall. Wall pipes where used as sleeves shall be fitted with Thunderline Link seals or comparable product. Before casting concrete, wall pipes and sleeves shall be accurately positioned and secured.

- E. Tapping Sleeves shall be full circle style constructed completely of stainless steel. The tapping sleeve flange shall also be stainless steel. All bolts, nuts, and washers shall be stainless steel. The tapping sleeve shall be Ford style FTSS rated for a minimum working pressure of 250 psi.
1. 4" – 12" Smith-Blair #663, Ford Meter Box Style FTSS or Mueller H-304SS
 2. 14" – 24" Smith-Blair #662 or Mueller H-304SS
- F. Accessories:
1. Tapping saddles: Ductile iron with double stainless steel straps and rubber sealing gasket, 250 psi pressure rating
 2. Pipe welded protective caps: Royston "Handy Cap 2", or accepted substitution
 3. Concrete for thrust blocks or encasement: Concrete type specified in Section 03000, Concrete.
- G. Gaskets:
1. SBR (styrene butadiene rubber):
 - a. All process, water and sewer piping unless otherwise indicated
 - b. 120 degrees F maximum service temperature
 - c. Gaskets to match pressure rating of piping and jointing system
 2. Neoprene:
 - a. All buried push-on joint piping, and high temperature process piping unless otherwise indicated
 - b. 200 degrees F maximum service temperature
 - c. Gaskets to match pressure rating of piping and jointing system
 3. Flange Gaskets:
 - a. Full faced
 - b. 1/8 inch thick natural rubber

2.3 CORROSION CONTROL

- A. Comply with provisions under Section 09900, Painting and Finishing of these Specifications.
- B. Shop paint:
1. Shop prime exterior surfaces of pipe and fittings to be installed in exposed interior or exterior locations
 2. Shop coat flange faces with rust preventative compound
 3. Shop coat all other exterior surfaces of pipe and fittings with a bituminous coating in buried locations, manufacturer's standard, AWWA C110, C151 or C153
- C. Shop lining for pipe and fittings:
1. Portland cement mortar lining, AWWA C104:
 - a. All process water, and gravity ductile iron piping and fittings unless otherwise indicated
 - b. 250 psi min working pressure
 - c. 150 degrees F maximum service temperature (without Sealcoat)
 - d. Standard thickness

2. Bituminous coating, AWWA C104:
 - a. Air and gas service piping
 - b. 150 degrees F maximum service temperature
 - c. Materials, thickness per manufacturers recommendations
 3. Fusion bonded epoxy, AWWA C116:
 - a. Gravity sewers, sewer force mains unless otherwise indicated
 - b. 250 psi min working pressure
 - c. 120 degrees F maximum service temperature
 - d. Materials, thickness per manufacturers recommendations
- D. Polyethylene encasement: ANSI/AWWA C105/A21.5-99:
1. Seamless tube:
 - a. Linear low density polyethylene
 - b. ASTM D4976, Type I, Class A, Grade E-1
 - c. Thickness: 8 mils thick minimum
 - d. Tensile strength: 3,600 psi, minimum, ASTM D822
 - e. Elongation: 800 percent, minimum, ASTM D882
 - f. Melt index: 0.4, maximum
 - g. Dielectric strength: 800V/mil, minimum, ASTM D149
 - h. Propagation tear resistance: 2,500 gf, minimum, ASTM D1922
 - i. Impact Resistance: 600 g, minimum, ASTM D1709, Method B
 2. Joint tape: Self-sticking, PVC or polyethylene, 2-inch wide, 10 mils thick, Chass "Chasekote 750", Kendall "Polyken 900", 3M "Scotchrap 50", or equal
 3. Strapping: Nonmetallic, water resistant, FS PPP-S-760, Type II
 4. Harness rods shall be covered by 4-inch flat width polyethylene tubing. The entire joint shall be covered by a complete wrap of 40-inch wide polyethylene sheet material cover over each set of lugs
- E. Insulating fittings:
1. Provide at all transitions between metal piping materials, and between interior and exterior piping
 2. Insulating kits to be used at all transitions, as manufactured by Central Plastics or accepted substitute
 3. Insulating gaskets:
 - a. Glass reinforced epoxy
 - b. 1/8 inch min thickness
 - c. Buna-N sealing element
 4. Insulating bolt sleeves:
 - a. Mylar
 - b. 1/32 inch min thickness
 5. Insulating washers:
 - a. Phenolic laminate
 - b. 1/8 inch min thickness
 - c. One washer per flange bolt
 6. Backing washers:
 - a. Steel
 - b. 1/8 inch min thickness

- c. Two washers per flange bolt

2.4 FABRICATION

A. Joints:

1. Except as indicated on Drawings:
 - a. Buried locations: Mechanical or push-on
 - b. Buried fittings: Mechanical
 - c. Bells in wall pipe or casting: Mechanical with tapped holes for follower bolts or extended min. 6 inches beyond wall
 - d. Bells in structures: Mechanical joint type
 - e. Exposed: Flanged or grooved
2. 12 inches and smaller branch outlets where main line is at least twice the diameter of the branch, tee or a tapping saddle is acceptable
3. Where restrained joint with groove or grooved couplings are required, increase pipe thickness to provide:
 - a. Buried: 0.29 inches minimum at bottom of groove
 - b. All other: 0.25 inches minimum at bottom of groove
4. Mark the centerline of each flange and mechanical joint piece
5. Screw flanges onto screwed-on flanged pipe so that pipe extends completely through and flush with the flange
6. Finish machine pipe ends and flange faces flat and perpendicular to pipe centerline in a single operation

B. Fittings and specials:

1. Finish with same lining and coating as abutting pipe
2. Coat by hand all fittings and specials that cannot be mechanically lined using the same materials and in accordance with AWWA C104
3. Mark each pipe with pipe class, date of manufacture and manufacturer's name or trademark
4. Directly thread into wall of pipe outlets up to 2 inches in diameter. Provide integral tee fitting for outlets greater than 2 inches in diameter

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions under provisions of Section 01010, Summary of Work of these Specifications.
- B. Carefully examine pipe and fittings for cracks, damage to linings and coatings, and other defects prior to installation.
- C. Remove all defective pipe from site and replace.
- D. Examine areas for defects such as weak structural components or deviations beyond allowable tolerances for piping clearances that adversely affect execution and quality of Work.

- E. Start installation only when conditions are satisfactory.

3.2 BEDDING

- A. Excavate pipe trench in accordance with Section 02200, Excavation, Filling and Backfilling in these Specifications for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated:
 - 1. Dig bell or coupling holes
 - 2. Do not support pipe on blocks or mounds of earth
 - 3. Provide uniform and continuous bearing and support for full length of pipe between bell holes.
 - 4. Minor disturbance over a maximum length of 18 inches near the middle of each length of pipe will be permissible by the withdrawal of pipe slings or other lifting tackle.
- B. Alignment and grade:
 - 1. Except as indicated on the Drawings, lay all pipe straight between changes in alignment and at a uniform grade between changes in grade.
 - 2. Use batter boards to determine and check pipe subgrades.
 - 3. Other methods of maintaining alignment and grade may be acceptable. Submit complete information describing the proposed method to the Engineer for review before pipe laying is started.
- C. Place bedding material at trench bottom, level fill materials in one continuous layer per Section 02200, Excavation, Filling and Backfilling of these Specifications.

3.3 INSTALLATION

- A. Install as specified or in accordance with the manufacturer's instructions.
- B. Cutting pipe:
 - 1. Cut pipe to measurements taken at the site, not from the Drawings
 - 2. Cut pipe neatly without damage to pipe or cement lining
 - 3. Cut smooth, straight, and at right angles to pipe axis
 - 4. Dress and bevel end of cut pipe to remove roughness and sharp corners, recoat exposed metal with coating approved for intended service
 - 5. Cut ductile iron pipe with saw or abrasive wheel
- C. Piping underground:
 - 1. Install ductile iron piping and fittings in accordance with AWWA C600 except as specified herein.
 - 2. Inspect pipe and accessories for defects before lowering into trench
 - 3. Repair or replace any defective, damaged or unsound pipe
 - 4. Carefully lower pipe, fittings, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage.
 - 5. Do not dump or drop pipe or accessories into trench

6. Do not lay pipe in water, under unsuitable weather conditions or under unsuitable trench conditions.
7. Joint to form true and smooth line
8. Trim pipe only for closures
9. Remove any pipe not making a good fit
10. Begin pipe laying at the lowest point unless reverse laying is accepted by Engineer.
11. Utilize implements, tools and facilities as recommended by the manufacturer
12. Keep pipe clean during and after laying.
13. Close all open ends with watertight expandable type plugs:
 - a. At the end of each day's operations
 - b. Whenever pipe ends are left unattended
 - c. Deposit adequate backfill on pipe to prevent flotation
 - d. Do not use wood, burlap or other similar temporary plugs
14. Remove and re-lay any pipe which has floated
15. Provide an isolation or shutoff valve and union at the water connections to each fixture and unit of equipment, whether shown on the Drawings or not
16. Group piping with other site piping work whenever practical. Maintain 10 feet minimum separation between potable water and sanitary or storm sewer pipes
17. Install pipe to indicated elevation to within tolerance of 1/2 inch
18. Route pipe in straight line
19. Install pipe to allow for expansion and contraction without stressing pipe or joints
20. Install access fittings to permit disinfection of water system performed under Section 02675, Disinfection of Water Distribution Systems of these Specifications.
21. Slope water pipe and position drain at low points
22. Protect from lateral displacement by placing embedment evenly on both sides of pipe.
23. Lay pipe with bell ends facing the direction of laying except when Engineer authorizes reverse laying.
24. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main. Not required when using restrained joint pipe.
25. Establish elevations of buried piping to ensure not less than 5 feet of cover
26. Backfill trench in accordance with Section 02200, Excavation, Filling and Backfilling of these Specifications.

D. Piping in buildings or structures:

1. Completed installation should present a neat, orderly appearance
2. Do not block openings, passageways, or pipe galleries
3. Run piping parallel to walls of building or structure
4. Keep piping from contacting walls, structures, or installed items

3.4 JOINTS

- A. Make joints carefully and neatly.
- B. Connect piping in accordance with manufacturer's instructions.

- C. Mechanical joints:
1. If an effective seal is not obtained, disassemble joint, clean thoroughly, and reassemble.
 2. Do not over-tighten bolts to compensate for poor installation.
 3. Carefully align holes in mechanical joints with restraint devices to permit installation of the harness bolts.
 4. Install flange and mechanical joint pieces so the four mechanical joint holes, as well as the flange holes, straddle the top centerline for horizontal piping, or the side centerline for vertical piping.
- D. Push-on joints:
1. Bevel spigot ends of field cut piping.
 2. Groove spigot ends of field cut restrained joint piping.
 3. Thoroughly clean and lubricate inside of receiving bell and outside of spigot and gasket immediately before jointing.
 4. Relieve any tension in rubber gasket by inserting a dull instrument under the gasket and rake two complete revolutions around joint.
 5. Place spigot end of the pipe in the bell end of the preceding pipe with care to prevent contact of the joint with the ground.
 6. Complete the joint by pushing pipe home with slow steady pressure, without jerky or jolting movements.
 7. Do not exceed 80 percent of the pipe manufacturer's instructions for maximum deflection.
- E. Flanged joints:
1. Take care when bolting flanges to insure that there is no restraint on the opposite end of the pipe which would prevent gasket compression or cause unnecessary stress in flanges.
 2. Leave one flange free to move in any direction while tightening flange bolts
 3. Do not pack or assemble bell and spigot joints until all flanges affected thereby have been tightened.
 4. Tighten bolts gradually at a uniform rate to compress gaskets uniformly
 5. Take special care in connecting to pumping equipment to insure no stresses are transmitted to pump flanges by connecting piping:
 - a. Permanently support piping for accurate matching of bolt holes and uniform contact over the entire face of abutting pump and pipe flanges are obtained before bolting those flanges.
 - b. Allow pump connection piping to move parallel to its longitudinal centerline while bolts are tightened.
 - c. Level, align, and wedge pumps into position to fit connecting piping but do not install grout until after initial pipe fitting and alignment to allow shifting the pump on its foundation.
 - d. Grout pumps prior to final bolting of connecting piping.
- F. Flanged coupling adapters:
1. Provide tie rods through adapter from pipe flange downstream to pipe flange upstream to prevent joint separation with follower nut behind adapter.

- G. Mechanical couplings:
 - 1. Cut pipe ends clean and smooth
 - 2. Leave a space of 1/4 inch to 1 inch between pipe ends

- H. Grooved couplings: Arrange piping so the clear space between pipe ends inside each grooved coupling is not more than one times, or less than 1/2 times, the maximum recommended by manufacturer

- I. Reducers:
 - 1. Provide eccentric reducers adjacent to flowmeters where installed in horizontal position.
 - 2. Install with straight side on top to avoid forming trapped air.

- J. Pipe restraining methods:
 - 1. In interior locations and where subject to internal pressure, bloc, anchor or harness piping with mechanically coupled, push-on or similar joints to prevent separation of joints.
 - 2. In buried piping subject to hydrostatic heads in excess of 30 feet provide restrained joints or concrete thrust blocking to prevent pipe movement caused by internal pressure at:
 - a. Fire hydrants and gate valves
 - b. Plugs, tees, and wyes
 - c. Bends deflecting 11-1/4 degrees or more
 - d. Other locations show on Drawings
 - 3. Concrete thrust blocking shall provide:
 - a. Bearing area as indicated on the Drawings
 - b. Provide bond break
 - c. Extend from fitting to solid undisturbed earth
 - d. Installed so joints are accessible for repair
 - e. If the lack of a solid vertical excavation face is due to improper excavation, all additional costs shall be borne by Contractor
 - 4. For areas where ground is unstable or unsuitable for concrete thrust blocking, as determined by the Engineer, or as indicated on the Drawings, provide joint restraint by tied pipe:
 - a. Provide sufficient number of tied joints to equal or exceed restraining length as shown on the Drawings.
 - b. In fills and embankments provide concrete thrust blocks and tied joints to equal or exceed restraining length as shown on the Drawings:
 - 1) Tie rods and Cor-ten eye bolts at mechanical joints
 - 2) Tie rods and clamps at push-on joints
 - 3) Restrained joint pipe

3.5 CONCRETE ENCASEMENT

- A. Provide as indicated on the Drawings.

- B. Provide reinforcing as indicated on the Drawings.

- C. Suitably support and block pipe and anchor against flotation

3.6 CONNECTION TO EXISTING PIPE LINES – NON POTABLE

- A. Make connections between new and existing piping by other contractors with suitable fittings, provide all fittings required for testing.
- B. Schedule connection to minimize inconvenience to the Owner, other contractors, and as authorized by Owner.
- C. Provide facilities for adequate dewatering and disposal of water from dewatered line and excavations without damage to adjacent property.

3.7 CONNECTIONS TO EXISTING MAINS [SPECIFIER NOTE: COLUMBIA CO. REQUIREMENTS]

- A. The Contractor shall verify existing conditions of tie-in and submit to Engineer for approval a sketch of the connection if conditions differ from Contract Documents. The Contractor shall contact the Columbia County Water Utility Engineering Office at 706-651-0433 and request approval 5 days prior to the intended connection date.
- B. The Contractor shall furnish and install all fittings and appurtenances necessary (unless otherwise noted) to make connections to the existing distribution system. All solid sleeves used to cut into existing pipes shall have a maximum gap of 3/4" between butted plain end pipes. Where this is unable to be achieved, a filler ring shall be installed to close the gap between the cut pipes. All sleeves shall be restrained joint. All restraint necessary, existing pipe and new piping, shall be the responsibility of the Contractor.
- C. Dewatering the existing pipe shall be done to prevent any cross contamination of trench water. The Contractor shall provide a pump sufficient for the rate of flow and/or appropriate drainage to ensure there is no backflow into the existing water line. The cut or break in the existing water line shall be at the highest point of the connection.
- D. All fittings, pipe, valves and appurtenances used to connect to the existing water system prior to standard disinfection shall be clean, free of foreign material and disinfected. Disinfection shall utilize a bleach solution of 1 1/2 parts water to 1 part bleach that shall be sprayed inside pipe, valves, fittings and appurtenances before the connection is to be put back on line with the existing water system.

3.8 PROTECTIVE COATING

- A. Provide polyethylene tube encasement on all buried ductile iron pipe, fittings, valves, and rodding:
 - 1. Comply with AWWA C105
 - 2. As detailed on the Drawings
- B. Metal surfaces:

1. Coat all steel clamps, rods, bolts, and other metal accessories used in tapping saddles, anchorages, cut ends of pipe, follower rings and bolts or joint harnesses subject to submergence or contact with the earth and not concrete encased, but including pipe fittings and bolts in polyethylene tube encasement.
2. Apply 2 coats of coal tar paint to clean, dry metal surfaces
3. Allow the first coat to dry and harden before applying the second coat.

3.9 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to 1/4 inch per foot, two percent minimum but never less than 1/8 inch per foot. Maintain gradients.
- B. Slope exposed water piping and arrange to drain at low points.

3.10 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400, Quality Control of these Specifications and AWWA C600.
- B. Test each line at the Contractor's expense in the presence and to the satisfaction of the Engineer.
- C. Provide all necessary pumping equipment, piping connections, pressure gauges with maximum of 1 psi increments, and other required equipment, facilities, and materials.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- E. Test Conditions: Identify lines, test pressure, and test medium according to Specification 01601, Piping Schedule of these Specifications.
- F. Hydrostatic Tests
 1. Pressure Test
 - a. All sample taps shall be installed before pressure testing. The contractor is required to thoroughly flush the newly laid water line prior to pressure testing. All newly installed pressure pipe or any valved section thereof shall be subjected to the appropriate hydrostatic pressure based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gage. The duration of each pressure test shall be two hours. Before applying the specified test pressure, all air must be expelled from the line. The Contractor will make the necessary taps and insert plugs to complete the test. All taps installed shall be marked in red on the Contract Drawings that will serve as the record drawings. Any exposed pipe, fittings, valves, and joints shall be carefully examined during the open trench test. All defective joints shall be repaired or replaced to the satisfaction of the Inspector. Any cracked or defective pipe, joints, fittings, valves or hydrants discovered in consequence of this

pressure test shall be removed and replaced with sound material and the test shall be repeated until satisfactory to the Inspector.

2. Leakage Test:

- a. The duration of the leakage test shall be two hours, and during the test the main or section of the main under test shall be subjected to the above noted pressure based on the lowest point in the line or section under test and corrected to the elevation of the test gage. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the air has been expelled and the pipe has been filled with water at the test pressure. No pipe installation will be accepted until leakage is less than the number of gallons per hour as determined by the formula

$$L = \frac{D\sqrt{P}}{148}$$

L = Allowable leakage in gallons per hour per 1,000 ft. pipe.

D = The nominal diameter of the pipe in inches.

P = The average test pressure during the leakage test in pounds per square inch gauge.

3.11 CLEANING AND DRAINING

- A. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected.
- B. Wire brush, if necessary, wipe clean and keep joint contact surfaces clean until connection is complete.
- C. Flush all lines thoroughly before disinfection in accordance with Section 02675, Disinfection of Water Distribution Systems.
- D. When testing against a closed valve connected to an existing potable water system, complete flushing and passing disinfection tests per Section 02675, Disinfection of Water Distribution Systems prior to conducting hydrostatic pressure test.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Valves indicated on Drawings, specified or as required for proper operation of equipment or systems.

1.2 RELATED SECTIONS

- A. Section 02667 - Water Lines
- B. Section 09900 - Painting and Finishing
- C. Section 15060 - Pipe and Pipe Fittings

1.3 REFERENCES

- A. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
- B. ASTM B148 - Standard Specification for Aluminum-Bronze Sand Castings
- C. ASTM A313 - Standard Specification for Stainless Steel Spring Wire
- D. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications
- E. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service
- F. AWWA C502 - Dry Barrel Fire Hydrants
- G. AWWA C508 - Swing Check Valves for Waterworks Service, 2 inch through 24 inch NPS
- H. AWWA C509 - Resilient Seated Gate Valves 3 inch through 12 inch NPS, for Water and Sewage Systems
- I. AWWA C511 - Reduced-Pressure Principle Backflow-Prevention Assembly
- J. AWWA C512 - Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
- K. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants
- L. NSF 61 - Drinking Water System Components - Health Effects
- M. UL 246 - Hydrants for Fire - Protection Service

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these Specifications.
- B. Product Data: Provide data on valves and accessories. Provide manufacturer's catalog information with dimensions, materials, and assembled weight. Indicate valve data and ratings.
- C. Manufacturer's Instructions: Provide complete manufacturer's installation instructions.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01720, Project Record Documents of these Specifications.
- B. Record actual size, type and location of all valves.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01730, Operation and Maintenance Data of these Specifications.
- B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE

- A. Manufacturer's name and pressure rating marked on valve body.
- B. Test valves in accordance with applicable standards referenced above.

1.8 GENERAL REQUIREMENTS

- A. All valves, hydrants and accessories furnished by the Contractor for incorporation into the work shall be new, unused, and of the type specified herein. Valves and hydrants for buried service shall be furnished with mechanical joint connections. Each valve shall have the identifying mark of the manufacturer, year of manufacture and pressure rating cast on the body. All valves shall be gate valves, shall be opened by turning counter-clockwise and shall have an arrow cast into the metal of the operating nut or on the handle or wheel to indicate direction of opening. ALL valves shall be furnished by a single manufacturer.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 10 years documented experience.

1.10 REGULATORY REQUIREMENTS

- A. Conform to all municipal codes and ordinances, laws and regulations of the State.
- B. In case of apparent conflict, State and local requirements govern over these specifications.
- C. In absence of State and local regulations, Uniform Plumbing Code will apply.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600, Materials and Equipment of these Specifications.
- B. Prepare valves and accessories for shipment according to AWWA C500.
- C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- D. Provide temporary protective coating on cast iron and steel valves.
- E. Seal valve ends to prevent entry of foreign matter into valve body.

PART 2 PRODUCTS

2.1 GENERAL

- A. Construction:
 - 1. Actual valve length within $\pm 1/16$ inch of specified or theoretical length.
 - 2. Ends, except as otherwise specified:
 - a. 2-1/2 inch and smaller, threaded or soldered ends
 - b. 3 inch and larger:
 - 1) Buried: Push-on or mechanical joint, ANSI A21.11
 - 2) Others: Flanges, ANSI 125 lb
 - c. Wafer style valves designed for installation between ANSI 125 lb flanges
- B. Shop Painting:
 - 1. Comply with provisions of Section 09900, Painting and Finishing of these Specifications.
 - 2. Shop paint all ferrous metal surfaces of valves and accessories, both interior and exterior for corrosion protection.
 - 3. Manufacturer's standard paint will be acceptable if it is functionally equivalent to the specified paint and compatible with the specified field painting
 - 4. Surfaces to be painted:
 - a. Unfinished surfaces:
 - 1) Interior: Coal tar epoxy or epoxy
 - 2) Exterior to be buried, submerged, or located in manholes: Coal tar epoxy or suitable exterior coating acceptable to Engineer
 - 3) Other exterior: Rust inhibitive primer

- b. Polished or machined surfaces: Rust-preventive compound
 - c. Operators and accessories: Rust inhibitive primer
- C. Actuators:
- 1. Provide manual actuators for all valves not specified to be power actuated or designed for automatic operation:
 - a. General use: Handwheel
 - b. Seven feet or more above the floor or grade: Chain wheel with operating chain:
 - 1) Equipped with chain guide to permit rapid chain handling of the chain without "gagging" the wheel and to permit reasonable side pull on the chain
 - 2) With extensions as required to prevent interference with adjacent piping or equipment
 - 3) Chain heavily zinc or cadmium-plated and looped to extend between 3 feet and 4 feet of the floor or grade below valve
 - c. Buried valve, valves operated through floor boxes, and as indicated on Drawings: Wrench nuts:
 - 1) AWWA C500, Section 19
 - 2) Provide 2 operating keys
 - d. Plug or ball valves not to be chain wheel or wrench nut operated: Lever:
 - 1) Provide 2 operating levers of each required size
 - 2. Rotation:
 - a. Counter clockwise (to the left) to open
 - b. The word "OPEN" and an arrow indicating the direction to open cast on each valve body or operator
 - 3. Extension stems:
 - a. Provide where indicated on Drawings, specified, required for proper operation and for buried valves with operating nuts more than 8 feet below grade
 - b. Non-rising stems:
 - 1) Solid steel shafting with O.D. not less than O.D. of valve stem or galvanized steel pipe with I.D. not less than O.D. of valve stem
 - 2) Connected to the valve by a flexible socket coupling
 - 3) All other connections pinned, keyed, or socket
 - c. Rising stem:
 - 1) Stainless steel or carbon steel shafting with O.D. not less than O.D. of valve stem
 - 2) Bronze or stainless steel sleeves securely attached to stem
 - 3) Sleeve length and location to extend through each stem guide throughout the full vertical travel of stem
 - d. Stem guides:
 - 1) Cast iron, bronze brushed, adjustable in two directions
 - 2) If extension stem length exceeds 10 feet or the weight exceeds 50 lbs, design top guide to carry the stem weight and provide a collar on the stem to bear against the thrust guide

- 3) Max spacing:
 - a) Non-rising stems: 100 times stem O.D.
 - b) Rising stems: 60 times stem O.D.
 - c) Ten feet max
- e. Buried valves:
 - 1) Stem extend to within 6 inches of grade
 - 2) Provide spacer to center stem in valve box
 - 3) Provide wrench nut
- 4. Operating Stands:
 - a. Provide as indicated on Drawings
 - b. Fabricated steel or cast iron
 - c. Support handwheel or lever approximately 36 inches above floor
 - d. Handwheel diam: 8 inch minimum
 - e. Provide standard weight galvanized pipe sleeve for opening in floor
 - f. For longer than 10 feet and without stem guides with thrust bearings, provide a suitable thrust bearing in each stand to carry extension stem weight
- 5. Floor boxes:
 - a. Provide when openings are provided in concrete slabs for key operation of wrench nuts in or below the slab
 - b. Cast iron with cover
 - c. Depth as required for slab
 - d. Nut in slab: Provide a stem guide to center nut in box
 - e. Nut below slab: Bottom opening to permit passage of key
 - f. Box and cover coated by coal tar epoxy
 - g. The word "SEWER" cast on each cover
- 6. Valve boxes:
 - a. Provide for all buried valves
 - b. Cast iron extension sleeve type with boxes and covers
 - c. Depth as required for valve
 - d. Minimum diam: 5 inch
 - e. Minimum thickness: 3/16 inch
 - f. Box, cover, and base coated by dipping in asphalt varnish
 - g. An appropriate word designating the valve service case on the cover
 - h. Box assemblies shall be Union Tyler 6850 series, 564-5 or approved equal.
 - i. An 18 inch round by 6-inch thick concrete slab shall be cast around the top of the valve box with the top of the box slab being flush with pavement in paved areas or 2 inches above finished grade in unpaved areas. All valve boxes shall be suitable to adjust to correct depth needed.

2.2 GATE VALVES

- A. Clear water service, 3/4 inch to 2 inch:
 - 1. Bronze, rising stem, solid wedge, screw in bonnet
 - 2. Threaded ends: Nibco T-111, Grinnell 3010, or approved equal
 - 3. Soldered ends: Nibco S-111, Grinnell 3010 SJ, or approved equal

- B. All gate valves shall be of the resilient seat type designed for a minimum working pressure of 250 psi. Valves > 16" shall be fitted with gear operators. Underground valves shall have restrained mechanical joint ends to match the piping in which they are installed. Valves \geq 20" shall be horizontal installations, unless otherwise noted in Valve Schedule, and shall have a built in bypass. Exposed valves shall be flanged. Gate valves shall have a clear waterway equal to the full normal diameter of the pipe. Prior to shipment from the factory, each valve shall be tested by hydraulic pressure equal to twice the specified working pressure. All valves shall conform to the specifications for Gate Valves for Ordinary Water Works Service, AWWA C515. Coatings shall be per AWWA C550. Valves shall be non-rising stem type with 2-inch square operating nut and shall open by turning counterclockwise (left) only. The gate valve shall have the identifying mark of the manufacturer, year of manufacture and pressure rating cast in the valve body. Valves shall be M&H Valve Company, Mueller Company, American Flow Control, or approved equal. Butterfly valves are not permitted for buried conditions.

- C. Valve Body shall be made of ductile iron. All pressure containing castings shall be full wall thickness and a clear waterway equal to the full nominal diameter of the pipe in accordance with AWWA C509. The interior and exterior of the body and bonnet shall be coated with fusion bonded epoxy in accordance with AWWA C550 Standard for Protective Interior Coatings for Valves and Hydrants. All bolts exposed to the earth shall be stainless steel grade 18-8.

- D. Valve Stem shall be bronze in accordance with AWWA C509.

- E. Stem Extension is required for gate valves or tapping valves deeper than 7'-0", a stem extension shall be added to the valve stem to bring the 2" operator nut to within 5'-0" of finished grade. All stem extensions shall be bronze bar stock with a bronze or stainless steel connector to the valve stem. The connector shall be fitted with a shear pin and locked into place.

- F. Gate shall be constructed of ductile iron and shall be fully encapsulated with SBR or EPDM rubber.

- G. Operator shall be fitted with a ductile iron 2" square nut for buried gate valves. All gate valves installation within a vault or pit shall be fitted with a standard ductile iron hand-wheel.

- H. Joints for buried gate valves 2" in diameter shall have threaded joints in accordance with ANSI B2.1. All buried gate valves 3" and larger shall be fitted with mechanical joints in accordance with these specifications. All gate valves installed within a vault or pit shall be flanged in accordance with these specifications.
- I. Valve Bearings: Valves shall be fitted with sleeve type bearings. Bearings shall be corrosion resistant stainless steel and self lubricating.
- J. Valve actuators shall conform to latest revision of AWWA C504, and shall be designed to hold the valve in any intermediate position between full open and fully closed without creeping or fluttering. The bearing load shall not exceed 1/5 of the compressive strength of the bearing or shaft material.
- K. Manual valve operators shall be of the worm gear or traveling nut type and fully enclosed. Units furnished for buried service shall be fully gasketed and grease packed. Above ground operators shall have a suitable indicator arrow to give valve position at any point from full open to fully closed. Manual operators shall require at least 30 turns of the handwheel to rotate 90°. Operator components shall, at the extreme operator positions, withstand without damage a pull of 200 lbs. for handwheel operators or an input torque of 300 ft. lbs. for operating nuts.

2.3 BUTTERFLY VALVES

- A. Butterfly valves shall be resilient seated, short body design, and shall be designed, manufactured, and tested in accordance with all requirements of AWWA C504 for Class 150B. Valves shall be rated for 150 psi working pressure unless otherwise specified or shown.
- B. Valve bodies shall be ductile iron conforming to ASTM A 536, Grade 65-45-12 or ASTM A 126, Grade B cast iron. Shafts shall be ASTM A 276, Type 304 stainless steel, machined and polished. Valve discs shall be ductile iron, ASTM A 536, Grade 65-45-12, ASTM A48 cast iron or ASTM A 126, Grade B cast iron. The resilient valve seat shall be located in the valve body and for valves 30-inch and greater, shall be fully field adjustable and field replaceable.
- C. Actuators
 - 1. Valves for non-buried service, 3 through 8-inches in diameter, shall be lever operated. The lever shall be capable of being locked in 10 positions. Valves for non-buried service, 10-inches in diameter and larger, shall be handwheel operated.
 - 2. Valves for buried service or non-buried service, 10-inches or greater in diameter shall be equipped with traveling nut or worm gear type, self-locking type manual actuators designed, manufactured and tested in accordance with AWWA C504. Actuators shall be capable of holding the disc in any position between full open and full closed without any movement or fluttering of the disc. Actuators shall be

furnished with fully adjustable mechanical stop-limiting devices. Actuators that utilize the sides of the actuator housing to limit disc travel are unacceptable.

3. Valves shall be equipped with motorized actuators where shown on the Drawings.

D. Operators

1. Valves for non-buried service, six feet or more above the operating floor shall be furnished with a chainwheel operator and chain for operation from floor level.
2. Valves for buried service shall be equipped with a valve box and stem extension required to bring the operation nut within 6-inches of finished grade. Valve boxes and extension stems shall be as specified in this Section. Three inch and larger valves shall have two-inch square operating nuts.
3. Valves shall be equipped with pedestal type operators where shown on the Drawings and as specified in this Section.

- E. Valves shall be installed with disc shaft horizontal, except where extended bonnets or levers are used. Valves and actuators shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water.

- F. Valve ends shall be mechanical joint type and meet the requirements of AWWA C111/ANSI 21.11, except where flanged or restrained joint ends are shown. Flange joints shall meet the requirements of ANSI B16.1, Class 125. At the contractor's option, grooved mechanical fittings meeting the requirements of AWWA C606 may be used in lieu of flanged connections in all interior ductile iron piping.

- G. Butterfly valves shall be manufactured by Mueller, SPX/DeZurik, Pratt or approved equal.

2.4 CHECK VALVES

A. Swing Check-Flex

1. Manufacturer
 - a. Valmatic or equal

2.5 BALL VALVES

A. Application:

1. Except as otherwise indicated or specified, provide ball valves for all 3 inch or smaller shutoff valves
2. Provide additional ball valves as indicated on drawings or as specified

- B. Air and water service, 3 inch and smaller: Jamesbury A-211 or approved equal

- C. Domestic Water Plumbing Valve, 2" and smaller: Class 150, chrome-plated brass ball, full port valve. Valve shall be Nibco S-580 or T-580 or equal.

D. Fabrication:

1. Handles showing direction of opening
2. Ball design which does not allow media contact with stem
3. Balancing stop for all applications

2.6 MUD VALVES

- A. Mud valves shall be non-rising stem type, flanged connection, constructed entirely of cast iron, bronze, and stainless steel. Bodies shall be cast iron; stem, operating nut, and seats shall be bronze. Seats shall be angled such that the plug ring fits into the body ring. Flat, face-to-face connection is not acceptable. Valves shall be equipped with extension stems, guides, and hand wheels where indicated. Valves shall be as manufactured by M&H Valve Company or approved equal.

2.7 THROTTLING VALVES

A. Water service, general:

1. Smaller than 3/4 inch:
 - a. Needle valves: Crane 88, Fairbanks 041, Jenkins 743-G, Stockham B-62, or approved equal
 - b. Screwdriver adjusted balancing valves: Hoffman 199-B, Savco V-60, or approved equal
2. 3/4 inch and larger:
 - a. Globe valves:
 - 1) Threaded end: Nibco T-211-Y, Fairbanks 01, Kennedy 97, Stockham B-13, or approved equal
 - 2) Soldered end: Crane 1310, Fairbanks 0582, Jenkins 1200, Stockham B-14, or approved equal
 - b. Angle valves: As specified
3. Locate per plans

2.8 ELECTRIC VALVES

A. 3/4 inch and smaller:

1. Solenoid valves:
 - a. General:
 - 1) Bronze bodies and bonnets
 - 2) Packless construction without packing box or sliding seal
 - 3) Asco, ITT, or approved equal
 - 4) 120 V AC encapsulated Class F coils:
 - a) In NEMA 4 enclosures: Spade type terminals
 - 5) Enclosures:
 - a) With conduit hubs
 - b) General use: NEMA 4
 - c) Explosion proof areas: NEMA 7

- 6) Working pressure:
 - a) Water service: 125 psig
 - b) Air service: 126 psig
- 7) Maximum required differential:
 - a) 1/4 inch: 0 psi
 - b) 3/8 inch-1 inch: 5 psi
- b. Accessories:
 - 1) In water service provide an upstream strainer:
 - a) Bronze bodied, Y-pattern
 - b) Monel or stainless steel screens
 - c) Asco 8600, Fisher 260, Hoffman 420, OPW Jordan 811 VP, or approved equal
 - d) With blowoff valve, Nibco "U-valve," Dyna-Quip "Combo Valve," or approved equal
 - 2) Provide strainers at other locations indicated on Drawings

2.9 PRESSURE RELIEF AND SURGE ANTICIPATOR VALVE

- A. This valve shall control high pressures and power failure surges by bypassing system pressure that exceeds the high pressure control setting and also by opening a preset amount when sensed pressure decreases below a preset minimum in anticipation of a surge.
- B. The valve shall be hydraulically operated, single diaphragm-actuated and globe pattern. The valve shall consist of three major components: the body with seat installed, the cover with bearings installed and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure.
- C. The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.
- D. The pressure relief pilot shall be an adjustable, spring-loaded, normally closed diaphragm control designed to permit flow when upstream pressure exceeds the control setting. The low pressure pilot shall be an adjustable, spring loaded, normally open diaphragm control designed to open when the sensed pressure falls below the control setting and close when pressures are normal. The pilot system shall contain an adjustable hydraulic limiter to limit valve travel during low pressure opening without affecting high pressure relief valve travel.
- E. Materials:
 1. Valve Body and Cover: ASTM A536 Ductile Iron
 2. Disc Retainer & Diaphragm Washer: Cast Iron
 3. Disc Guide, Seat and Cover Bearing: Bronze

4. Disc: Buna - N Rubber
5. Diaphragm: Nylon Reinforced Buna-N Rubber
6. Stem, Nut & Spring: 316 Stainless Steel

F. The valves shall be as manufactured by Cla-Val Co. Model 5203/652-03, or an approved equal.

2.10 YARD HYDRANTS

A. Manufacturers:

1. Wade - W-8609
2. Josam - 71600
3. Smith - 5810
4. Zurn - Z-1360
5. Or approved equal

B. Hydrant, 3/4 inch to 2 inch:

1. Exterior locations
2. Cast iron box and cover, brass valve, and casing for 4'-0" bury

2.11 HYDRANTS

A. Hydrants shall be cast iron, fully bronze mounted designed for 250 psi working pressure, and shall conform to the requirements of AWWA C502. Hydrants shall be suitable for connection to pipe having a minimum of 48 inch cover. Stem and barrel extensions shall be installed where necessary to bring the hydrants to an approved mounting height.

B. Hydrants shall have a minimum valve opening of 5-1/4 inches, and shall be equipped with two 2-1/2 inch hose nozzles and one 4-1/2 inch pumper nozzle, with National Standard Hose Thread. Each hydrant shall have the standard red enamel paint finish.

C. Manufacturer:

1. Mueller Super Centurion 250
2. M & H Style 129
3. American Flow Control # B84B.

2.12 PRESSURE REDUCING VALVE

A. General:

1. Tight shutoff under no flow conditions
2. No "hunting" under normal flow conditions
3. Sized and selected as recommended by valve manufacturer

B. Water service:

1. Provide as indicated on Drawings
2. Max flow greater than 150 gpm: Pilot operated, Cla-Val 90-01, GA 45, OCV 127-3, or approved equal
3. All others: Non-pilot operated Fisher 75A, Mueller H- 9000, or approved equal

4. 2-1/2 inch or smaller: Provide a Y pattern strainer:
 - a. Bronze body
 - b. Stainless steel or monel screen
 - c. Cash-Acme SY, Hoffman 420, Mueller H-9330, Fisher 260C, or approved equal
 - d. Blow-off Valve: Nibco "U-Valve," Dyna-Quip "Combo Valve," or approved equal

C. Gas service:

1. Provide as indicated on Drawings
2. Air and gas: Aluminum or bronze, Mueller H-9000, Fisher 64, or approved equal
3. Sludge gas: Stainless steel, Rockwell 121, Fisher 133, or approved equal
4. Gas service: AGA approved
5. Fisher, Mueller, or approved equal

2.13 PRESSURE SUSTAINING VALVE

A. General:

1. Tight shutoff under no flow conditions
2. No "hunting" under normal flow conditions
3. Sized and selected as recommended by valve manufacturer

B. Non-potable water service:

1. Provide as indicated on Drawings
2. Max flow greater than 125 gpm: Pilot operated, Cla-Val 92-01, GA Fig 6700-DR, or approved equal

2.14 AIR RELEASE VALVES

A. General:

1. Provide as indicated on Drawings
2. Water working pressure: 125 psig

B. Clear water service:

1. Individual air release valves:
 - a. Inlet size as indicated on Drawings
 - b. GA "Figure 930-T," Val-Matic "Model 38," APCO "200A," or approved equal
 - c. Provide throttling devices where indicated.

C. Wastewater Siphon Service

1. Single Chamber Design
2. 304 Stainless Steel body screen and ends
3. HDPE cylindrical control floats
4. Discharge orifice area equal to nominal valve size
5. EPDM rubber orifice seals

6. Valve design shall be air release only without reentrant air for use with siphons.
7. Vent-O-Matic Series RGXV or approved equal

D. Sanitary Sewer Force Main Service

1. Single Chamber Design
2. 304 Stainless Steel body screen and ends
3. HDPE cylindrical control floats
4. Discharge orifice area equal to nominal valve size
5. EPDM rubber orifice seals
6. Valve design shall be air and vacuum release
7. Vent-O-Matic Series RGX or approved equal

2.15 SHEAR GATES

- A. Shear gates shall be 304 stainless steel gate frame, 304 stainless steel slide plate equipped with an extended lift road with guides and “T” handle with an adjustable lift hook and hardware. Shear gate shall be Whipps Type 703 or approved equal.

2.16 FLAP VALVES

- A. Flap valves shall be cast iron body, bronze mounted Clow Figure F3012 with flanged end or shall be the approved equal product of Waterman, or Rodney Hunt.

2.17 ALTITUDE VALVES

- A. Model 610-01, Reduced Internal Port
 1. Size - 12”
 2. Epoxy Coating
 3. X1051CW Limit Switch
 4. AWWA C508 Certified
 5. NSF/ANSI 61 Certified for Drinking Water
- B. Manufacturer
 1. Cla-Val or equal

2.18 BACKFLOW PREVENTER

- A. Dual check valve assembly with reduced pressure zone
- B. Construction:
 1. Bronze body
 2. Bronze mounted
 3. 1 inch - Watts 909QT or approved equal
 4. 2 inch - Watts 909MIQT or approved equal

2.19 TAPPING SLEEVES AND VALVES

- A. Provide as indicated on Drawings:
 - 1. Designed for 150 psig working pressure
 - 2. Tested to 300 psig working pressure
- B. Tapping Sleeves:
 - 1. Flanged outlet type designed for attachment to inlet end of tapping valve
 - 2. Mechanical joints at each end of run
 - 3. Mueller No. H-615, Clow F-5205, or approved equal

2.20 CORPORATION ACCESSORIES

- A. Corporation stops:
 - 1. Bronze body, AWWA tapered threaded tap
 - 2. 100 psi maximum working pressure
 - 3. Ford #B-22 or approved equal
- B. Curb stops: Ball type (1 inch - 2 inch), Ford "B22" Series, or approved equal
- C. Curb stop box: 4 Ford arch base curb box, or approved equal
- D. Tapping saddles: Ductile iron with double stainless steel strap and rubber sealing gasket, 250 psi pressure rating, Ford Meter Box FC202, Smith-Blair 397," or approved equal

2.21 CORROSION CONTROL

- A. Comply with provisions under Section 09900, Painting and Finishing of these Specifications.
- B. Shop paint all ferrous metal surfaces of valves and accessories, both interior and exterior, for corrosion protection.
- C. All iron surfaces of the valves shall be painted; surfaces shall be clean, dry, and free from grease before painting.
- D. Manufacturer's standard paint will be acceptable if it is functionally equivalent and compatible with specified field coatings
- E. Bituminous coating or asphalt varnish: Manufacturer's Standard.
- F. Shop lining: Cement, AWWA C104/C205 or Epoxy coating for potable water, AWWA C210.
- G. Rust inhibitive primer (for non-buried valves): Tnemec "Series 77 Chem-Prime," Sherwin Williams "Ken Kromick Universal Metal Primer," or equal.

- H. Rust preventative compound: Houghton "Rust Veto 344," Rust-Oleum "R-9," or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Install valves and accessories in accordance with the manufacturer's instructions
2. Provide union or flanged connection within 2 feet of each threaded end valve unless valve can otherwise be easily removed from piping
3. Set buried valves on solid bearing
4. Center and plumb valve box over valve
5. Set box cover flush with finished grade
6. Evenly fill around box and thoroughly compact on all sides
7. Extend stem to within 6 inches of final grade
8. Provide spacers to center stem in valve box

B. Yard hydrants:

1. Provide a concrete slab 18 inch square by 4 inch thick
2. Install plumb
3. Provide 1 cu ft gravel or crushed stone below each hydrant for drainage

C. Backflow preventers: Install in an area not subject to flooding

3.2 HYDRANTS

- A. Hydrants shall be set plumb and at such elevation that the connecting pipe shall have at least 48 inch cover plus $\frac{1}{2}$ the diameter of the water line over the pipe. 6'-0" bury depth. The entire fire hydrant assembly shall be restrained joints. The top of the hydrant operating nut shall be a minimum of 32" higher than finish grade. The Contractor shall furnish and install a fire hydrant extension if the water line is installed deeper than the minimum depth and at no additional cost to the Owner.**

- B. Earth fill suitable for backfill as previously defined, shall be carefully placed in 6 inch layers and to 3 feet on all sides, or to the undisturbed face of the trench if nearer, and carefully tamped. Not less than 7 cubic feet of crushed or broken stone shall be placed around the base of the hydrant to insure drainage.**

- C. The interior of the hydrant shall be thoroughly cleaned of all foreign matter prior to installation, and after installation, each hydrant shall be operated to assure proper operation.**

- D. The 6 inch auxiliary valve shall be independently secured to the hydrant and main line tee. Concrete blocking will not be permitted. End line hydrant installation detail shall be submitted to Engineer for approval. The fire hydrant assembly will be completely restrained from the water line to the fire hydrant.**

- E. Install reflective marker one foot right of the center line of pavement along the roadway.**

3.3 ADJUSTMENT

- A. Check and adjust valves and accessories for smooth operation in accordance with manufacturer's instructions

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and equipment hangers and supports
- B. Equipment bases and supports
- C. Sleeves and seals
- D. Flashing and sealing equipment and pipe stacks

1.2 RELATED SECTIONS

- A. Section 03000 - Concrete
- B. Section 03600 - Grout
- C. Section 05120 - Structural Steel and Miscellaneous Metal
- D. Section 07900 - Joint Sealants
- E. Section 09900 - Painting and Finishing
- F. Section 15060 - Pipe and Pipe Fittings
- G. Section 15062 - Ductile Iron Pipe

1.3 REFERENCES

- A. ASME B31.1 - Power Piping
- B. ASME B31.2 - Fuel Gas Piping
- C. ASME B31.5 - Refrigeration Piping and Heat Transfer Components
- D. ASME B31.9 - Building Services Piping
- E. AISI 304 - Stainless Steel Material Specifications
- F. ASTM A123 - Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products
- G. ASTM F708 - Design and Installation of Rigid Pipe Hangers
- H. ASTM A1011 - Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability

- I. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer
 - J. MSS SP69 - Pipe Hangers and Supports - Selection and Application
 - K. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices
 - L. NFPA 13 - Installation of Sprinkler Systems
 - M. NFPA 14 - Installation of Standpipe and Hose Systems
 - N. UL 203 - Pipe Hanger Equipment for Fire Protection Service
- 1.4 SYSTEM DESCRIPTION
- A. Provide complete system of pipe supports and anchors for all piping.
 - B. Support all piping to prevent undue strain on any valve, fitting or piece of equipment.
 - C. Provide support and anchors at changes in direction, changes in elevation, and adjacent to flexible couplings.
 - D. Do not install in equipment access areas or bridge crane runs.
- 1.5 PERFORMANCE REQUIREMENTS
- A. Pipe support system components to withstand total dead load:
 - 1. Dead load: Weight of pipe filled with water plus any insulation
 - 2. Factor of safety: 5.0 minimum
 - B. Pipe restraint system components to withstand thrusts created by fluid pressure within pipes:
 - 1. Factor of safety: 5.0 minimum
 - C. Hangers and Supports shall be designed and manufactured in conformance with MSS SP58.
 - D. Do not exceed manufacturers' recommended loads.
 - E. Brace all piping 2-1/2 inch and larger for Seismic Design Category C forces in accordance with the International Building Code.
 - F. Design and select channels and accessories for 25,000 psi maximum stress and 1/360 of span maximum deflection.
 - G. Steel pipe hangers and supports shall have the manufacturer's name, part number and applicable site stamped in the part itself for identification.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Shop Drawings: Indicate system layout with location and detail of hangers. Include location of all pipe supports.
- C. Product Data: Provide manufacturers catalog data including load capacity.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for support of plumbing piping.
- B. Supports for Sprinkler Piping: In conformance with NFPA 13.
- C. Supports for Standpipes: In conformance with NFPA 14.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Stainless steel, 304L
- B. Provide copper plated hangers and supports for copper piping.

2.2 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Clevis hangers:
 - a. ITT Grinnell
 - b. Unistrut Corporation
 - c. B-Line by Eaton
 - d. Or accepted substitution
 - 2. Pipe clamps:
 - a. ITT Grinnell
 - b. Unistrut Corporation
 - c. B-Line by Eaton
 - d. Or accepted substitution

2.3 MODULAR FRAMING STRUT SYSTEMS

- A. Manufacturers:
 - 1. Unistrut Corporation
 - 2. Elcen Metal Product Company
 - 3. Other approved manufacturers offering equivalent products

2.4 ACCESSORIES

- A. Hanger rods: Stainless steel, 304L, threaded both ends, threaded one end, or continuous threaded.

2.5 SLEEVES

- A. Sleeves for pipes through non-fire rated floors: 18 gage Stainless steel, 304L.
- B. Sleeves for pipes through non-fire rated beams, walls, footings, and potentially wet floors: Stainless steel, 304L.
- C. Sleeves for round ductwork: Stainless steel, 304L.
- D. Sleeves for rectangular ductwork: Stainless steel, 304L.
- E. Sealant: refer to Section 07900, Joint Sealants of these specifications.

2.6 FINISHING

- A. All hangers, rods, clamps, saddles, protective shields, unistrut and appurtenances or metal framing support components, and hanger accessories: Stainless steel, 304L unless otherwise indicated or specified no coating required. All bolting, nuts, washers, threaded screws or anchors shall be a minimum of S.S. 304L.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Pipe supports and anchors are not indicated on Drawings in all locations; provide adequate support for all pipes as necessary and as specified in PART 2 – PRODUCTS.
- C. Hangers for insulated pipes shall be sized to accommodate insulation thickness.

3.2 INSERTS

- A. Provide inserts for placement in concrete formwork before concrete is poured.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches in diameter.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and recessed into and grouted flush with slab.

3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled or as necessary and specified in PART 2 - PRODUCTS.
- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Piping connections to equipment: Provide pipe support adjacent to equipment.
- J. Do not support lower pipe from pipe above.
- K. Support pipe 1-1/2 inch minimum from walls and 3 inch minimum below ceilings.
- L. Prime coat exposed steel hangers and supports. Refer to Section 09900, Painting and Finishing. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Paint galvanized hangers and supports in chlorine, dechlorination and feed rooms.

3.4 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment unless shown otherwise on Drawings. Refer to Section 03000, Concrete.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

3.6 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install stainless steel escutcheons at finished surfaces.

3.7 MODULAR FRAMING STRUT

- A. Install level and plumb.
- B. Attach to structural surfaces with chemical adhesive anchors or as indicated on the Drawings.
- C. May be used for equipment support framing, pipe and conduit hangers, lighting fixture hangers, and other miscellaneous framing, except where indicated otherwise on Drawings.

3.8 SCHEDULES

- A. Maximum hanger/support spacing and minimum rod diameter for steel, cast or ductile iron pipes:

Pipe Size Inches	Max. Hanger Spacing Feet	Hanger Rod Diameter Inches
1/2 to 1-14	5	3/8
1-1/2 to 2	8	3/8
2-1/2 to 3	9	1/2
4 to 6	10	5/8 – 3/4
8 to 12	14	7/8 – 1
C.I. Bell and Spigot (or No-Hub) And at joints	5	Same as for steel

- B. Maximum hanger/support spacing and minimum rod diameter for FRP and PVC pipes: Reduce hanger spacing for liquid or air temperatures greater than 68 degrees F per manufacturers instructions.

Pipe Size Inches	Max. Hanger Spacing Feet	Hanger Rod Diameter Inches
Less than 1	Continuous Support	Same as for steel
1	4	Same as for steel
1-1/4 to 2	5	Same as for steel
3 to 6	6	Same as for steel
8 to 12	8	Same as for steel

- C. Maximum hanger/support spacing and minimum rod diameter for copper and stainless steel piping:
1. Spacing:
 - a. 1 inch and small: 5 feet maximum
 - b. 1-1/4 inch and larger: 2 feet less than maximum spacing for steel pipe of same size
 2. Hanger rod size: Same as for steel

END OF SECTION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. The work covered by this section of the specifications consists of furnishing all plant, labor and material, and in performing all operations in connection with the installation of the all plumbing fixtures and all waste drain, vent, and hot and cold water piping in strict accordance with applicable plumbing code and this section of the specifications and the applicable drawings, and subject to the terms and conditions of the Contract.

1.2 RELATED SECTIONS

- A. Section 02200 - Excavation, Filling and Backfilling

1.3 REFERENCES

- A. ANSI B1.20.1 - Unified Screw And Pipe Threads
- B. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- C. ASTM D2665 - Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

1.4 PERMITS, INSPECTION FEES, ETC.:

- A. The Contractor shall obtain at his own expense, all necessary permits required for the proper prosecution of the work covered by this section of the specifications. All plumbing work shall be done under the authority and direction of a Licensed Master Plumber. Further, he shall comply with code requirements of any and all municipal, county and state agencies having jurisdictional authority in connection with this work and shall deliver to the Owner, without charge, all certificates of inspection issued by the inspecting authorities.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:
 - 1. Manufacturer's specifications, catalog data, descriptive matter, illustrations and diagrams.
 - 2. Nameplates.
 - 3. Installations and grouting.
 - 4. Operating and maintenance instructions and parts lists.

1.6 GENERAL

- A. Drawings: The drawings show the general arrangement of all piping and equipment; however, where local conditions necessitate a rearrangement, the Contractor shall prepare, and submit for approval, drawings of the proposed rearrangement. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly, furnishing such fittings, traps, valves, and accessories as may be required to meet such conditions.
- B. Cuttings and Repairing: The work shall be carefully laid out in advance and any cutting of construction shall be done only with the written permission of the Engineer. Cutting shall be carefully done and damage to building, piping, wiring or equipment as a result of cutting for installation shall be repaired by skilled workmen of the trade involved, at no additional expense to the Owner, as part of this Contract.
- C. Intent: The drawings and specifications are intended to cooperate and should any items be specified and not shown on the drawing, or vice versa, which are necessary for the completion of the system, they shall be furnished by the Contractor the same as if shown on both.
- D. Workmanship: The complete plumbing system shall be installed in a first class workmanlike manner in the best general practice of the trade.
- E. Material and Equipment: All material and equipment shall be new, and equipment intended for incorporation in this work shall be submitted to the Engineer for approval prior to purchase or fabrication.
- F. Material List: As soon as practicable, after award of the Contract, the Contractor shall submit for approval in quadruplicate, the names of manufacturers, catalog number of trade name of all items of material and equipment as noted in these specifications or on the drawings. This list shall include all items not noted, which are necessary to the installation of the aforesaid material and equipment.

1.7 SAFETY PROVISIONS

- A. All belts, gears, chains, sheaves, couplings, projecting set screws, keys and other rotating or reciprocating parts shall be enclosed or properly guarded. All overflows, relief valve discharges, etc., shall be piped to a point of safe discharge.

1.8 GUARANTY

- A. The plumbing work furnished under these specifications shall be guaranteed for a period of one year from the date of final acceptance against defective material, equipment, and workmanship. Upon written notice by the Engineer of failure of any part of the system,

during the guaranty period, the affected part or parts shall be repaired promptly with new parts by and at the expense of the Contractor.

PART 2 PRODUCTS

2.1 SOIL, WASTE, DRAIN AND VENT PIPING

- A. All sanitary, waste, drain, vent piping, and fittings 2 inches and larger, and indirect drains shall be coated service weight bell and spigot cast iron soil pipe, or no-hub soil pipe or PVC. Bell and spigot pipe shall be used below the floor or underground, with the bell of the pipe or fitting extending above the floor. Waste, drain and vent piping 1-1/2 inches and less shall be galvanized standard weight steel pipe with cast iron drainage type fittings coated with asphaltum.

2.2 PIPE SLEEVES, PIPE HANGERS, AND PIPE SUPPORTS

- A. Pipe sleeves shall be in footings shall be of cast iron or steel pipe and shall not be less than 4 inches larger in diameter than the pipe to be installed. Pipe sleeves in walls and partitions shall be of cast iron or steel pipe.
- B. Pipe Hangers, Inserts and Supports: Hangers shall be forged steel clevis type and provided turnbuckles or other approved means of adjustment. Chain, strap, perforated bar or wire hangers will not be permitted. Except as otherwise shown, cast iron pipe shall be supported at 5 foot intervals, steel pipe at 10 foot intervals, and copper pipe at 6 foot intervals. Copper plated hangers shall be used on copper pipe.

2.3 FLOOR, WALL AND CEILING PLATES

- A. Where exposed pipes pass through ceilings, floors or finished walls, they shall be fitted with chromium-plated cast brass plates on chromium-plated pipe, or with cast iron or steel plates on ferrous or copper pipe. Plates shall be large enough to completely close the hole around the pipes and shall be square, octagonal, or round, with the least dimension not less than 1-1/2 inches larger than the outside diameter of the pipe. Plates shall be secured in an approved manner.

2.4 WATER PIPE, FITTINGS AND CONNECTIONS

- A. Pipe and Fittings: All pipe required for hot water, and cold water shall be copper water tube type "L" hard temper with cast bronze or wrought copper solder type fittings. Threaded adapters and IPS brass nipples shall be provided as required for connection to fixtures and equipment. Underground water pipe shall be type "K" copper, hard temper. Dielectric unions shall be provided where copper pipe connects to pipe or equipment of other metals.

B. JOINTS

1. Soldered Joints: Joints in copper water tube above the floor shall be made with soft solder; below the floor and underground with silver solder. Tube shall be cut square and burrs removed. Outside of the tube and inside of the fitting shall be cleaned bright and fluxed. Fitting shall be heated evenly until proper soldering temperature is reached. Solder shall be fed into the joint until a ring of solder appears at the end of the fitting. Soft solder shall be 95.5% tin, 4% copper and 0.5% silver, and flux shall be non corrosive. Silver solder shall be Easy-Flo, Sil-Fos, or equal, and flux shall be as recommended by the solder manufacturer.
2. Screwed Joints: All threaded joints shall have American National Taper Pipe Thread ANSI B1.20.1. Pipe ends shall be reamed or filed out to the full size of the bore and all burrs, chips and cuttings shall be removed. Joint compound shall be applied to the male thread only. Joint compound shall be Teflon tape.

C. Valves on Copper Pipe:

1. Gate Valves on copper pipe shall be 150 pound bronze, union bonnet, rising stem, solid wedge, sweat-end, Milwaukee 1169 or equal.
2. Globe Valves shall be 150 pound SWP, cast bronze, rising stem, union bonnet, sweat end, with "Buna-N" disc, Milwaukee 1590, or equal.
3. Ball Valves shall be 150 lb. forged brass, chrome plated ball, Teflon seats and seals, blow-out proof item, sweat ends, Milwaukee BA-250, or equal.
4. Sillcocks shall be freezeless type with vacuum breaker-backflow preventer, Woodford Model 25 with Nidel Vacuum Breaker-Backflow Preventer, or equal.
5. Hose Bibs shall be brass or bronze, with vacuum breaker, Woodford Model 24CP, or equal. Exterior hose bibs shall be installed through the wall with a 90° drop ell copper to FPS and secured to the wall.

D. Unions on Copper Pipe shall be copper to copper, ground joint, sweat end, Nibco No. 733, or equal.

E. Dielectric Fittings shall be designed to eliminate metal to metal contact between copper pipe and other metallic pipe or equipment, Epcu Dielectric Unions, or equal.

2.5 PLUMBING FIXTURES

- A. General: References made to catalog numbers of plumbing fixtures are to be the products of Kohler Co. unless otherwise indicated. The use of Kohler Co. figure numbers is for the purpose of indicating the style and quality of the fixtures to be furnished and does not exclude furnishing fixtures of other manufacturers which are of equal quality and similar in design. All fixtures shall be White. All exposed fittings, trimmings and connections shall be chromium plated with polished surfaces.

B. Fixtures:

1. Water Closet: Fixture No. K-4350 - Vitreous china, elongated bowl, siphon jet water closet, K-4670-C white open front seat; Sloan Royal 111 flush valve.
2. Water Closet: Fixture No. K-4368 - Vitreous china, elongated bowl, siphon jet water closet; K-4670-C white open front seat; Sloan Royal 111 flush valve.
3. Urinal: Fixture No. K-5016 - Vitreous china, siphon jet, wall hung urinal; Sloan Royal 186-1 flush valve.
4. Lavatory: Fixture No. K-2196-4 - Vitreous china self rimming lavatory, size 20-1/4 x 17-1/2 inches; K-7404 lavatory faucet with blade handles and aerator; K-7605 angle supply with stops and annealed vertical tube on hot and cold water; K-13885 1-1/4 inch offset drain with perforated strainer; K-8999 1-1/4 inch cast brass P trap.
5. Janitors Sink: Fixture No. K-6710, enameled cast iron corner service sink; K-8940 coated wire rim guard; K-8928 service sink faucet with vacuum breaker, loose key stops, rubber hose, and wall hook; K-9146 strainer, tapped for 3 inch IPS.
6. Floor Drains: General Areas – J. R. Smith 2005L (FD-1); Mechanical Rooms – J. R. Smith 2005L-F37-C1 (FD-2); General Areas With Funnel – J. R. Smith 3510 (FD-3).
7. Sink: K-3310-4 Self rimming with K-15172 faucet; K-8801 Duostrainer sink strainer, with 1-1/2" tailpiece, K-9000 1-1/2" P-Trap.
8. Shower: Job built tile enclosure; mixing valve No. K-TK611-X4-CP, Drain No. K-9132.

2.6 LABORATORY FIXTURES

- A. See Section 12400, Laboratory Casework for laboratory fixtures.

2.7 INSULATION

- A. Domestic Water Piping shall be insulated with flexible foam plastic, closed cell insulation with a "K" factor of not more than 0.27 at 75° F mean temperature, Armstrong "Armaflex 2000", or equal. Adhesive used with insulation shall be Armstrong 520, or equal. The following piping shall be insulated with the thickness indicated:
1. Domestic hot water 1/2 inch
 2. Domestic cold water 1/2 inch
- B. Insulation shall be furnished in preslit tubular form. Insulation shall be placed around the pipe, release paper peeled from the adhesive surface and the edges of the longitudinal joint pressed firmly together. End joints shall be butted firmly together and sealed either with Armstrong 520 adhesive or 3M #471 tape 1-1/2 inches wide. Fittings shall be insulated with PVC fitting covers installed according to manufacturer's recommendations. Fitting covers shall be sealed to adjoining insulation with 3M #471 tape 1-1/2 inches wide. Insulation shall be continuous through walls and floors. Pipe hangers shall be placed on the outside of the insulation. A rigid insert shall be placed in the insulation to support the weight of the pipe, and a galvanized insulation saddle on the outside to

protect the insulation. Inserts and saddles shall be in accordance with the manufacturer's instructions.

PART 3 EXECUTION

3.1 PREPARATION

- A. Avoid interferences with other trades.
- B. Contractor to field verify all existing plumbing conditions before starting work.

3.2 EXCAVATING, TRENCHING AND BACKFILLING

- A. Excavating, trenching and backfilling shall be in accordance with Section 02200, Excavation, Filling And Backfilling of these specifications.

3.3 INSTALLATION

- A. **Drainage Pipes and Vent Piping:** Horizontal drainage piping shall be run in practical alignment at a uniform grade. Sloping fixture drains and horizontal branches of 3 inches nominal size and smaller shall be installed with a slope of not less than 1/4 inch per foot, and larger than 3 inches nominal size, not less than 1/8 inch per foot. Where practicable, two or more vent pipes shall be connected together and extended as one pipe through the roof. Vent pipes in roof spaces shall be run as close as possible to the underside of the roof with horizontal piping pitched down without forming traps in the pipes, using fittings as required. Vertical vent pipes may be connected into one main vent riser above the vented fixtures. Where an end or circuit vent pipe from a fixture or line of fixtures is connected to a vent line serving other fixtures, the connection shall be at least 3'-6" above the floor on which the fixtures are located, to prevent the use of any vent line as a waste. Horizontal waste lines receiving the discharge from two or more fixtures shall be provided with ends vents, unless separate venting of the fixtures is noted. The cast iron bell and spigot pipe inside the buildings shall be extended above the floor.
- B. **Fittings:** All changes in pipe size on soil, waste, and drain lines shall be made with reducing fittings or recessed reducers. All changes in direction shall be made by appropriate use of 45° wyes, half wyes, long-sweep 1/4 bends, 1/6, 1/8 or 1/16 bends. Where it becomes necessary, because of space conditions, to use short-radius fittings in any location, approval of the Engineer shall be obtained before they are installed.
- C. **Union Connections:** Slip joints will be permitted only in trap seals or on the inlet side of the traps. Tucker or hub drainage fittings shall be used for making union connections wherever practical in connection with dry vents. The use of long screws and bushings is prohibited.

D. Pipe Joints

1. Join PVC DWV Piping according to ASTM D2665.
2. Copper Pipe Joints:
 - a. Soldered Joints: Joints in copper water tube above the floor shall be made with soft solder; below the floor and underground with silver solder. Tube shall be cut square and burrs removed. Outside of the tube and inside of the fitting shall be cleaned bright and fluxed. Fitting shall be heated evenly until proper soldering temperature is reached. Solder shall be fed into the joint until a ring of solder appears at the end of the fitting. Soft solder shall be 95.5% tin, 4% copper and 0.5% silver, and flux shall be non corrosive. Silver solder shall be Easy-Flo, Sil-Fos, or equal, and flux shall be as recommended by the solder manufacturer.
 - b. Screwed Joints: Pipe ends shall be reamed or filed out to the full size of the bore and all burrs, chips and cuttings shall be removed. Joint compound shall be applied to the male thread only.
3. Gasket: Joints in bell and spigot cast iron soil, waste, and vent pipe may be made with neoprene gaskets, at the Contractor's option. Bell of the pipe shall be cleaned and gasket inserted. Cut end of pipe shall be rounded off and burrs removed. Outside of the pipe and inside of the gasket shall be lubricated, and the pipe inserted. Gaskets shall conform to ASTM C564.
4. No-Hub: Joints in no-hub pipe shall be made with a neoprene gasket and stainless steel sleeve. Pipe ends shall be inserted into the neoprene gasket, the stainless steel sleeve placed around the gasket and screws tightened to the manufacturer's recommended torque. Gaskets shall conform to ASTM C564, sleeves to ANSI 301-305.
5. Threaded Pipe: All threaded joints shall have American Standard Taper Pipe Thread with joint compound applied to the male thread only. Pipe ends shall be reamed or filed out to the full size of the bore, and all burrs, chips and cuttings shall be removed. The use of close nipples or threaded bushings will not be permitted. Joint compound shall be Teflon tape.

E. Cleanouts

1. An easily accessible cleanout shall be provided at the foot of each vertical soil or waste stack, and where indicated on the drawings. Cleanouts shall be of the same nominal size as the pipe in which they are installed up to 4 inches and not less than 4 inches for larger sizes. A cleanout shall consist of a long sweep 1/4 bend or one or two 1/8 bends with a cast ferrule and countersunk with round Nikaloy top and carpet cleanout marker trap screw cover. Cleanouts in carpeted floors shall be similar to J. R. Smith 4031L-Y; in concrete, J. R. Smith 4031L. Cleanouts on exposed piping shall be J. R. Smith. J. R. Smith is named to indicate style and quality, equivalent products of others will be acceptable.

F. Flashing

1. Vent pipes and stack vents shall be flashed and made watertight at the roof with 6 pound sheet lead. Flashings shall extend not less than 8 inches from the pipe in all directions. Flashings for the pipe shall be extended up the pipe and turned down inside the pipe to form a counterflashing. Vent pipes shall be extended not less than 6 inches above the roof.

G. Traps

1. Each fixture requiring a connection to the drainage system shall be equipped with a trap having a water seal of not less than 2 inches nor more than 4 inches, and placed as near the fixture as possible. Each fixture trap, except those in combination with the fixtures in which the trap seal is readily accessible, shall have an accessible brass trap screw of ample size, protected by the water seal. Provided that a portion of a trap can be completely removed for cleaning purposes, no trap screw is required. All traps shall be set true with respect to their water seals. Traps installed on bell and spigot pipe shall be cast iron and those on threaded pipe shall be recess drainage pattern.

3.4 PIPE SLEEVES, PIPE HANGERS, AND PIPE SUPPORTS

- A. Pipe sleeves, pipe hangers, and pipe supports shall be furnished and set, and the contractor shall be responsible for their proper and permanent location, and approval thereof by the Engineer. Pipe will not be permitted to pass through footings, beams or ribs, unless noted on the drawings.
- B. Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through masonry or concrete, except unframed floors on earth. Pipe sleeves, except sleeves in footings, shall be of sufficient diameter to provide approximately 1/4 inch clearance around the pipe, and in the case of insulated pipe, 1/4 inch clearance around the insulation. Pipe sleeves in footings shall be of cast iron or steel pipe and shall not be less than 4 inches larger in diameter than the pipe to be installed. Pipe sleeves in walls and partitions shall be of cast iron or steel pipe.
- C. Pipe Hangers, Inserts and Supports. Except as otherwise shown, cast iron pipe shall be supported at 5 foot intervals, steel pipe at 10 foot intervals, and copper pipe at 6 foot intervals.

3.5 FLOOR, WALL AND CEILING PLATES

- A. Where exposed pipes pass through ceilings, floors or finished walls, they shall be fitted with chromium-plated cast brass plates on chromium-plated pipe, or with cast iron or steel plates on ferrous or copper pipe. Plates shall be large enough to completely close the hole around the pipes and shall be square, octagonal, or round, with the least dimension not less than 1-1/2 inches larger than the outside diameter of the pipe. Plates shall be secured in an approved manner.

3.6 JOINTS

- A. Soldered Joints: Joints in copper water tube above the floor shall be made with soft solder; below the floor and underground with silver solder. Tube shall be cut square and burrs removed. Outside of the tube and inside of the fitting shall be cleaned bright and fluxed. Fitting shall be heated evenly until proper soldering temperature is reached. Solder shall be fed into the joint until a ring of solder appears at the end of the fitting. Soft solder shall be 95.5% tin, 4% copper and 0.5% silver, and flux shall be noncorrosive. Silver solder shall be Easy-Flo, Sil-Fos, or equal, and flux shall be as recommended by the solder manufacturer.
- B. Screwed Joints: Pipe ends shall be reamed or filed out to the full size of the bore and all burrs, chips and cuttings shall be removed. Joint compound shall be applied to the male thread only. Joint compound shall be Teflon.
- C. All surfaces of metal, pipe, insulation and other equipment furnished under this section of the specifications which are exposed shall be thoroughly cleaned of grease, scale, dirt, and other foreign materials and left ready for painting.

3.7 INSPECTION AND TESTS

- A. General: Upon completion of the plumbing, all piping shall be tested for leaks, and all equipment shall be tested and inspected for proper operation. All underground piping or piping to be concealed shall be tested and approved prior to backfilling or concealing. All tests shall be conducted in the presence of the Owner or his authorized representative.
- B. Drainage System: The entire drainage and venting system shall have all necessary openings plugged to permit the entire system to be filled with water to the level of the highest vent stack above the roof. The system shall hold this water for 15 minutes before inspection starts; the system shall then be tight at all points. Where a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system, except that a vertical stack 10 ft. above the highest horizontal line to be tested may be installed and filled with water to maintain pressure required.
- C. Domestic Cold Water and Hot Water: Upon completion of the roughing-in and before setting fixtures, the entire water piping system shall be tested at a hydrostatic pressure of not less than 100 pounds per square inch gauge, and proved tight at this pressure. This pressure shall be maintained for a minimum of 30 minutes. Where a portion of the water system is to be concealed before completion, this portion shall be tested separately in a manner described for the entire system. The Contractor is cautioned to disconnect or remove all equipment and devices not capable of withstanding this pressure prior to performing this pressure test.

3.8 DEFECTIVE WORK

- A. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests repeated. All repairs to piping shall be made with new material. No caulking of screwed joints or holes will be acceptable. Any changes or adjustments required in order to obtain satisfactory operation of the system shall be made by the Contractor without additional expense to the Owner.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Division 16, ELECTRICAL, covers the work necessary for the complete electrical system. Furnish materials, labor, and equipment in accordance with these Specifications and the accompanying Drawings

1.2 RELATED SECTIONS

- A. Section 13400 - Instrumentation
- B. Section 16050 - Basic Materials and Methods
- C. Section 16075 - Electrical Identification
- D. Section 16110 - Raceways
- E. Section 16120 - Conductors
- F. Section 16130 - Boxes
- G. Section 16441 - Safety Switches
- H. Section 16450 - Grounding
- I. Section 16461 - Dry-Type Transformers
- J. Section 16470 - Panelboards
- K. Section 16500 - Lighting

1.3 WORK PROVIDED OUTSIDE THIS CONTRACT

- A. Incoming underground transformer primary power cables, materials, installation, termination, and connection; under this Contract, provide trench, and backfill, and duct system.
- B. Transformers supplying main electrical service to the facility; site preparation and transformer pad included in this Contract.
- C. Power company metering facilities, except as indicated.

1.4 MATERIALS AND EQUIPMENT FURNISHED UNDER OTHER DIVISIONS WITH RACEWAY AND ELECTRICAL CONDUCTORS FURNISHED, INSTALLED, AND CONNECTED UNDER DIVISION 16, ELECTRICAL

- A. All Equipment shown on the plans with an electrical or control wiring connection shown on the plans.
- B. Section 13400, Instrumentation of these specifications.

1.5 INSPECTION OF THE SITE AND EXISTING CONDITIONS

- A. The electrical drawings were developed from information supplied by the Owner. Verify all scaled dimensions prior to submitting bids.
- B. Before submitting a bid, visit the site and determine conditions at the site and at all existing structures in order to become familiar with all existing conditions and electrical systems which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the Contractor's failure to fulfill this requirement.

1.6 RESPONSIBILITY

- A. The Contractor shall be responsible for:
 - 1. Complete systems in accordance with the intent of these Contract Documents.
 - 2. Coordinating the incoming electrical service with the electric utility company providing service.
 - 3. Coordinating the details of facility equipment and construction for all Specification Divisions which affect the work covered under Division 16, ELECTRICAL.
 - 4. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.

1.7 DEFINITIONS

- A. Integrated Equipment Short Circuit Rating (IESCR): The short circuit current at the line terminals of an assembly which the assembly can interrupt without damage beyond that allowed by NEMA or UL for the short circuit design test for similar equipment; unless otherwise noted, IESCR is expressed in 3-phase, symmetrical, rms amps.

1.8 INTENT OF DRAWINGS

- A. Electrical plan drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned. The Contractor shall be responsible for the proper routing of raceway, subject to the review of the Engineer.

1.9 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. Make no such departures without written review of the Engineer.

1.10 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. In accordance with provisions elsewhere in these Contract Documents, manufacturers' names and catalog numbers stated herein are intended to indicate the type and quality of equipment or materials desired. Unless substitution is specifically forbidden, proposed alternatives may be submitted for approval.
- B. Make requests for review of alternatives in writing to the Engineer before submittals of shop drawings. Provide sufficient material or data to allow evaluation of the proposed alternative and determination of compliance with these Contract Documents. List any proposed deviations from these Contract Documents.

1.11 STANDARDS, CODES, PERMITS, AND REGULATIONS

- A. Perform all work; furnish and install all materials and equipment in full accordance with the latest applicable rules, regulations, requirements, and specifications of the following:
 - 1. Local Laws and Ordinances.
 - 2. State and Federal Laws.
 - 3. National Electrical Code (NEC).
 - 4. State Fire Marshall.
 - 5. Underwriters' Laboratories (UL).
 - 6. National Electrical Safety Code (NESC).
 - 7. American National Standards Institute (ANSI).
 - 8. National Electrical Manufacturer's Association (NEMA).
 - 9. National Electrical Contractor's Association (NECA) Standard of Installation.
 - 10. Institute of Electrical and Electronics Engineers (IEEE).
 - 11. Insulated Cable Engineers Association (ICEA).
 - 12. Occupational Safety and Health Act (OSHA).
 - 13. National Electrical Testing Association (NETA).
 - 14. American Society for Testing and Materials (ASTM).
- B. Conflicts, if any, that may exist between the above items will be resolved at the discretion of the Engineer.
- C. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with these codes.

- D. Obtain all permits and pay all fees required by any governmental agency having jurisdiction over the work. Arrange all inspections required by these agencies. On completion of the work, furnish satisfactory evidence to the Engineer that the work is acceptable to the regulatory authorities having jurisdiction.

1.12 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Provide complete manufacturers' descriptive information and shop drawings for equipment, material, and devices furnished under Division 16, ELECTRICAL, interconnection and connection diagrams, in accordance with provisions elsewhere in these Contract Documents.
- C. In addition to submittals for specific items that may be mentioned in other sections, furnish shop drawing information and submittal data on the following items as applicable to the project:
1. Switchgear
 2. Panelboards.
 3. Separately mounted circuit breakers and nonfused disconnect switches.
 4. PVC conduit.
 5. Liquid-tight flexible metal conduit.
 6. Wireway.
 7. Pull boxes and junction boxes with any dimension over 12 inches.
 8. Terminal junction boxes.
 9. Precast handholes.
 10. 600-volt conductors.
 11. Control cable.
 12. Lighting fixtures.
 13. Emergency lighting units.
 14. Light poles.
 15. Pushbuttons, Indicating Lights, Selector Switches: devices and stations .
 16. Elapsed time meters, separately mounted.
 17. Control relays and timers, separately mounted.
 18. Dry type small power transformers, 0-600V primary.
 19. Surge protective equipment.
 20. Automatic transfer switches.
 21. Lightning protection system.
 22. Conductor and Field Test Data
 23. Short circuit and protective device coordination study.

D. OPERATIONS AND MAINTENANCE MANUALS

1. Provide operations and maintenance manuals in accordance with provisions of GENERAL REQUIREMENTS, in these Contract Documents. Provide the number of copies specified therein containing:
 - a. Information required by GENERAL REQUIREMENTS.
 - b. Information listed under individual specification items.
 - c. Provide reproducible time-current coordination study.

1.13 GUARANTY

- A. Materials, equipment, and workmanship shall be guaranteed in accordance with provisions of General Conditions in these Contract Documents.

PART 2 PRODUCTS**2.1 PRODUCTS AND EQUIPMENT, COMMON REQUIREMENTS****A. GENERAL**

1. Unless otherwise indicated, provide all first-quality, new materials and equipment, free from any defects, in first-class condition, and suitable for the space provided. Provide materials and equipment listed by UL wherever standards have been established by that agency.
2. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

B. STANDARD PRODUCTS

1. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.

C. CLASSIFICATION OF AREAS

1. The following areas are classified nonhazardous and shall use watertight, dusttight, and corrosion resistant NEMA 4X materials and methods unless otherwise specified under specific equipment section or noted otherwise on drawings:
 - Outdoor Areas, Chemical Building
2. The following areas are classified nonhazardous and shall use raintight NEMA 3R materials and methods, unless otherwise noted.
 - Piping Gallery, High Service Pump Room
3. The following areas are not classified and shall use dusttight NEMA 1A or NEMA 12 materials and methods:
 - All areas not covered above.

D. EQUIPMENT FINISH

1. Unless otherwise indicated, provide materials and equipment with manufacturers' standard finish system. Provide manufacturers' standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with ANSI No. 61, light gray color.

E. EQUIPMENT RATINGS

1. Equipment shall be applied only within its rating. Equipment ratings shown are minimums. Voltage and current ratings shall be as required to adequately power the connected equipment. Fault current ratings shall be as shown for the particular item or for the next upstream device that has a fault current rating shown.

F. ALTITUDE

1. Provide materials and equipment suitable for installation and operation under rated conditions at the elevations given on the plans in feet above mean sea level.

G. OUTDOOR EQUIPMENT

1. Provide equipment and devices to be installed outdoors or in unheated enclosures capable for continuous operation within an ambient temperature range of 10 degrees F to 110 degrees F. If the equipment being provided will not work within these ambient temperatures, then additional heating or cooling must be provided at no additional cost to the Owner.

2.2 MOUNTING HARDWARE FOR ALL ITEMS

- A. Provide all fasteners and mounting hardware of Type 316 stainless steel. This shall include screws, anchors, bolts, nuts, fasteners, rivets, or any other fastening or mounting hardware.
- B. Unistrut: Provide all unistrut mounting channel made of Aluminum or Stainless Steel and all track and mounting hardware for unistrut out of Stainless Steel.

PART 3 EXECUTION**3.1 INSTALLATION, COMMON REQUIREMENTS**

- A. Install materials and equipment correctly using workers skilled in the Particular trade. Provide work which has a neat and finished appearance. Carry out work in accordance with NEMA Standard of Installation, unless otherwise specified.
- B. Coordinate electrical work with Engineer and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the plant during construction.
- C. Check the approximate locations of light fixtures, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having furred locations. In

the event of conflicts, notify the Engineer in writing. The Engineer's decision shall govern. Make modifications and changes required to correct conflicts.

3.2 PROTECTION DURING CONSTRUCTION

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturers' recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in transformers, switchboards, motors, and motor control centers which do not have space heaters.
- B. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the Contractor's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction, ensure that adequate protection from these atmospheres is provided that is acceptable to the Engineer. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Energize all space heaters furnished with equipment.

3.3 MATERIAL AND EQUIPMENT INSTALLATION

- A. Follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between the manufacturers' instructions, codes and regulations, and these Contract Documents, follow Engineer's decision. Keep copy of manufacturers' installation instructions on the jobsite available for review at all times.
- B. Use appropriate conduit and conductor entry fittings with enclosures which maintain the specified enclosure environmental capability after proper installation.

3.4 REMOVAL OR RELOCATION OF MATERIALS AND EQUIPMENT

- A. Where existing materials and equipment are removed or relocated, remove all materials no longer used such as studs, straps, conduits, and wires. Remove or cut off concealed or embedded conduit, boxes, or other materials and equipment to a point at least 3/4-inch below the final finished surface .
- B. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface in a neat and workmanlike manner. Follow specific instructions given by the equipment manufacturer.

3.5 CUTTING AND PATCHING

- A. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to original condition. Use skilled craftsmen of the trades involved.

3.6 LOAD BALANCE

- A. The Drawings and Specifications indicate circuiting to electrical loads and distribution equipment. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, etc.

3.7 MOTOR ROTATION

- A. After final service connections are made, check and correct the rotation of all motors.
- B. Coordinate rotation checks with the Engineer and the Contractor responsible for the driven equipment. Submit a written report to the Engineer for each motor verifying that rotation has been checked and corrected.

3.8 CLEANING AND TOUCHUP PAINTING

- A. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove all materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides a finish equal to or better than the factory finish, that meets the requirements of the Specifications, and that is acceptable to the Engineer.

3.9 INSPECTION

- A. Allow materials, equipment, and workmanship to be inspected at any time by the Engineer, or their representatives. Correct work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the Engineer.

3.10 CHECKOUT AND STARTUP

- A. During checkout and startup of the various plant systems, provide a crew of skilled craftsmen to be available for checkout and troubleshooting activities as required by the Engineer. Since coordination with other crafts and contractors will often be required, the craftsmen assigned to checkout must be available outside normal working hours when necessary.

3.11 TESTS

- A. Carry out tests specified hereinafter and as indicated under individual items of materials and equipment specified in other sections.
- B. OPERATIONS: After the electrical system installation is completed and at such time as the Engineer may indicate, conduct an operating test for approval. Demonstrate that the equipment operates in accordance with the requirements of these Specifications and Drawings. Demonstrate that protective functions are operating properly and are properly incorporated in control system, circuit breaker, and motor control center circuitry. Perform the test in the presence of the Engineer. Furnish all instruments and personnel required for the tests. The Owner will furnish the necessary electric power.
- C. VOLTAGE: When the installation is essentially complete and the plant is in operation, check the voltage at the point of termination of the power company supply system to the project. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
- D. Record the supply voltage (all three phases simultaneous on the same graph) for 24 hours during a normal working day. Submit the recording with a letter of transmittal to the Owner and his authorized representative within 5 days of the date the test was taken.
- E. If an unbalance (as defined by NEMA) exceeds 1 percent, or if the voltage varies throughout the day and from loaded to unloaded conditions more than plus or minus 4 percent of nominal, make a written request to the power company, with a copy to the Owner and his authorized representative, that the condition be corrected. If corrections are not made, obtain from a responsible power company official a written statement that the voltage variations and/or unbalance are within their normal standards. Send a copy of this statement with a transmittal letter to the Owner and his authorized representative .
- F. EQUIPMENT LINE CURRENT AND VOLTAGE
 - 1. Check the line current and voltage in each phase for each piece of equipment. If the power company makes adjustments to the supply voltage magnitude or balance, make the line current check after the adjustments are made. If any phase current in any piece of equipment is above the rated nameplate current, determine the cause of the problem and submit it in writing to the Engineer.
- G. CONDUCTOR AND EQUIPMENT FIELD TESTS
 - 1. The Contractor shall furnish the necessary test equipment and labor to test the insulation of the electrical equipment and circuits before they are energized. A 500-volt megger shall be used to test the insulation resistance of equipment and circuits insulated for 600 volts.
 - 2. The insulation to ground of each conductor shall be tested and must be at least 5 megohms. The insulation resistance of motors shall be at least 80 percent of the factory test value. The insulation resistance of motors for which factory test values are not available must be at least equal to the values required for low voltage transformers.

3. The insulation resistance of low voltage transformers must be at least as great as the following values:

Case Temperature	Test Value
0	12.0
10	7.0
20	4.2
30	2.5
40	1.5
50	1.0

4. Any equipment which does not pass test shall be replaced or repaired to bring the insulation resistance up to the value of comparable new equipment. Any piece of equipment which passes the above test but is significantly below values obtained for comparable new equipment or which the Contractor or the Engineer believe to be faulty on the basis of insulation resistance tests shall be replaced or repaired as above.
5. A written record of all insulation resistance tests shall be kept. The test records shall show the Contractor, tester, witness (if any), date, air temperature at test site, test instrument manufacturer, model and serial number. For each tested circuit or apparatus, the records shall show the test voltage and test results in megohms. These records shall be turned over to the Engineer on request or at the end of the work.

H. METER TESTING

1. After installation, each meter in an electrical assembly shall be calibrated by NEC traceable standards. Where metering circuits include instrumentation transformers, the circuits shall be calibrated using primary injection. A record of the calibration, certifying the calibration and fitness of the standards, shall be submitted to the Engineer.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section covers the work necessary to furnish and install, complete, the materials specified hereinafter.

1.2 RELATED SECTIONS

- A. Section 16010 - Electrical – General Provisions

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NEMA ICS 1 - General Standards for Industrial Control Systems.
- C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.
- D. NEMA ICS 3 - Industrial Systems.
- E. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- F. IEEE - All applicable standards
- G. UL - All applicable standards

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Provide complete manufacturers' descriptive information and shop drawings for equipment, material, and devices furnished under Division 16, ELECTRICAL, interconnection and connection diagrams, in accordance with provisions elsewhere in these Contract Documents.

PART 2 PRODUCTS

2.1 SERVICE ENTRANCE

- A. When service entrance work is required provide materials and work, as required by the electric utility which will provide service to the facility, for installation of service conductors, and mounting of utility company equipment. All such materials and work shall meet the requirements of the utility company.

2.2 WIRING DEVICES

A. Switches:

1. General Use Switches: Provide specification grade, totally-enclosed, ac type, quiet tumbler switches meeting NEMA WD 1 performance standards and Federal Specification W-S-896E, and capable of control of 100 percent tungsten filament and fluorescent lamp loads. Use switches rated at 20 amps, 120/277 volts. Provide operating handles colored ivory in office areas, and brown in all other areas. Switches shall have screw terminals.
2. Weatherproof Switches: Use switches as specified mounted in a cast metal box with gasketed, weatherproof device plate as specified.
3. Switches with Pilot Lights: Provide switches as specified with 125 volt, neon light with red jewel, or lighted toggle which is lighted when the switch is ON.
4. Acceptable Manufacturers: Bryant, General Electric, Hubbell, Pass and Seymour, or equal.

B. Receptacles:

1. Single and Duplex: Provide specification grade receptacles meeting NEMA WD 1 performance standards and Federal Specification W-C 596, and having a contact arrangement such that contact is made on two sides of each inserted blade without detent. Use two-pole, three wire grounding type receptacles rated 20 amps, 125 volts, NEMA Configuration 5-20R, and with screw type wire terminals suitable for No. 10 AWG. Provide high strength thermoplastic bases colored ivory. Acceptable manufacturers: Bryant, General Electric, Hubbell, Pass and Seymour, Sierra, or equal.
2. Weatherproof Receptacles: Receptacles shall be specified above mounted in a cast metal box with gasketed, weatherproof device plate as specified below.
3. Ground Fault interrupter (GFI) Receptacles: Provide duplex specification grade GFCI receptacles tripping at 5 milliamps; rated 20 amps, 120 volts, NEMA Configuration 5-20R. Use units meeting NEMA WD 1, fitting standard sized outlet boxes, having provision for testing, and ivory in color. Use standard model where ground fault protection is needed. Do not use feed-thru model. Acceptable manufacturers: Pass and Seymour, Arrow Hart, Hubbel, or equal.
4. Corrosion-Resistant Receptacles: Receptacles shall meet the requirements for single and duplex Receptacles, above. Receptacle bodies shall be made from polycarbonate or other corrosion-resistant material. Metal parts shall be stainless steel or nickel plated brass or bronze. Receptacles shall be mounted in a nonmetallic box with a gasketed corrosion-resistant device plate as specified below.
5. Special Purpose Receptacles: Provide receptacles of the type, rating, and number of poles indicated or required for the anticipated purpose. Furnish a matching plug with cord-grip features for each special purpose receptacle.

C. Device Plates:

1. Provide plates fitting closely and tightly to the box on which they are to be installed. On surface mounted boxes, provide plates which do not extend beyond the sides of the box unless the plates do not have sharp corners or edges. Flush mount plates shall be oversize style plates.
2. Use plate material compatible with the box material such that galvanic corrosion of the plate and/or box does not occur.
3. Metal (M) Plates: Provide specification grade, one-piece, 0.040-inch nominal minimal thickness, No. 430 satin finish stainless steel device plates with oval-head, matching mounting screws.
4. Engraved Plates: Where device titles are indicated, provide device plates engraved with the designated titles. Provide engraved letters, numbers, or characters 3/16-inch high with filler of red color.
5. Acceptable Manufacturers: Cooper, Arrow Hart, Leviton, or equal.

D. Weatherproof (WP) Plates:

1. Where weatherproof receptacles are designated, the receptacle shall be installed in the specified box with a gasketed, weatherproof, cast metal or stainless steel cover plate with individual cap over each receptacle opening and stainless steel mounting screws. Utilize plates with caps held tightly closed with stainless steel springs when receptacle is not in use. Acceptable manufacturers: General Electric, Bryant, Hubbell, Sierra, Pass and Seymour, Crouse-Hinds, Bell, or equal.
2. Where weatherproof switches are designated, the switch shall be installed in the specified box with a gasketed, weatherproof, cast metal cover plate incorporating an external operator for the internal switch and with stainless steel mounting screws. Acceptable manufacturers and types: Crouse-Hinds DS-181 or DS-185, Appleton FSK-1VTS or FSK-1VS, or equal.
3. Raised Sheet Metal (SM) Plates: Provide 1/2-inch high zinc- or cadmium-plated steel device plates designed for one-piece drawn type sheet steel boxes.
4. Corrosion-Resistant (CR) Plates: Where corrosion-resistant receptacles are designated, the receptacle shall be installed in the specified box with a gasketed, weatherproof, corrosion-resistant, nonmetallic cover plate individual cap over each receptacle opening and stainless steel mounting screws. Use plates with caps held tightly closed with stainless steel springs when receptacle is not in use. Acceptable manufacturers: General Electric, Hubbell, or equal.

2.3 FUSES, 0 TO 600 VOLTS

- A. Provide a complete set of current-limiting fuses whenever fuses are indicated. Supply a set of six spare fuses of each type and each current rating installed. Utilize fuses that fit mountings specified with switches and which provide features rejecting Class H fuses. Provide the following types :
1. For 0- to 600-volt motor and transformer circuits, 0 to 600 amps, UL Class RK-1 with time delay, Bussmann Type LPS-RK, Shawmut Type A6D-R, or equal.
 2. For 0- to 250-volt motor and transformer circuits, 0 to 600 amps, UL Class RK-1 with time delay, Bussmann Type LPN-RK, Shawmut Type A2D-R, or equal.

3. For 0- to 600-volt feeder and service circuits, 0 to 600 amps, UL Class RK-1, Bussmann Type KTS-R, Shawmut Type A6K-R, or equal.
4. For 0- to 250-volt feeder and service circuits, 0 to 600 amps, UL Class RK-1, Bussmann Type KTN-R, Shawmut Type A2K-R, or equal.

2.4 PUSHBUTTONS, INDICATING LIGHTS, AND SELECTOR SWITCHES

- A. For nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, provide heavy-duty, oiltight type pushbuttons, indicating lights, selector switches, and stations for these devices. Utilize Square D Type K, Alien Bradley, Cutler-Hammer Type T, or other acceptable manufacturer.
- B. For nonhazardous, outdoor, or normally wet locations, or where otherwise indicated, provide heavy-duty corrosion-resistant, watertight type pushbuttons, or indicating lights, or selector switches mounted in NEMA 4X watertight enclosures. Provide special gasketing required to make complete station watertight. Utilize Square D Type SK, or equivalent by Alien Bradley, Cutler-Hammer, or other manufacturers.
- C. Provide devices meeting the requirements of NEMA ICS 2, and having individual, extra large nameplates indicating their specific function. Provide pushbutton stations with laminated plastic nameplates indicating the drive they control. Provide contacts with NEMA designation rating A600. Install provisions for locking pushbuttons and selector switches in the OFF position wherever lockout provisions are indicated.
- D. Utilize selector switches having standard operating levers. Make all indicating lights transformer push-to-test type. Provide ON or START pushbuttons colored black. Provide OFF or STOP pushbuttons colored red.

2.5 TERMINAL BLOCKS 0 TO 600 VOLTS

- A. Provide terminal blocks for termination of control circuits at enclosures and for termination of power and control conductors where shown. Terminal blocks shall be solderless box lug type, rated for the highest phase-to-phase voltage used in the enclosure. Provide terminal blocks manufactured by Square D, General Electric, or equal.

2.6 CONTROL RELAYS

- A. Provide magnetic control relays, NEMA Class A600 (600 volts, 10 amps continuous, 7,200VA make, 720VA break), industrial control type with field convertible contacts, and meeting the requirements of NEMA ICS 2. Provide Cutler-Hammer Type M-600, General Electric Type CR120B, or equal.
- B. Where time delay relays are specified or required, units shall have adjustable time delay with the number of contacts and contact arrangements required. Contacts shall be rated for 10 amperes at 120V ac. Integral knob with calibrated scale shall be provided for adjustment of time delay. Time delay range shall be at least 10:1. Operating voltage

shall be 120V ac, plus 10 percent, -15 percent at 60-Hz. Repeat timing accuracy shall be plus or minus 10 percent over the operating range. Units shall be Agastat Series 7000, or equal.

- C. Where latching (mechanically held) relays or motor thermal detector relays are specified, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts. Utilize an attachment allowing easy manual latching and unlatching.

2.7 ELAPSED TIME METERS

- A. Provide synchronous-motor-driven , elapsed time meters, 0 to 99,999.9 hours range, nonreset type, suitable for semiflush, panel mounting. Provide General Electric Type 240, 2-1/2-inch Big Look unit, Eagle Signal Bulletin 705 unit, or equal.

2.8 SURGE PROTECTIVE DEVICES

A. STANDARDS

1. ANSI/IEEE: C62.41, C62.45 & C62.48
2. National Electric Code: 285
3. Underwriters Laboratories: UL1449 & UL1283

B. SURGE SUPPRESSOR

1. SPD shall be listed in accordance with UL1449 second edition and UL1283.
2. SPD shall be marked with a short circuit current rating equal to or greater than available fault currents at the point of installation.
3. SPD shall provide surge current diversion paths for all modes of protection; L-N, L-G, N-G in WYE systems, and L-L, L-G, in delta systems.
4. Each mode including N-G shall be fused with a UL Recognized 200kAIC surge rated fuse and incorporate a thermal cutout device.
5. At Service Entrance, a UL approved disconnect switch shall be provided as a means of disconnect if a 60A breaker is not available.
6. UL 1449 Listed and Recognized component suppression voltage rating shall not exceed the following:

<u>VOLTAGE</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>	<u>MCOV</u>
208Y/120	330V	330V	330V	150V
480Y/277	700V	700V	700V	320V

7. SPD shall have a minimum EMI/RFI filtering of -50dB at 100kHz.
8. SPD shall monitor all modes; L-N, L-G and N-G.
9. SPD shall have a five-year warranty.
10. SPD shall be provided with individual suppression modules per phase for ease of maintenance.
11. SPD shall be provided with 1 set of NO/NC dry contacts to signal SCADA system when suppression module fails.
12. SPD shall be provided with surge event counter.

13. SPD shall be provided with spare suppression module mounted in cabinet.
14. Unit to be rated for 200kA minimum.

C. MANUFACTURERS

1. Advanced Protection Technologies, Inc., American Power Conversion, Siemens or engineering approved equal.

2.9 CHANNEL FRAMING

- A. Provide Unistrut channel framing, fittings, and hardware of stainless steel in corrosive areas and aluminum in other areas. Contractor may propose, for review by the Engineer, a welded framework as a substitution provided there is no additional cost to the Owner.

2.10 PHASE REVERSAL RELAY

- A. Phase reversal relay shall open a contact to protect against phase failure and phase reversal. Phase reversal relay shall be rated to withstand 10,000 volts, momentarily. Phase reversal relay shall be manufactured by Furnas.

2.11 SWITCHBOARD MATTING

- A. Provide 36-inch wide switchboard matting having a breakdown of 20 kV, minimum. Manufacturers: U.S. Mat and Rubber Company; or equal.

PART 3 EXECUTION

3.1 WIRING DEVICES

- A. Switches: Mount switches for switch operation in the vertical position.
- B. Receptacles: Mount receptacles with grounding slot up except where horizontal mounting is indicated, in which case mount with neutral slot Lip. Ground receptacles to boxes with grounding wire, not by yoke or screw contact. Mount weatherproof receptacles with the hinge for the protective cover above (not at side, or below) the receptacle opening.
- C. Mounting Heights:
 1. Install wall switch 48 inches above finished floor
 2. Install wall convenience receptacle 18 inches above finished floor
 3. Install counter convenience receptacle 6 inches above backsplash of counter
 4. Install dimmer 48 inches above finished floor
 5. Install telephone jack 18 inches above finished floor
 6. Special Purpose Receptacles: Locate special purpose receptacles where shown. Install and mount the receptacles in accordance with the manufacturer's instructions and the applicable codes.

- D. Device Plates: Securely fasten device plates to switch or receptacle boxes or the wiring device contained therein. Install device plates used with flush mounted boxes with all four edges in continuous contact with the finished wall surfaces without the use of mats or similar materials. Plaster fillings will not be acceptable. Install device plates vertically or horizontally with an alignment tolerance of 1/16-inch. Do not use sectional type device plates.

3.2 SWITCHBOARD MATTING

- A. Install switchboard matting at switchboards, motor control centers, and panelboards. Matting shall run the full length of all sides of equipment which have operator controls or provide access to devices.

3.3 SPD INSTALLATION

- A. SPD shall be installed per manufacturer's installation instructions with lead lengths as short and straight as possible. Gently twist conductors together.
- B. SPD shall be installed on the load side of the main disconnect or as directed by engineer.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section includes electrical identification materials

1.2 RELATED SECTIONS

- A. Section 16050 - Basic Materials and Methods
- B. Section 16130 - Boxes
- C. Section 16441 - Safety Switches
- D. Section 16470 - Panelboards

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Product data: Provide catalog data for nameplates and wire markers.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Nameplates: Engraved three-layer laminated plastic, white letters on black background. Edges shall be chamfered. Minimum size shall be 1 inch high by 2.5 inches wide.
- B. Locations: Major items of electrical equipment including switchboards, motor control centers, panelboards, individual starters, safety switches, transformers and individual components of switchboards and motor control centers shall be marked with a nameplate to identify the equipment.
- C. Letter Size:
 - 1. Use ¼ inch letters for identifying individual loads.
 - 2. Use ½ inch letters for identifying equipment and grouped loads.

2.2 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Terra-Tape
 - 2. or equal

- B. Description: Provide heavy-gauge, red plastic tape of 6-inch minimum width for use in trenches containing electric circuits. Utilize tape made of material resistant to corrosive soil. Use tape with printed warning that an electric circuit is located below the tape.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

- A. Install nameplate parallel to equipment lines.
- B. Secure nameplate to equipment front using screws or rivets.
- C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- D. Warning Tapes: Bury warning tapes approximately 12 inches above all underground conduit runs or duct banks. Align parallel to and within 12 inches of the centerline of runs.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section covers the work necessary to furnish and install, complete, electrical raceway systems.

1.2 RELATED SECTIONS

- A. Section 03000 - Concrete
- B. Section 16010 - Electrical - General Provisions

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Multiple Channel Prewired Raceway submittals shall show the complete layout of all products that make up the complete system prior to installation with raceway lengths, device type, locations and circuit identification.

PART 2 PRODUCTS

2.1 GALVANIZED RIGID CONDUIT (GRC)

- A. Use Galvanized rigid steel conduit, including couplings, bushings, elbows, nipples, and other fittings, hot-dip galvanized and meeting the requirements of UL and the NEC. Do not use setscrew type couplings, bushings, elbows, nipples, and other fittings, unless approved by the Engineer. Galvanized rigid steel conduit shall be threaded on both ends and threads shall be hot-dip galvanized after cutting. Shall be produced in accordance with UL safety standard #6 and ANSI C80.1.

2.2 INTERMEDIATE METAL CONDUIT (IMC)

- A. Use intermediate metal conduit, including couplings, bushings, elbows, nipples, and other fittings, hot-dip galvanized and meeting the requirements of UL and the NEC. Do not use setscrew type couplings, bushings, elbows, nipples, and other fittings, unless approved by the Engineer. Intermediate metal conduit shall be threaded on both ends and threads shall be hot-dip galvanized after cutting. Shall be produced in accordance with UL safety standard #1242 and ANSI C80.6.

2.3 PVC SCHEDULE 40 CONDUIT

- A. Use rigid PVC Schedule 40 conduit, UL listed for concrete-encased, underground direct burial, concealed and direct sunlight exposed use, and UL listed and marked for use with conductors having 90 degrees C insulation. Use conduits, couplings, bushings, elbows, nipples, and other fittings meeting the requirements of NEMA TC 2 and TC 3, Federal Specification W-C-1094, UL, NEC, and ASTM specified tests for the intended use. Use only conduit with a factory formed bell on one end. Conduit that requires the use of couplings for straight runs will not be acceptable.

2.4 FLEXIBLE METAL CONDUIT, LIQUID-TIGHT

- A. Use UL listed liquid-tight flexible metal conduit consisting of galvanized steel flexible conduit covered with an extruded PVC jacket and terminated with nylon bushings or bushings with steel or malleable iron body and insulated throat and sealing O-ring.

2.5 WIREWAYS

- A. Provide screw-cover, indoor, outdoor, rain tight, steel-enclosed wireway and auxiliary gutter where indicated. Utilize wireways and fittings that are UL listed, have a cover that can easily be removed, and have a gray, baked enamel finish. Manufacturers and types: Square D Square-Duct; General Electric Type HS; or equal.

2.6 RACEWAY FITTINGS

- A. Use insulated throat bushings of metal with integral plastic bushings rated for 105 degrees C. For insulated throat bushings for rigid steel conduit, use Thomas & Betts Nylon Insulated Metallic Bushings, or O.Z. Gedney Type B.
- B. Use Myers Scru-Tite hubs.
- C. Use conduit bodies for rigid steel conduit of metal and sized as required by the NEC (NFPA 70-1984). Use Appleton Form 35 threaded Unilets; Crouse-Hinds Mark 9 or Form 7 threaded condulets; Killark Series O Electrolets; or equal, for normal conduit bodies for rigid steel conduit. Where conduit bodies for rigid steel conduit are required to be approved for hazardous (classified) locations, use conduit bodies manufactured by Appleton, or Crouse-Hinds.
- D. Use Appleton Type EYF, EYM, or ESU; or Crouse-Hinds Type EYS or EZS; sealing fittings for rigid steel conduit. Where condensate may collect on top of a seal, provide a drain by using Appleton Type SF or Crouse-Hinds Type EYD or EZD Drain Seal.
- E. Use Appleton Type ECDB or Crouse-Hinds ECD drain fittings for rigid steel conduit.
- F. Fittings for Liquid-Tight Flexible Metal Conduit: Use insulated throat connectors for liquid-tight flexible metal conduit of metal with an integral plastic bushing rated for 221°F, and of the long design type extending outside of the box or other device at least 2-inches. Use Thomas & Betts Super-Tite Nylon Insulated Connectors, or equal.

- G. Use cable sealing fittings forming a watertight nonslip connection to pass cords and cables into conduit. Size cable sealing fitting for the conductor OD. For conductors with OD's of 1/2 inch or less, provide a neoprene bushing where the conductor enters the connector. Use Crouse-Hinds CGBS, Appleton CG Series, or equal, cable sealing fittings.

2.7 CABLE TRAY

- A. A cable tray system shall be furnished to support interlocked armor cable as shown on the drawings. The cable tray system shall be aluminum ladder type, 6" flange out, and 9" rung spacing. Tray shall be of widths shown on the drawings, and shall include all components to make a complete system.
- B. Cable tray shall be manufactured and installed in accordance with NEMA Standard VE1, and shall be Class 12B. Tray supports shall be furnished and installed on 10' centers. Tray deflection shall be no more than 0.43" when loaded to 100 lbs/linear ft. with 10' span length.
- C. Expansion connectors shall be used on all straight runs to prevent forces from expansion on support members. Grounding conductors shall be installed as shown on the Drawings, and clamps installed at each section of tray. Wall sleeves shall be furnished and installed where trays enter building, and shall be sealed after cables are installed to prevent entry of moisture.
- D. Tray shall be Type A9PB Electray aluminum ladder as manufactured by MPHusky, or equal by P-W Industries, Inc.

2.8 MULTIPLE CHANNEL PREWIRED RACEWAY

- A. The multioutlet assembly specified herein shall be the Isoduct Prewired System Series AL4320, as manufactured by Wiremold. Manufacturers requesting consideration as an alternative to the Isoduct Prewired Systems shall submit documentation establishing their product equality at least 10 days prior to bid date. Request shall include documentation of UL listings as both a Multioutlet Assembly and a Surface Metal Raceway and include a sample of the prewired components. A list of similar installations in service for two years or longer must be provided. Systems of other manufacturers may be considered equal, if in the opinion, and the written approval of the engineer, they meet all the performance standards specified herein.
- B. Materials:
 - 1. Raceway shall have two (2) wiring compartments with field removable covers. Raceway shall have a nominal wall thickness of 0.078". Multiple compartment raceway shall have an integral deviding barrier isolating wiring compartments and provided with fittings that maintain the separation of compartments. Raceway covers shall be 12" in length to facilitate future modification. Covers must be removable with a standard straight blade screwdriver without marring. Raceway to

- have two covers and must allow each cover to be removed separately without allowing access into the compartment enclosed by the other cover.
2. Raceway shall be manufactured of extruded #6063-T5 aluminum and have an Ivory Power Coat finish. Dimensions of the raceway shall be 5-1/4" W x 1-3/4 H and each length of raceway shall be cut to specified job requirements. Field cutting of raceway will not be permitted.
 3. Each receptacle shall be identified noting the panel number and circuit number from which it is fed. Receptacles rated higher than a NEMA 5-20R configuration shall also be provided with voltage, phase and amperage identified in the same manner. Raceway sections shall be provided with 12" [304.8mm] pigtails at feed locations for ease of installation. Grounding shall be maintained by means of factory installed NEC sized grounding conductor(s) and utilize insulation displacement connectors as required.
 4. Raceway covers shall have either holecut provision for communications outlets, if Wiremold Interlink Cabling System data connectors are used, or the voice and data/LAN outlets shall be factory mounted to the cover plates. The raceway must be capable of containing, but not limited to, snap-in modular jacks (3-pair, 4-pair, 4-pair keyed and MMJ), coaxial and F-connectors and communication grommets. Wiring connections of these devices shall be completed at the jobsite by the appointed contractor.
 5. The multioutlet assembly is to consist of factory assembled product with a full complement of fittings including, but not limited to, elbows (90°, internal and external), slide couplings for joining raceway sections, blank end caps for closing open ends of the raceway, and flat tees.
 6. The raceway manufacturer will provide a complete line of connectivity outlets and modular inserts for UTP (including Category 5), STP (150 ohm) Fiber Optic, Coaxial and other cabling types with face plates and bezels to facilitate mounting. A complete line of preprinted station and port identification labels, snap-in icon buttons as well as write-on station identification labels shall be available.

2.9 ELECTRICAL PRECAST HANDHOLES

- A. Install handholes precast with 28-day, 3,000 psi minimum compressive strength concrete and designed for AASHTO H-20 loading. Minimum dimensions for handholes are shown on the Drawings. Increase these as required by use of extension sections to accommodate the several raceway entrances at their required elevations.
- B. Slope floors toward drain points, leaving no pockets or other nondraining areas. Provide a drainage outlet at the low point of the floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and 4-inch minimum outlet and outlet pipe.
- C. Provide raceway entrances on all four sides. For raceways installed under this Contract, knockout panels or precast individual raceway openings may be used. On sides where no raceways are installed under this Contract, provide 12-inch high by 24-inch wide (minimum) knockout panels for future raceway installation.

- D. Utilize heavy-duty type frames and covers made of cast iron, suitable for H-20 loading, and having machined bearing surfaces. Provide indented type covers, solid top design, with two drop handles each. On the upper side of each cover, cast or burned by welder, in integral letters not less than 2 inches high appropriate titles, ELECTRIC HV (for above 600 volts), ELECTRIC LV (for 600 volts and below), or TELEPHONE. Field stamp covers with manhole or handhole numbers indicated on the Drawings.
- E. Provide a pulling iron embedded in the concrete wall opposite each raceway entrance and one in the floor vertically below the center of the handhole cover. Utilize 3/4-inch round stock securely fastened to the overall steel reinforcement before concrete is poured.
- F. Utilize handhole hardware of steel, hot-dip galvanized after fabrication.
- G. Manufacturers: Brooks Products, Inc.; Penn-Cast Products, Inc.; Concrete Conduit Company; Associated Concrete Products, inc.; or equal.

2.10 COMMUNICATIONS HANDHOLE

- A. Provide 12" X 12" x 24" polymer concrete box with 20k loading, open bottom, and hex head bolts for communication cabling.
- B. Logo to read "Communications".
- C. Manufacturer to be Armorcast or equal.

2.11 RACEWAY TAGS

- A. Provide permanent, nonferrous metal markers with raceway designations pressure stamped, embossed, or engraved onto the tag. Tags relying on adhesives or taped-on markers are not acceptable. Attach tags to raceways with noncorrosive wire.

2.12 WARNING TAPE

- A. Provide heavy-gauge, red plastic tape of 6-inch minimum width for use in trenches containing electric circuits. Utilize tape made of material resistant to corrosive soil. Use tape with printed warning that an electric circuit is located below the tape. Manufacturers and types: ITT Blackburn Type RT; Griffolyn Co. Terra-Tape; or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide raceway systems meeting or exceeding the requirements of the NEC.

3.2 PROTECTION DURING CONSTRUCTION

- A. In addition to the requirements of the General Conditions, Division 1, General Requirements, and Section 16010, Electrical - General Provisions, prior to installation,

store all products specified in this section in a dry location. Following installation, protect products from the effects of moisture, corrosion, and physical damage during construction. Keep openings in conduit and tubing capped with manufactured seals during construction.

3.3 MINIMUM RACEWAY SIZE

- A. Conduit runs smaller than 3/4" trade size shall not be used except 1/2" conduit may be used for making attachments to equipment which, because of its construction, will not accept a larger size conduit. Lengths of 1/2" conduits shall be as short as possible.

3.4 REQUIRED RACEWAY TYPE FOR LOCATION AND INSTALLATION METHOD

- A. Exterior, Exposed: GRC.
- B. Interior, Exposed: IMC.
- C. Corrosive, Nonhazardous Areas: PVC coated GRC.
- D. Interior, Concealed (Not Embedded in Concrete): IMC.
- E. Interior, Concealed above ceiling (Not Embedded in Concrete): EMT
- F. Aboveground, Embedded in Concrete Walls or Floors: PVC.
- G. Underground, Direct Earth Burial: PVC Schedule 40 conduit.
- H. Concrete Encased Raceways:
 - 1. 1. GRC for analog circuits.
 - 2. 2. PVC Schedule 40 conduit for all other circuits.
- I. Under Concrete Floor Slabs: PVC.
- J. Analog: GRC, IMC or PVC coated GRC (dependant on location).

3.5 FINAL CONNECTION TO CERTAIN EQUIPMENT

- A. Make final connection to motors, wall or ceiling mounted fans and unit heaters, dry type transformers, valves, local instrumentation, and other equipment where flexible connection is required to minimize vibration or where required to facilitate removal or adjustment of equipment, with 18-inch minimum, 60-inch maximum lengths of liquid-tight, PVC-jacketed, flexible steel conduit where the required conduit size is 4 inches or less. For larger sizes, use nonflexible conduit as specified.
- B. The flexible conduit shall be long enough to allow the item to which is connected to be withdrawn or moved off its base. Use liquid-tight flexible metal conduit in all areas.

- C. Special Locations: Use GRC:
 - 1. Where conduit changes from underground and/or concrete embedded to exposed.
 - 2. Under equipment mounting pads.
 - 3. In exterior light pole foundations.
- D. Contractor shall use conduit types as specified in section 3.4 unless noted otherwise on drawings.

3.6 GENERAL INSTALLATION REQUIREMENTS FOR RACEWAYS

- A. Location, Routing, and Grouping:
 - 1. Conceal or expose raceways as indicated. Group raceways in same area together. Locate raceways at least 12 inches away from parallel runs of heated piping for other utility systems.
 - 2. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes to provide a neat appearance. Follow surface contours as much as possible.
 - 3. Avoid obstruction of passageways. Run concealed raceways with a minimum of bends in the shortest practical distance considering the building construction and other systems.
 - 4. In block walls, do not run raceways in the same horizontal course with reinforcing steel.
 - 5. Do not route conduits in concrete wall or slabs unless specifically stated on drawings or approved by engineer.
 - 6. In outdoor, underground, or wet locations, use watertight couplings and connections in raceways. Install and equip boxes and fittings so as to prevent water from entering the raceway.
 - 7. Paint all threads of galvanized conduits that are installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound before assembling. Touch up after assembly to cover nicks or scars.
 - 8. Do not notch or penetrate structural members for passage of raceways except with prior approval of the Engineer.
 - 9. Do not run raceways in equipment foundation pads.
 - 10. Locate aboveground raceways concealed in poured concrete so that the minimum concrete covering is not less than 1-1/2 inches.
 - 11. Avoid trapped runs, where possible. Aboveground trapped runs shall have a drain fitting installed at the low point.
 - 12. Except at raceway crossings, separate raceways in slabs not less than six times the raceway outside diameter.
 - 13. Raceways installed under slab floors shall lie completely under the slab with no part of the horizontal run of the raceway embedded within the slab.
 - 14. Install concealed, embedded, and buried raceways so that they emerge at right angles to the surface and have none of the curved portion of the bend exposed. Provide support during pouring of concrete to ensure that raceways remain in position.
 - 15. Support raceways at intervals not exceeding NEC requirements unless otherwise indicated. Support multiple raceways adjacent to each other by ceiling trapeze.

Support individual raceways by wall brackets, strap hangers, or ceiling trapeze, fastened by wood screws on wood, toggle bolts on hollow masonry units, expansion shields on concrete or brick, and machine screws or welded thread studs on steelwork.

16. Threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion shields.
17. Support all raceways from structural members only. Do not support from pipe hangers or rods, cable tray, or other conduit.
18. Do not use nails anywhere or wooden plugs inserted in concrete or masonry as a base for raceway or box fastenings. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.
19. Appropriate pulleys and supports shall be used during cable installation to prevent damage to cable jackets.

B. Bends:

1. Make changes in direction of runs with symmetrical bends or cast metal fittings. Make bends and offsets of the longest practical radius. Avoid field-made bends and offsets where possible. Do not heat metal raceways to facilitate bending.
2. Factory elbows may be used in parallel or banked raceways.
3. For PVC conduits, use factory-made elbows for all bends.
4. Make no bends in flexible conduit that are smaller than allowable bending radius of the cable to be installed or that significantly restricts the conduit's flexibility.

C. Bushing and Insulating Sleeves:

1. Where metallic conduit enters metal equipment enclosures through conduit openings, install a bonding bushing on the end of each conduit. Install a bonding jumper from the bushing to any equipment ground bus or ground pad.
2. If neither exists, connect the jumper to a lag-bolt connection to the metallic enclosure.
3. Use manufacturer's standard insulating sleeves in all metallic conduits terminating at an enclosure.
4. All metal conduits terminating at NEMA 3R and NEMA 4X enclosures shall use Myers SRU-TITE hubs.
5. Expansion Joints: Provide suitable expansion fittings for raceways crossing expansion joints in structures or concrete slabs, or provide other suitable means to compensate for expansion and contraction. Provide for the high rate of thermal expansion and contraction of PVC conduit by providing PVC expansion joints as recommended by the manufacturer and as required.

- D. PVC Conduit:** Chamfer the end of all PVC conduit. Solvent weld PVC conduit joints with solvent recommended by the conduit manufacturer. Follow manufacturer's solvent welding instructions and provide watertight joints. Use acceptable PVC terminal adapters when joining PVC conduit to metallic fittings. Use acceptable PVC female adapters when joining PVC conduit to rigid metal conduit or IMC.

- E. PVC Coated Galvanized Rigid Conduit: Installers of PVC coated Galvanized Rigid conduit shall be certified by the manufacturer and be able to present a valid, unexpired installer card upon inspection.

3.7 PENETRATIONS

- A. Seal the interior of all raceways entering structures at the first box or outlet with oakum or suitable plastic expandable compound to prevent the entrance into the structure of gases, liquids, or rodents.
- B. Dry pack with nonshrink grout around raceways that penetrate concrete walls, floors, or ceilings aboveground, or use one of the methods specified for underground penetrations.
- C. Where an underground conduit enters a structure through a concrete roof or a membrane waterproofed wall or floor, provide an acceptable, malleable iron, watertight, entrance sealing device. When there is no raceway concrete encasement specified or indicated, provide such a device having a gland type sealing assembly at each end with pressure bushings, which may be tightened at any time. When there is raceway concrete encasement specified or indicated, provide such a device with a gland type sealing assembly on the accessible side. Securely anchor all such devices into the masonry construction with one or more integral flanges. Secure membrane waterproofing to such devices in a permanently watertight manner.
- D. Where an underground raceway without concrete encasement enters a structure through a nonwaterproofed wall or floor, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve with a suitable plastic expandable compound, or an oakum and lead joint, on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device as specified may be used in lieu of the sleeve.
- E. Where raceways penetrate fire-rated walls, floors, or ceilings, fire stop openings around electrical penetrations to maintain the fire resistance rating.

3.8 MULTIPLE CHANNEL PREWIRED RACEWAY

- A. Raceway shall be installed with all appropriate fittings in accordance with the manufacturer's installation instructions and in compliance with all appropriate codes. Raceway is to be plumb, square, level and in alignment with casework or furniture as required.

3.9 INSTALLATION REQUIREMENTS FOR UNDERGROUND DIRECT BURIAL CONCRETE-ENCASED RACEWAYS

- A. Coordinate installation of underground raceways with other outside and building construction work. Maintain existing outside utilities in operation unless otherwise authorized by the Engineer.

- B. Remove entirely and properly reinstall all raceway installations not in compliance with these requirements.
- C. Do not use union type fittings underground.
- D. Provide a minimum cover of 2 feet over all underground raceways unless otherwise indicated.
- E. Where a concrete-encased duct bank is installed over an extensive area of disturbed earth such as that within the periphery of a building, provide a separate concrete base under the duct bank to ensure stability of raceways during installation. Allow this base to set before the duct bank is installed.
- F. Do not backfill underground direct burial and concrete-encased raceways until they have been inspected by the Engineer.
- G. Warning Tapes: Bury warning tapes approximately 12 inches above all underground conduit runs or duct banks. Align parallel to and within 12 inches of the centerline of runs.

3.10 SEPARATION AND SUPPORT

- A. Separate parallel runs of two or more raceways in a single trench with preformed, nonmetallic spacers designed for the purpose. Install spacers at intervals not greater than that specified in the NEC for support of the type raceways used, and in no case greater than 10 feet.
- B. Support raceways installed in fill areas to prevent accidental bending until backfilling is complete. Tie raceways to supports, and raceways and supports to the ground, so that raceways will not be displaced when concrete encasement or earth backfill is placed.

3.11 ARRANGEMENT AND ROUTING

- A. Arrange multiple conduit runs substantially in accordance with any details shown on the Drawings. Locate underground conduits where indicated on the Drawings.
- B. Make minor changes in location or cross-section as necessary to avoid obstructions or conflicts. Where raceway runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, refer the condition to the Engineer for instructions before further work is done.
- C. Where other utility piping systems are encountered or being installed along a raceway route, maintain a 12-inch minimum vertical separation between raceways and other systems at crossings. Maintain a 12-inch minimum separation between raceways and other systems in parallel runs. Do not place raceways over valves or couplings in other piping systems. Refer conflicts with these requirements to the Engineer for instructions before further work is done.

- D. Provide insulated grounding bushings on all metallic raceways entering handholes. Provide bell-ends flush with handhole walls on all nonmetallic raceways entering handholes.
- E. Provide markers at grade to indicate the direction of underground conduits provided under this Contract. Provide markers consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction. Provide markers at all bends and at intervals not exceeding 100 feet in straight runs. Use markers made of sheet bronze not less than 1/4-inch thick embedded in and secured to the top of concrete posts. Use markers not less than 10 inches long and 3/4-inch wide and marked ELECTRIC CABLES in letters 1/4 inch high incised into the bronze to a depth of 3/32 inch.
- F. All conduits shall enter handholes and structures at right angles.
- G. Raceway Coating: Coat all metallic conduit embedded in the slab or buried under the slab and a minimum 6-inch coating length where metallic conduit exits concrete or ground. Coating shall be a bitumastic coating with a final coat thickness a minimum of 10mils.

3.12 DIRECT EARTH BURIAL CONDUIT ZONE BACKFILL INSTALLATION

- A. Backfill material for the conduit zone of direct burial conduit trenches may be selected from the excavated material if it is free from roots, foreign material, and oversized particles. Use material with 3/4-inch maximum particle size and suitable gradation for satisfactory compaction. Remove material if necessary to meet these requirements.
- B. Imported 3/4-inch minus gravel or sand may be used in lieu of material from the excavation.
- C. After conduits have been properly installed, backfill the trench with specified material placed around the conduits and carefully tamped around and over them with hand tampers. Final, tamped conduit cover shall be 4 inches minimum.

3.13 CONCRETE ENCASEMENT

- A. Concrete for electrical conduit encasement shall be standard mix with pea gravel aggregate, with admixture to produce red color. Admixture shall be 3% by weight of pure synthetic red iron oxide uniformly mixed into the concrete. Use 3,000 psi concrete as specified in Section 03000, Concrete.
- B. Maintain a grade of at least 4 inches per 100 feet, either from one handhole or pull box to the next, or from a high point between them, depending on the surface contour.
- C. Hold conduits for concrete-encased raceways securely in place by acceptable window type spacer supports. Where, in the opinion of the Engineer, ground conditions are such as to require concrete forms, install forms constructed of materials and in a manner acceptable to the Engineer. No variations greater than 1/2 inch in 50 feet will be permitted from a straight line.

- D. Envelopes may be poured directly against the sides of trenches if the cut is clean, even, and free of loose material. Remove loose material from trenches before and during pouring of concrete to ensure sound envelopes. Carefully spade concrete during pouring to eliminate all voids under and between raceways and honeycombing of the exterior surface.
- E. Do not use power-driven tampers or agitators unless they are specifically designed for the application, in order to ensure that the watertight integrity of the raceways is maintained.
- F. Generally, pour an entire concrete envelope in one continuous pour. Where more than one pour is necessary, terminate each pour in a sloped plane, and insert 3/4-inch reinforcing rod dowels extending into the concrete 18 inches minimum on each side of the joint. Obtain Engineer's approval for the number and location of dowels.
- G. Provide reinforcement where envelopes connect to handholes or building structures to prevent shearing of joints.

3.14 BACKFILL INSTALLATION

- A. Above Conduit Zone of Direct Burial Conduit or Above Concrete Envelope of Concrete Encased Conduit: Backfill material above the conduit zone of direct burial conduit or above concrete envelope of concrete-encased conduit may be selected from the excavated material, if it contains no particles larger than 3 inches in diameter and is free from roots or debris. Imported material meeting these same requirements may be used in lieu of material from the excavation. Compact backfill in maximum 12-inch layers to at least 95 percent of the maximum density at optimum moisture content as determined by AASHTO T 180.

3.15 HANDHOLES

- A. Install handholes where shown on the Drawings. Provide excavation, shoring, bracing, backfilling, grading, etc., in accordance with requirements specified elsewhere in these Contract Documents.
- B. Do not install handholes until final conduit grading, including field changes necessitated by underground interferences, has been determined. Set frames to final grades as required.
- C. Make installation so that raceways enter handholes at nearly right angles and as near as possible to one end of a wall, unless otherwise indicated.
- D. Install one ground rod in each handhole. Connect all noncurrent-carrying metal parts in the handhole and any metallic raceway grounding bushings to this ground rod with No. 6 AWG (minimum) copper conductor.

3.16 WIREWAYS

- A. Mount wireways securely in accordance with the NEC and manufacturer's instructions. Locate removable cover or hinged cover on accessible vertical face of wireway unless otherwise indicated.

3.17 PREPARATION FOR PULLING IN CONDUCTORS

- A. Do not install crushed or deformed raceways. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
- B. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors.
- C. For concrete-encased raceways, after the concrete envelope has set, pull a mandrel of a diameter approximately 1/4 inch less than the raceway inside diameter, through each raceway. Then pull a bristle brush through each raceway to remove debris.

3.18 EMPTY RACEWAYS

- A. Certain raceways may have no conductors pulled in as part of this Contract. Identify with tags at each end and at any intermediate pull point the origin and destination of each such empty raceway. Where a raceway has been identified with a name (number) in a Raceway Schedule, use that name on the tag in lieu of origin and destination. Provide a removable permanent cap over each end of each empty raceway. Provide a nylon pull cord in each empty raceway.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section covers the work necessary to furnish and install, complete, electrical conductor systems.

1.2 RELATED SECTIONS

- A. Section 16010 - Electrical - General Provisions
- B. Section 16075 - Electrical Identification

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Provide complete manufacturers' descriptive information and shop drawings for equipment, material, and devices furnished.

1.5 CONDUCTOR IDENTIFICATION SYSTEM

- A. Provide complete power and control conductor identification system so that after installation, circuits can be easily traced from origin to final destination.
- B. Identify power and control conductors with preselected circuit name at each termination and in all accessible locations such as handholes, panels, switchboards, pull boxes, terminal boxes, etc. For identification, use type of tags specified herein.
- C. Tag circuits by using the circuit name in the Circuit Schedule if given.
- D. For circuits that do not appear in the Circuit Schedules or if a circuit schedule is not given, assign a circuit name based on the device or equipment at the load end of the circuit. Where this would result in the same name being assigned to more than one circuit, add a number or letter to each otherwise identical circuit name to make it unique.
- E. Before tagging the circuits, submit a list of circuit names to the Engineer for approval prior to any use of that list. Include in this list circuit names not appearing in the Circuit Schedules, along with the same circuit information as is given for circuits in the Schedules if a schedule is given.
- F. Change any circuit name that the Engineer finds unacceptable.

1.6 CONDUCTOR COLOR CODING

- A. Color coding of multiconductor control and instrumentation cable is specified in the individual cable type specification.
- B. For power conductors, provide all single conductors and individual conductors of multiconductor power cables with integral insulation pigmentation of the designated colors, except conductors larger than No. 6 AWG may be provided with color coding by wrapping the conductor at each end and at all accessible locations with vinyltape. Where this method of color coding is used, wrap at least six full overlapping turns of tape around the conductor covering an area 1-1/2 to 2 inches wide at a visible location.
- C. Phase A, B, C implies the direction of positive phase rotation.

D. Use the following colors:

<u>System</u>	<u>Conductor</u>	<u>Color</u>
All systems	Equipment Grounding	Green
208Y/120 volts	Grounded neutral	White
3-phase, 4-wire, and circuits derived therefrom without transformation	Phase A	Black
	Phase B	Red
	Phase C	Blue
480Y/277 volts	Grounded neutral	White, Black Tracer
3-phase, 4-wire, and circuits derived therefrom without transformation	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow

PART 2 PRODUCTS

2.1 GENERAL

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered in accordance with the General Conditions.

2.2 CONDUCTORS

- A. Conductors 600 Volts and Below:
 - 1. Unless otherwise indicated, provide stranded conductors, except provide solid conductors where No. 10 AWG and No. 12 AWG are designated for branch circuit power wiring in lighting and receptacle circuits.

2. Utilize only conductors meeting applicable requirements of NEMA WC 3, WC 5, WC 7, and ICEA S-19-81, S-61-402, and S-66-524.
3. Provide conductors with Type THHN/THWN insulation, except for sizes No. 6 and larger, provide conductors with XHHW insulation.
4. Provide copper conductors. Unless noted otherwise, conductor sizes indicated are based on copper conductors. Do not provide conductors smaller than those indicated.
5. For direct burial conductors and cables, provide conductors with UL labeling "TYPE USE" and RHW insulation with heavy-duty, black, neoprene sheath meeting the physical requirements and minimum thickness requirements of ICEA S-19-81 and NEMA WC 3.
6. Where flexible cords and cables are specified, provide Type SO, 600 volt, with the number and size of copper conductors as required.

2.3 CONDUCTORS ACCESSORIES (LOW VOLTAGE)

- A. Splices for No. 10 and smaller wire shall be self-insulated crimp connectors, Thomas & Betts Sta-Kon, Burndy Insulink, or equal. Splices and terminations for No. 8 and larger wire shall be wide range compression type, designed for installation with a dieless tool and shall be Square D VERSAtile connectors, or equal. Terminations for No. 10 and smaller wire shall be self-insulating crimp connectors, which lock to a screw head and shall be Thomas & Betts Sta-Kon Locking Spade, Burndy Vinylug Flanged-Fork-Tongue Terminal, or equal. Tools for installing the above connectors shall be designed for a complete, controlled crimp and shall not release until the connection is completed. Such tools shall be Thomas & Betts Shure-Stake, Burndy Hytool MR8, Square D VERSA-CRIMP tool, or equal.
- B. Wire ties shall be Thomas & Betts Ty-Rap Cable Ties, or equal. Where wire or cord is exposed, Thomas & Betts Ty-Rap Lashing Ties, or equal, shall be used. Cords shall terminate in Thomas & Betts Liquid Tight Strain Relief Connectors, or equal. Where hubs would be required for cord connections Thomas and Betts Chase Liquid Tight Cord Connectors, or equal, shall be used.

2.4 MULTI-CONDUCTOR CABLE

- A. Provide cable that is UL listed Type TC and conforms to the requirements of UL 1277 and NEC Article 340, or UL listed Power Limited Circuit Cable that conforms to the requirements of Article 725 of the National Electrical Code. Provide cables permanently and legibly marked with the manufacturer's name, the maximum working voltage for which the cable was tested, the type of cable, and labeled UL (or submit evidence of UL listing).
- B. Provide cables as specified under the type number in this section (Type 1, Type 2, etc.). Conduits shown on the Drawings and in the Circuit/Raceway Schedule have been sized to accommodate the outside diameter for each type. For this reason, use cable diameters equal to or less than the diameters specified.

- 1. Type 1 (600-Volt Multi-Conductor Control Cable, Type TC):
 - a. General: Multi-conductor control circuit interconnection cable with ground. Suitable for installation in open air, in cable trays, conduit, or other approved raceways. Minimum cable temperature rating 90 degrees C dry locations, 75 degrees C wet locations. Passes vertical tray flame test.
 - b. Individual Conductors: No. 14 AWG, 7-strand copper.
 - c. Insulation and Jackets: Provide conductors having 15-mil PVC insulation with 4-mil nylon jacket, and UL listed as Type THHN/THWN. Color code the conductor group in accordance with ICEA S-61-402, Appendix K, Method 1, Table K-2. Include one full size green equipment grounding conductor. Bind conductor group with a spiral wrap of barrier tape. Provide cable with overall outer PVC jacket, which is flame-retardant, sunlight- and oil resistant, and has a nominal thickness as shown in the table below.
 - d. Use only 7-, 12-, 19- and 25-conductor cables. The green grounding conductor is included in the number of conductors shown in the table below.

No. of Conductors	Max. Outside Diameter (inches)	Jacket Thickness (mils)
7	0.48	45
12	0.65	60
19	0.76	60
25	0.93	60
 - e. Manufacturers: The Okonite Company, Pome Cable, or approved equal.

- 2. Type 3 (600-Volt No. 16 AWG Twisted, Shielded Pair Instrumentation Cable, Type TC):
 - a. General: Single pair instrumentation cable designed for noise rejection for process control, computer, or data log applications. Suitable for installation in cable trays, conduit, or other approved raceways. Minimum cable temperature rating shall be 90 degrees C dry locations, 75 degrees C wet locations.
 - b. Individual Conductors: Bare soft annealed copper, Class B, 7-strand concentric per ASTM B 8; 20 AWG, 7-strand tinned copper drain wire.
 - c. Insulation and Jacket: Each conductor 15-mil nominal PVC and 4-mil nylon insulation. Pair conductors pigmented black and red. Jacket flame-retardant and sunlight- and oil-resistant PVC with 45 mils nominal thickness. Shield 1.35-mil aluminum/mylar overlapped to provide 100 percent coverage.
 - d. Dimension: 0.31 inch nominal OD.
 - e. Manufacturers: The Okonite Company, Alpha Wire Corporation, or approved equal

2.5 CONDUCTOR AND CABLE TAGS

- A. Tags relying on adhesives or taped-on markers are not acceptable.
- B. Provide conductor tags for conductors No. 12 AWG and below with legible permanent sleeve of yellow or white PVC with machine printed black marking.
- C. Provide tags for cables, and for conductors No. 10 AWG and larger, consisting of permanent nylon marker plates with legible designations hot stamped on the plate. Attach these marker plates to conductors and cables with nylon tie cord.

2.6 EQUIPMENT GROUNDING CONDUCTORS

- A. Provide stranded copper conductors, as indicated or as required by NEC, for equipment grounding.
- B. Provide conductors bare or with green covering.

2.7 DIRECT BURIED GROUNDING CONDUCTORS

- A. Provide bare stranded copper conductors, size as indicated, for the ground system at transformers, switchgear, and where indicated.
- B. Copper-clad steel conductor of equivalent capacity and surface area may be substituted if accepted by the Engineer.

2.8 FIBER OPTICS CABLE AND TERMINATIONS

- A. Fiber optics cable shall be 62.5/125 micron, 12-fiber minimum, OFNP/FT-6 listed, UV-resistant, and fully water blocked. Fiber optics cable shall be suitable for indoor or outdoor installation. Fiber optics cable shall be suitable for duct and aerial with no need for a transition splice when entering the building.
- B. Fiber optics cable shall be Corning FREEDM One Plenum cable.

PART 3 EXECUTION

3.1 GENERAL

- A. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. Where pulling compound is used, use only UL listed compound compatible with the cable outer jacket and with the raceway involved.
- B. Wires shall be gripped either directly or by basket weave pulling grips. Pulling force shall not exceed 0.008 pounds per circular mill cross section. Pull around bends shall not exceed 300 pounds per foot of bend radius.
- C. Conductors shall not be bent tighter than a bending radius of eight (8) cable diameters.

- D. Tighten all screws and terminal bolts using torque type wrenches and/or drivers to tighten to the inch-pound requirements of the NEC and UL.
- E. Where single conductors and cables in handholes, junction boxes, and similar locations are not wrapped together by some other means such as are and fireproofing tapes, bundle throughout their exposed length all conductors entering from each conduit with nylon, self-locking, releasable, cable ties placed at intervals not exceeding 12 inches on centers.
- F. Run conductors as indicated on the Drawings, with no splices except as indicated or accepted by the Engineer.

3.2 CONDUCTOR 600 VOLTS AND BELOW

- A. Provide conductor sizes indicated on Drawings.
- B. Wire nuts may be used on solid conductors of 120-volt lighting and receptacle circuits only. Place no more than one conductor in any single barrel pressure connector. Use crimp connectors with tools by same manufacturer and/or UL listed for connectors of all stranded conductors.
- C. Vinyl plastic insulating tape for wire and cable splices and terminations shall be flame retardant, 7-mil thick minimum, rated for 90°C minimum meeting the requirements of UL 510.
- D. Where conductors pass through holes or over edges in sheet metal, remove all burrs, chamfer all edges, and install bushings and protective strips of insulating material to protect the conductors.
- E. Arrange wiring in cabinets, panels, and motor control centers neatly cut to proper length, remove surplus wire, and bridle and secure in an acceptable manner. Identify all circuits entering motor control centers or other control cabinets in accordance with the conductor identification system specified herein.
- F. Where interlocked armor cables enter enclosures or splice boxes, they shall be terminated with properly sized Adalet PLM Type JAG armored cable fittings.

3.3 JOINTS AND TERMINATIONS (LOW VOLTAGE)

- A. All joints, splices, terminations, or other conductor connections shall be compression type, installed with an approved tool. Connections to motor terminals through 15 horsepower may be by rubber wrap cap. Connections to motor terminals above 15 horsepower shall be by tape insulated split bolt connectors. Wire up through No. 1/0 may be terminated directly in tubular clamps and set screw connectors, where provided by the manufacturer. Wire up through Size 14 may also be terminated in saddle clamps, where provided by the manufacturer. All other terminations shall be in a specified connector.
- B. Soldered mechanical joints will not be acceptable.

- C. Terminate control and instrumentation wiring with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions. Where terminals provided will accept such lugs, terminate all control and instrumentation wiring (except solid thermocouple leads) with insulated, locking-fork compression lugs, Thomas & Betts Sta-Kon, or equal.
- D. For terminals designed to accept only bare wire compression terminations, use only stranded wire, and terminate only one wire per terminal. Tighten all terminal screws with torque screwdriver to recommended torque values.
- E. Attach compression lugs with a tool specifically designed for that purpose which provides a complete, controlled crimp where the tool will not release until the crimp is complete. Use of plier type crimpers is not acceptable.
- F. For conductors that will be connected by others, provide at least 6 feet spare conductor in freestanding panels and at least 2 feet spare in other assemblies. Provide spare conductors in any particular assembly, where it is obvious that more conductors will be needed to reach the termination point.

3.4 CABLES

- A. Do not splice without permission of the Engineer. Locate splices, when permitted, only in readily accessible cabinets or junction boxes using terminal strips.
- B. Where connections of cables installed under this section are to be made under Section 13400 INSTRUMENTATION, leave pigtailed of adequate length for neat bundled type connections.
- C. Maintaining the integrity of shielding of instrumentation cables is essential to the operation of the control systems. Take special care in cable installation to ensure that grounds do not occur because of damage to the jacket over the shield.
- D. Where conductors carrying both discrete and analog signals are run in the same item, such as a box or handhole, route analog and discrete conductors on the opposite side of the item, maintaining as much separation as possible.

3.5 CONDUCTOR ARC AND FIREPROOFING TAPES

- A. Use arc and fireproofing tapes on all 600-volt single conductors and cables except those rated Type TC at splices in all manholes, handholes, vaults, cable trays, and other indicated locations.
- B. Wrap together as a single cable all conductors entering from each conduit.
- C. Follow tape manufacturer's installation instructions. Secure the arc and fireproofing tape at frequent intervals with bands of the specified glass cloth electrical tape. Make each band of at least two wraps of tape directly over each other.

3.6 FIELD QUALITY CONTROL

- A. Medium Voltage Cable Testing:
1. Perform a high voltage dc leakage test on all new 5 kV and 15 kV cable immediately after installation
 2. Tests shall be performed by an electrical engineer specializing in electrical cable testing
 3. Complete all terminations, connections, and splices prior to testing
 4. Isolate cables from all equipment prior to testing
 5. Utilize the test voltages and durations recommended by IPCEA for the particular cable construction
 6. Record results on forms similar to the sample included in this specification
 7. Replace conductors which do not meet IPCEA or manufacturer's specifications
- B. Low Voltage Cable Testing:
1. Test 600 V power cables for continuity and freedom from short circuits and ground, except where grounding is intentional immediately after installation
 2. Test all circuits with a 500 V megger or its equivalent
 3. Replace conductors which read less than 1.5 Megohms between conductors and ground
- C. Instrumentation Cable: After instrumentation cable installation and conductor termination per the recommendations of the instrumentation and control supplier, perform tests witnessed by the Engineer to ensure that instrumentation cable shields are isolated from ground, except at the grounding point. Remove all improper grounds.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Floor boxes.
- C. Pull and junction boxes.

1.2 RELATED SECTIONS

- A. Section 16050 - Basic Materials and Methods
- B. Section 16110 - Raceways
- C. Section 16120 - Conductors

1.3 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- D. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 GENERAL

- A. Boxes shall be the type, size and configuration required for its specific use, location, device or fixture to be mounted in or on the box, and number, size and arrangement of raceways connecting thereto.

2.2 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel, unless otherwise specified herein.
- B. Where install exposed to a corrosive atmosphere, rain or spray, boxes shall be corrosion-resistant cast metal with threaded entrances, removable covers, gaskets, and corrosion-resistant screws.
- C. Recessed boxes in plaster or gypsum board walls or columns shall be 4" or 4.688" square, 2.125" deep with plaster rings.
- D. Surface-mounted boxes on walls or columns shall be 4" square, 2.125" deep, with no plaster rings or knock-outs.
- E. Switch boxes with only one conduit entrance shall be single gang.
- F. Boxes for devices recessed in metal door jambs shall be sheet metal partition boxes sized for the application.
- G. Recessed boxes in masonry walls shall be square cornered masonry boxes or standard 4" square boxes fitted with square cornered tile covers of proper depth for block. Both type boxes shall be 2.125" minimum depth.
- H. Recessed boxes in ceilings shall be 4" octagonal or square, 2.125" depth.
- I. Recessed boxes in concrete shall be UL approved for the application.
- J. Through-wall type boxes are not acceptable.
- K. Recessed wall telephone and data boxes shall be 4" deep with single-gang device plaster covers and coverplates.
- L. Provide specially designed boxes where required for special devices.
- M. Boxes containing low voltage and line voltage devices or multiple 277V switches, supplied from different phases, shall have metal barriers.
- N. Boxes for surface-mounted luminaires shall have fixture studs.

- O. Manufacturers: Appleton, Crouse-Hinds, Efcor, Midland Ross, O-Z/Gedney, Raco, or Steel City.

2.3 FLOOR BOXES

- A. Floor boxes for slabs on grade shall be zinc-coated cast iron with integral threaded conduit openings.
1. Boxes shall be watertight, fully adjustable, and constructed to prevent the free entrance of water when the box is embedded in concrete.
 2. Boxes shall be provided with a minimum of 2 integral leveling screws for rough leveling. Adjusting rings shall provide a minimum 0.75" vertical or angular adjustment of the top after concrete pour and installation of wiring devices.
- B. A cap shall be provided over the top of each box to protect adjusting ring during concrete pour.
- C. Floor plates shall be of aluminum construction, configuration as indicated on the Drawings.
- D. Carpet flanges shall be of aluminum construction.
- E. Manufacturer: Crouse-Hinds, Hubbell, Pyle National, Steel City, or Thomas & Betts.

2.4 PULL AND JUNCTION BOXES

- A. Non-Corrosive Areas
1. Boxes shall be constructed of type 5052 H-32 Aluminum unless otherwise indicated on the drawings or specified herein. Boxes shall be of dimensions as required by number and size of connection raceways and wire, and as required by NFPA 70.
 2. Boxes shall be provided with continuous hinge door with stainless steel door clamp assemblies.
 3. Boxes shall be NEMA 4X with Oil-resistant gasket.
 4. Manufacturers: Hoffman or approved equal.
- B. Corrosive Areas (Chemical Building & Tank Farm)
1. Boxes shall be constructed of type 304 Stainless Steel unless otherwise indicated on the drawings or specified herein. Boxes shall be of dimensions as required by number and size of connection raceways and wire, and as required by NFPA 70.
 2. Boxes shall be provided with continuous hinge door with stainless steel door clamp assemblies.
 3. Boxes shall be NEMA 4X with Oil-resistant gasket.
 4. Manufacturers: Hoffman or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify locations of floor boxes and outlets in offices prior to rough-in. Coordinate with architect/engineer so boxes match with furniture layout.

3.2 INSTALLATION

- A. Install boxes in accordance with NECA "Standard of Installation."
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Set wall mounted boxes at elevations to accommodate mounting heights as indicated.
- D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
- E. Orient boxes to accommodate wiring devices oriented as specified or shown on drawings.
- F. Maintain headroom and present neat mechanical appearance.
- G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- I. Install boxes to preserve fire resistance rating of partitions and other elements.
- J. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- K. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- L. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- M. Use flush mounting outlet box in finished areas.
- N. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- O. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches (150 mm) separation. Provide minimum 24 inches (600 mm) separation in acoustic rated walls.
- P. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

- Q. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- R. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- S. Use adjustable steel channel fasteners for hung ceiling outlet box.
- T. Do not fasten boxes to ceiling support wires.
- U. Support boxes independently of conduit.
- V. Use gang box where more than one device is mounted together. Do not use sectional box.
- W. Use gang box with plaster ring for single device outlets.
- X. Use cast outlet box in exterior locations exposed to the weather and wet locations.
- Y. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
- Z. Set floor boxes level.
- AA. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate installation of outlet box with wire/cable and raceway installation.
- B. Coordinate box installation with other trades so that boxes will remain accessible.

3.4 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes metal-enclosed, low-voltage power circuit-breaker switchgear rated 1000 V and less for use in ac systems.

1.2 RELATED SECTIONS

- A. Section 03000 - Concrete
- B. Section 16075 - Electrical Identification

1.3 REFERENCES

- A. IEEE C37.13
- B. IEE C37.20.1
- C. IEEE C37.90
- D. IEEE C57.13
- E. IEEE 62.11
- F. NECA 400
- G. NFPA 70

1.4 SUBMITTALS

- A. Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated.
- B. Shop Drawings: For each type of switchgear and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that switchgear, overcurrent protective devices, accessories, and components will withstand seismic forces defined for this project region including the following:
 - 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

- a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces and the unit will be fully operational after the seismic event."
 2. Dimensioned Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based.
- D. Field quality-control test reports.
- E. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Cutler-Hammer.
 2. General Electric Company.
 3. Siemens.
 4. Square D.

1.7 RATINGS

- A. Nominal System Voltage: 480 V, 3-wire, 60 Hz.
- B. Short-Time and Short-Circuit Current: Match rating of highest-rated circuit breaker in switchgear assembly.

1.8 FABRICATION

- A. Factory assembled and tested and complying with IEEE C37.20.1.
- B. Indoor Enclosure: Steel with removable, hinged, rear cover panels to allow access to rear interior of switchgear.

1. Section barriers between main and circuit-breaker compartments shall be extended to rear of section.
 2. Bus isolation barriers shall be arranged to isolate line bus from load bus at each main circuit breaker.
 3. Circuit-breaker compartments shall be equipped to house drawout-type circuit breakers and shall be fitted with hinged outer doors.
 4. Finish: IEEE C37.20.1, manufacturer's standard gray finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.
 5. Auxiliary Compartments: Match and align with basic switchgear assembly. Include the following:
 - a. Power monitor and metering compartment.
 - b. Bus transition sections.
 - c. Incoming-line pull sections.
 - d. Hinged front panels for access to metering, accessory, and blank compartments.
- C. Bus bars connect between vertical sections and between compartments. Cable connections are not permitted.
1. Neutral Bus: None required.
 2. Phase-Bus Material: Tin-plated copper.
 3. Circuit-Breaker Line Connections to Phase Bus: Use copper for connecting to copper bus.
 4. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.
 5. Ground Bus: Hard-drawn tinned copper of 98 percent minimum conductivity, with pressure connector for feeder and branch-circuit ground conductors, minimum size 1/4 by 2 inches.

1.9 COMPONENTS

- A. Instrument Transformers: Comply with IEEE C57.13.
1. Potential Transformers: Secondary-voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens as required.
 2. Current Transformers: Ratios as required; burden and accuracy class suitable for connected relays, meters, and instruments.
- B. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three wire systems and with the following features:
1. Switch-selectable digital display of the following:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Three-Phase Real Power: Plus or minus 2 percent.
 - e. Three-Phase Reactive Power: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.

- h. Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
 - i. Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
 - 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
- C. Relays: Comply with IEEE C37.90, types and settings as indicated; with test blocks and plugs.
- D. Surge Arresters: Distribution class, metal-oxide-varistor type. Comply with IEEE C62.11 and NEMA LA 1.
 - 1. Install in cable termination compartments and connect in each phase of circuit.
- E. Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.
- F. Control Power Supply: Control power transformer supplying 120-V control circuits through secondary disconnect devices. Include the following features:
 - 1. Dry-type transformers, in separate compartments for units larger than 3 kVA, including primary and secondary fuses.
 - 2. Control Power Fuses: Primary and secondary fuses with current-limiting and overload protection.
- G. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:
 - 1. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges and for conductors for interconnections between shipping units.
 - 2. Conductors sized according to NFPA 70 for duty required.

1.10 CIRCUIT BREAKERS

- A. Description: Comply with IEEE C37.13.
- B. Ratings: As indicated for continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear. All breakers shall be 100% rated.
- C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:
 - 1. Normal Closing Speed: Independent of both control and operator.
 - 2. Slow Closing Speed: Optional with operator for inspection and adjustment.
 - 3. Stored-Energy Mechanism: Manually charged.
 - 4. Operation counter.

- D. Trip Devices: Solid-state, overcurrent trip-device system consisting of one or two current transformers or sensors per phase, a release mechanism, and the following features:
1. Functions: Long-time-delay, short-time-delay, ground-time-delay, and instantaneous-trip functions, independent of each other in both action and adjustment.
 2. Temperature Compensation: Ensures accuracy and calibration stability from minus 5 to plus 104 deg f.
 3. Field-adjustable, time-current characteristics.
 4. Current Adjustability: Dial settings and rating plugs on trip units or sensors on circuit breakers, or a combination of these methods.
 5. Three bands, minimum, for long-time- and short-time-delay functions; marked "minimum," "intermediate," and "maximum."
 6. Pickup Points: Five minimum, for long-time- and short-time-trip functions. Equip short-time-trip function for switchable I^2t operation.
 7. Pickup Points: Five minimum, for instantaneous-trip functions.
 8. Ground-fault protection with at least three short-time-delay settings and three trip-time-delay bands; adjustable current pickup. Arrange to provide protection for the following:
 - a. Three-wire, double-ended substation.
 9. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
- E. Auxiliary Contacts: Two Type "a" and two Type "b" contacts wired through secondary disconnect devices to a terminal block in stationary housing.
- F. Drawout Features: Circuit-breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, and disconnected positions. Include the following features:
1. Interlocks: Prevent movement of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test, or disconnected position.
 2. Circuit-Breaker Positioning: An open circuit breaker may be racked to or from connected, test, and disconnected positions only with the associated compartment door closed unless live parts are covered by a full dead-front shield. An open circuit breaker may be manually withdrawn to a position for removal from the structure with the door open. Status for connection devices for different positions includes the following:
 - a. Test Position: Primary disconnect devices disengaged, and secondary disconnect devices and ground contact engaged.
 - b. Disconnected Position: Primary and secondary devices and ground contact disengaged.
- G. Arc Chutes: Readily removable from associated circuit breaker when it is in disconnected position and arranged to permit inspection of contacts without removing circuit breaker from switchgear.

- H. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of drawout mechanism.
- I. Operating Handle: One for each circuit breaker capable of manual operation.
- J. Electric Close Button: Not required.
- K. Key Interlocks: Arranged so keys are attached at devices indicated on contract drawings. Mountings and hardware are included where future installation of key-interlock devices is indicated.
- L. Undervoltage Trip Devices: Where indicated on contract drawings.
- M. Undervoltage Trip Devices: Where indicated on contract drawings.
- N. Shunt-Trip Devices: Where indicated on contract drawings.

1.11 ACCESSORIES

- A. Accessory Set: Furnish tools and miscellaneous items required for circuit-breaker and switchgear test, inspection, maintenance, and operation.
 - 1. Racking handle to manually move circuit breaker between connected and disconnected positions.
 - 2. Portable test set for testing all functions of circuit-breaker, solid-state trip devices without removal from switchgear.
 - 3. Relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.
- B. Circuit-Breaker Removal Apparatus: Portable, floor-supported, roller-base, elevating carriage arranged for moving circuit breakers in and out of compartments.
- C. Circuit-Breaker Removal Apparatus: Overhead-circuit-breaker lifting device, track mounted at top front of switchgear and complete with hoist and lifting yokes matching each size of drawout circuit breaker installed.
- D. Spare-Fuse Cabinet: Identified and compartmented steel box or cabinet with lockable door.
- E. Storage for Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

PART 2 EXECUTION

2.1 INSTALLATION

- A. Comply with applicable portions of NECA 400.

- B. Anchor switchgear assembly to 4-inch, channel-iron floor sill embedded in concrete base and attach by bolting.
 - 1. Sills: Select to suit switchgear; level and grout flush into concrete base.
 - 2. Design each fastener and support to carry load as required.
 - 3. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 3 inches in all directions beyond the maximum dimensions of switchgear unless otherwise indicated. Construct concrete bases according to Section 3000, Concrete.

2.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 16075, Electrical Identification.
- B. Diagram and Instructions:
 - 1. Frame and mount under clear acrylic plastic label on the front of switchgear.
 - a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
 - 2. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

2.3 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1. Inspect switchgear installation, including wiring, components, connections, and equipment. Test and adjust components and equipment.
 - 2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 16 Sections.
 - 3. Complete installation and startup checks according to manufacturer's written instructions.
 - 4. Assist in field testing of equipment including pretesting and adjusting of equipment and components.
 - 5. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:
 - a. Switchgear.

- b. Circuit breakers.
 - c. Protective relays.
 - d. Instrument transformers.
 - e. Power monitor/metering and instrumentation.
 - f. Ground-fault systems.
 - g. Surge arresters.
2. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section covers the work necessary to furnish and install, complete, the low-voltage fused and non-fused switches as specified herein and as shown on the contract drawings.

1.2 RELATED SECTIONS

- A. Section 16050 - Basic Materials and Methods
- B. Section 16075 - Electrical Identification
- C. Section 16450 - Grounding

1.3 REFERENCES

- A. NEMA KS-1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)
- B. UL-98 - Enclosed and Dead-Front Switches

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. The following information shall be submitted to the Engineer:
 - 1. Dimensioned outline drawing
 - 2. Conduit entry/exit locations
 - 3. Switch ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 - 4. Fuse ratings and type
 - 5. Cable terminal sizes
 - 6. Product data sheets

1.5 QUALIFICATIONS

- A. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

1.6 REGULATORY REQUIREMENTS

- A. The safety switches shall bear a UL label.

1.7 DELIVERY

- A. Storage and Handling: Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- 1. Cutler-Hammer
 - 2. Square D
 - 3. GE
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 HEAVY-DUTY SAFETY SWITCHES

- A. Provide switches as shown on drawings, with the following rating:
 - 1. 30 to 1200 amperes
 - 2. 250 volts AC, DC; 600 volts AC (30A to 200A 600 volts DC)
 - 3. 2, 3, 4, and 6 poles
 - 4. Fusible and non-fusible
 - 5. Mechanical lugs suitable for aluminum or copper conductors.
- B. Construction:
 - 1. Switch blades and jaws shall be visible and plated copper.
 - 2. Switches shall have a red handle that is easily padlockable with three 3/8-inch shank locks in the OFF position.
 - 3. Switches shall have defeatable door interlocks that prevent the door from opening when the handle is in the ON position. Defeater mechanism shall be front accessible.
 - 4. Switch assembly and operating handle shall be an integral part of the enclosure base
 - 5. Switches rated 30A to 600A shall have reinforced fuse clips.
 - 6. Switch blades shall be readily visible in the ON and OFF position.
- C. Switch operating mechanism shall be non-teasable, positive quick-make/quick-break type. Bail type mechanisms are not acceptable.
- D. Fusible switches shall be suitable for service entrance equipment.
- E. Switches shall have line terminal shields.
- F. Suitable for systems capable of 200 kA at 480V with Class J, L, R, or T fusing as applicable.

- G. Embossed or engraved ON-OFF indication shall be provided.
 - H. Double-make, double-break switch blade feature shall be provided.
 - I. Fuse pullers shall be provided on all NEMA 4X and 12 switches through 200A.
 - J. Renewal parts data shall be shown on the inside of the door.
 - K. All switches shall be manufactured in the USA.
 - L. Enclosures:
 - 1. All enclosures shall be NEMA 1 general purpose unless otherwise noted.
 - 2. Other types, where noted, shall be:
 - a. NEMA 3R rainproof
 - b. NEMA 4 watertight (800A max.)
 - c. 30A to 200A – 304 stainless steel
 - d. 400A to 800A – 304 stainless steel
 - e. NEMA 12 dust-tight and oil-tight special industry (800A max.).
 - M. Paint color shall be ANSI 61 gray.
 - N. 30A to 100A NEMA 4, 4X, and 12 enclosures shall be provided with draw-pull latches.
 - O. All Safety Switches shall be of the heavy-duty type unless noted otherwise on drawings.
- 2.3 ENCLOSED ROTARY DISCONNECT SWITCHES
- A. Provide 16–80A ampere rotary disconnect switches as shown on the drawings with the following ratings and characteristics:
 - 1. Padlockable in the OFF position (up to three padlocks) to meet OSHA lockout requirements.
 - 2. Available in 16–80A ratings
 - 3. 600 Vac, three- and four pole non-fusible device
 - 4. Rated for making and breaking loads
 - 5. Accepts auxiliary contacts; capability to signal PLC controllers
 - 6. Ground lug connection provided
 - 7. Possibility of adding one power pole and one auxiliary contact
 - 8. NEMA® Type 1, 3R, 12, 4, and 4X
 - 9. Non-fusible switches shall be suitable for use on a circuit capable of delivering up to 10,000A, 1000Vdc.
 - 10. Switches shall have a factory-installed neutral block for terminating grounded conductors when applied on a grounded system.
 - 11. Switches shall be installed with an equipment ground bar.

2.4 NAMEPLATES

- A. Nameplate shall be front cover mounted, containing a permanent record of switch type, ampere rating, and maximum voltage rating.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install switches in locations as follows.
 - 1. Where shown on the Contract Drawings.
 - 2. Where required by the NEC or other governing Code.
 - 3. Where required by local authority having jurisdiction.
 - 4. Where required by manufacturer of equipment.
- B. Install such that clear working space per NEC Art 110 provided at the disconnect switch.
- C. Coordinate size and location of concrete bases, where required. Verify structural requirements with structural engineer.
- D. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- E. Retain first paragraph below if seismic controls are required for Project. Coordinate with Drawings.
 - 1. Comply with mounting and anchoring requirements specified in Division 16 Sections.
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.2 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment provided under this section. All test shall be in accordance with the latest version of UL and NEMA standards.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section covers the work necessary to furnish and install, complete, the electrical grounding system.

1.2 RELATED SECTIONS

- A. Section 16010 - Electrical – General Provisions
- B. Section 16120 - Conductors

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. IEEE - All applicable standards
- C. UL - All applicable standards

1.4 SUBMITTALS

- A. Provide under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. Provide complete manufacturers' descriptive information and shop drawings for equipment, material, and devices furnished under this section.

PART 2 PRODUCTS

2.1 GROUND RODS

- A. Provide copper-clad steel ground rods not less than 3/4 inch in diameter, 10 feet long driven full length into the earth.

2.2 GROUND CONDUCTORS

- A. Provide grounding conductors of the size shown and the type specified in Section 16120, Conductors of these specifications.

2.3 GROUND CONNECTIONS

- A. For below grade connections, provide exothermic-welded type of connectors as manufactured by Cadweld, Thermoweld, or equal.
- B. For above grade connections, provide exothermic-welded, or compression type connectors.

PART 3 EXECUTION

3.1 GENERAL

- A. A green or bare equipment grounding conductor shall be run in each raceway. Such conductors shall be based on the most current edition of the NEC and sized for the highest overcurrent device protecting any conductor in that raceway. The equipment grounding conductors shall be electrically continuous from each piece of equipment to the service ground.
- B. Except where specifically indicated otherwise, ground all exposed noncurrent-carrying metallic parts of electrical equipment, raceway systems, and the neutral of all wiring systems in strict accordance with the NEC, state, and other applicable laws and regulations.
- C. Where grounding conductors are shown, bond the wires to metallic enclosures at each end and to all intermediate metallic enclosures. Connect grounding conductors to all grounding bushings on raceways. Where any equipment contains a ground bus, extend and connect grounding conductors to that bus. Connect the enclosure of the equipment containing the ground bus to that bus. Run ground conductors inside conduits enclosing the power conductors.
- D. Where an equipment grounding means is not provided, make connections of any grounding conductors to motors 10 hp and above or circuits 20 amps or above by a solderless terminal and a 5/16-inch minimum bolt tapped to the motor frame or equipment housing. Ground connections to smaller motors or equipment may be made by fastening the terminal to a connection box. Connect junction boxes to the equipment grounding system with grounding clips mounted directly on the box or with 3/8-inch machine screws. Completely remove all paint, dirt, or other surface coverings at grounding conductor connection points so that good metal-to-metal contact is made.
- E. Install sufficient ground rods in addition to code required grounding so that resistance to ground as tested by standard methods does not exceed 5 ohm unless otherwise accepted. Where more than one rod is required, install rods at least 6 feet apart.
- F. Ground shields of any shielded power cable at each splice or termination in accordance with recommendations of the splice or termination manufacturer. Ground shields of any control cables in accordance with manufacturer's recommendations.
- G. Ground metal sheathing and any exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond any metal equipment platforms, which support electrical equipment to that equipment. Provide good electrical contact between metal frames and railings supporting pushbutton stations, receptacles, instrument cabinets, etc., and raceways carrying circuits to these devices.
- H. Bond neutrals of transformers within buildings to the system ground network, and to any additional indicated grounding electrodes.

3.2 GROUNDING CONNECTIONS

- A. Unless shown otherwise, make connections of grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection point below finished grade. Provide a capped well, formed of 4-inch PVC conduit, from grade to 2 inches below connection to ground rod, to allow for inspection.
- B. Make connections of grounding conductors accessible.
- C. In handholes, install ground rods with ends 4 to 6 inches above the floor with connections of grounding conductors fully visible and accessible. When making thermite welds, wire brush or file the point of contact to a bare metal surface. Use thermite welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly clean the joint. For compression connectors, use homogeneous copper, anti corrosion, surface treatment compound at connectors in accordance with connector manufacturer's recommendations. Use connectors of proper size for conductors and ground rods specified. Use connector manufacturer's compression tool. Notify Engineer prior to backfilling any ground connections.

3.3 FIELD TESTS

- A. The Contractor shall test the resistance of the grounding electrode system by the fall-of-potential method. The Contractor shall supply a Biddle No. 6322 Earth Tester, or equal, and make the test in the presence of the Engineer with grounding conductors disconnected. If the grounding electrode test resistance exceeds 5 ohm, the Contractor shall add ground rods or other grounding electrodes to the grounding electrode system until the grounding electrode test resistance is 5 ohms or less. Methods, which change soil resistivity, are not acceptable as means of lowering the grounding electrode test resistance. This test shall not be made within 24 hours after rainfall.
- B. Test all ground fault interrupter (GFI) receptacles and circuit breakers for proper connection and operation with methods and instruments prescribed by the manufacturer.
- C. Provide copies of reports of all grounding system tests for inclusion in Operation and Maintenance Manuals and for review by the Engineer.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall furnish and install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings. Where indicated on the drawings provide K-factor transformers for nonsinusoidal loads

1.2 RELATED SECTIONS

- A. Section 16010 – Electrical - General Provisions
- B. Section 16050 – Basic Materials and Methods
- C. Section 16075 - Electrical Identification
- D. Section 16110 - Raceways
- E. Section 16120 - Conductors
- F. Section 16450 - Grounding
- G. Section 16470 - Panelboards

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NEMA ICS 1 - General Standards for Industrial Control Systems.
- C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.
- D. NEMA ICS 3 - Industrial Systems.
- E. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- F. IEEE - All applicable standards
- G. UL - All applicable standards

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. The following information shall be submitted to the Engineer:
 - 1. Outline dimensions and weights

2. Technical certification sheet
3. Transformer ratings including:
 - a. kVA
 - b. Primary and secondary voltage
 - c. Taps
 - d. Basic impulse level (BIL) for equipment over 600 volts
 - e. Design impedance
 - f. Insulation class and temperature rise
 - g. Sound level.
4. Product data sheets

C. OPERATION AND MAINTENANCE MANUALS

1. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

D. SUBMITTALS – FOR CONSTRUCTION

1. The following information shall be submitted for record purposes.
2. Final as-built drawings and information for items listed.
3. Connection diagrams
4. Installation information
5. Seismic certification and equipment anchorage details.
6. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.5 QUALIFICATIONS

- A. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- C. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the BOCA National Building Code, paragraph 1612.6. This shall include both vertical and lateral required response spectra as specified. Alternatively, the manufacturer's certification may be based on a detailed computer analysis of the entire assembly structure and its components. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment.

- D. The test response spectra shall meet or exceed the required response spectra peak acceleration of 1.6g's (3.2–11 Hz) and a ZPA of 1.0g as specified in the BOCA National Building Code, for all equipment natural frequencies up to at least 35 Hz.

1.6 GENERAL REQUIREMENTS

- A. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
- B. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
- C. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.7 REGULATORY REQUIREMENTS

- A. All transformers shall be UL listed and bear the UL label.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cutler-Hammer
- B. Square D
- C. Approved equal
- D. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 RATINGS

- A. kVA and voltage ratings shall be as shown on the drawings.

B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.

C. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

0 to 9 kV	40 dB
10 to 50 kVA	45 dB
51 to 150 kVA	50 dB
151 to 300 kVA	55 dB
301 to 500 kVA	60 dB
501 to 700 kVA	62 dB
701 to 1000 kVA	64 dB
1001 to 1500 kVA	65 dB

D. Where K-factor transformers are indicated on the drawings, the transformers shall be specifically designed to supply circuits with a harmonic profile equal to or less than a K-factor of 13 without exceeding 115 degrees C temperature rise.

2.3 CONSTRUCTION – GENERAL PURPOSE TRANSFORMERS

A. Insulation Systems- Transformer insulation system shall be as follows:

1. Less than 15 kVA: 185 degrees C insulation system with 115 degree C rise, encapsulated design; 15 kVA and above: 220 degrees C insulation system with 115 degree C rise, ventilated design.
2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient, and a 24 hour average ambient of 30 degrees C.
3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

B. Core and Coil Assemblies:

1. Transformer core shall be constructed with high-grade, nonaging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction.
2. On three-phase units rated 15 kVA and above the core and coil assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture. The assembly shall be installed on vibration-absorbing pads.

C. Taps:

1. Three-phase transformers rated 15 through 500 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage.

2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer's standard tap configuration.
- D. Electrostatic Shielding:
1. Where shown on the drawings, provide shielded isolation transformers with an electrostatic shield consisting of a single turn of aluminum placed between the primary and secondary winding and grounded.
- E. NEMA TP-1-1996 Energy Star Labeled:
1. Where shown on the drawings, provide transformers that are low loss type with minimum efficiencies per NEMA TP-1 when operated at 35% of full load capacity. Transformers shall bear the Energy Star label.
- F. Motor Drive Isolation:
1. Where shown on the drawings, provide motor drive isolation transformers.
 2. Motor drive isolation transformers shall be designed for use with three-phase AC adjustable frequency drives 600 volts and below to provide isolation between the incoming line and drive circuitry. These drives minimize the line disturbances caused by SCR firing within the drive unit. Thermoguards shall be included in all motor drive isolation transformers to provide additional protection for the transformer from increased heating due to the non-sinusoidal characteristics of drive currents. The transformer shall provide reduced short-circuit currents and voltage line transients. The transformer shall be specifically sized to the drive kVA requirements dictated by the horsepower of the motor and, as such, will be mechanically braced to withstand the stress of current reversals and short-circuit currents associated with the specific drive kVA rating. Transformers shall be low loss type with minimum efficiencies per NEMA TP-1 when operated at 35% of full load capacity.

2.4 CONSTRUCTION - K-FACTOR TRANSFORMERS

A. Insulation Systems:

1. Transformers shall be insulated with a UL recognized 220 degrees C insulation system.
2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient and a 24-hour average ambient of 30 degrees C.
3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

B. Core and Coil Assemblies:

1. Transformer core shall be constructed with high-grade, nonaging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be

tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction. The core shall provide reduced induced currents in the steel caused by the high ratios of peak-to-rms currents and voltages found in harmonic loads.

2. The neutral bus shall be configured to accommodate 200% of the rated current.
3. The core and coil assembly shall be impregnated with non-hygroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture. The assembly shall be installed on vibration-absorbing pads.

C. Taps:

1. Three-phase K-factor rated transformers through 300 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage.
2. Single-phase K-factor rated transformers shall be provided with manufacturer's standard tap configuration.

D. Electrostatic Shielding:

1. Provide K-rated transformers with electrostatic shielding consisting of a single turn of aluminum placed between the primary and secondary winding and grounded.

2.5 WIRING/TERMINATIONS

- A. Recommended external cable shall be rated 90 degrees C (sized at 75 degrees C ampacity) for encapsulated and 75 degrees C for ventilated designs. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.

2.6 ENCLOSURE - GENERAL PURPOSE TRANSFORMERS

- A. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees C. The core of the transformer shall be grounded to the enclosure.
- B. On three-phase units rated 15 kVA and above and single-phase units rated 15 kVA and above the enclosure construction shall be ventilated, NEMA 12, drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt.

2.7 ENCLOSURE - K-FACTOR TRANSFORMER

- A. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 50 degrees C rise above a 40 degree C maximum ambient (90 degrees C.) The core of the transformer shall be grounded to the enclosure.

B. The enclosure construction shall be ventilated, NEMA 2 drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt. On outdoor units, provide weathershields over ventilated openings.

C. FINISH

1. Enclosures shall be finished with ANSI 61 color, weather-resistant enamel.

2.8 ACCESSORIES

A. On ventilated outdoor units provide suitable weather shields over ventilation openings

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all equipment per the manufacturer's recommendations and the contract drawings.

3.2 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. Ratio tests at the rated voltage connection and at all tap connections
2. Polarity and phase relation tests on the rated voltage connection
3. Applied potential tests
4. Induced potential test
5. No-load and excitation current at rated voltage on the rated voltage connection.

3.3 FIELD ADJUSTMENTS

A. Adjust taps to deliver appropriate secondary voltage.

3.4 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall furnish and install panelboards as specified herein, and as shown on the contract drawings.

1.2 RELATED SECTIONS

- A. Section 16050 - Basic Materials and Methods
- B. Section 16450 - Grounding

1.3 REFERENCES:

- A. UL 67 - Panelboards
- B. UL 50 - Cabinets and boxes
- C. NEMA PB1 - Panelboards
- D. Fed. Spec. W-P-115C
 - 1. Circuit Breaker – Type I class I
 - 2. Fusible Switch – Type II class I
- E. NECA Standard of Installation (published by the National Electrical Contractors Association).
- F. NEMA AB1 - Molded Case Circuit Breakers.
- G. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.
- H. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).
- J. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.
- B. The following information shall be submitted to the Engineer:
 - 1. Breaker layout drawing and dimensions indicated and nameplate designation
 - 2. component list

3. Conduit entry/exit locations
4. Assembly ratings including
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
5. Cable terminal sizes
6. Product data sheets

C. SUBMITTALS FOR CLOSEOUT

1. Record actual locations of panelboards and record actual circuiting arrangements in project record documents.
2. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

- A. The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers and fusible switches.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 MAINTENANCE MATERIALS

- A. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. SQUARE D
- B. CUTLER HAMMER
- C. GENERAL ELECTRIC
- D. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the engineer prior to bid date. To be considered for pre approval, submittals must be received by Engineer a minimum of 10 days prior to bid date.

2.2 PANELBOARDS

- A. Ratings:
 - 1. Panelboards rated 240V AC or less shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.
 - 2. Panelboards rated 480V AC shall have short-circuit ratings as shown on the drawings or as herin scheduled, but not less than 14,000 amperes RMS symmetrical.
 - 3. Panelboards shall be labeled with a UL short-circuit ratings. When series ratings are applied with integral or remote upstream devices, a label or manual shall be provided. It shall state the conditions of the UL series ratings including:
 - a. Size and type of upstream device
 - b. Branch devices that can be used
 - c. UL series short-circuit rating
- B. Construction:
 - 1. Interiors shall be completely factory assembled devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
 - 2. Panelboards shall be continuous hinged door-in-door trim. Door in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and chatch assembly. Doors over 48 inches in height shall have auxiliary fasteners. Removing trim screws will allow the trim to swing away from the panelboard interior.
 - 3. Distrubition panelboard trims shall cover all live parts. Switching devices handles shall be accessible.
 - 4. Surface trims shall be same height and width as box. Flush trims shall overlap the box by $\frac{3}{4}$ of an inch on all sides.

5. A director card with a clear plastic cover shall be supplied and mounted on the side of each door.
 6. All locks shall be keyed alike.
- C. Bus:
1. Main bus bars shall be copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65°C above an ambient of 40°C maximum.
 2. A system ground bus shall be included in all panels.
 3. Full-size (100%-rated) insulated neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200%-rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.
- D. Branch Circuit Panelboards:
1. The minimum short-circuit rating for branch circuit panelboards shall be as specified herein or as indicated on the drawings.
 2. Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.
 3. Circuit breakers shall be thermal-magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame and through 100-ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be UL listed as type SWD for lighting circuits. Circuit breakers shall be UL listed as type HACR for air conditioning equipment circuits. Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
 - a. Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.
 4. Circuit breakers shall have a minimum interrupting rating of 10,000 amperes symmetrical at 240 volts, and 14,000 amperes symmetrical at 480 volts, unless otherwise noted on the drawings.
- E. Distribution Panelboards:
1. Distribution panelboards with bolt-on devices contained therein shall have interrupting ratings as specified herein or indicated on the drawings. Panelboards shall have molded case circuit breakers as indicated below.
 2. Distribution panelboards with plug-on devices contained therein shall have interrupting ratings as indicated on drawings. Panelboards shall have molded case circuit breakers permanently affixed to plug-on breaker adapter, as indicated below.
 3. Where indicated, provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.

4. Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

F. Enclosure:

1. Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.
2. Enclosures shall be provided with blank ends.
3. Where indicated on the drawings, branch circuit panelboards shall be column width type.

G. Nameplates:

1. Provide an engraved nameplate for each panel section.

H. Finish:

1. Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of gray ANSI 61 paint applied.

2.3 CIRCUIT BREAKERS, INDIVIDUAL, 0 TO 600 VOLTS

- A. General: Provide circuit breakers of the indicating type showing ON/OFF and TRIPPED positions of the operating handle. Do not use single-pole circuit breakers with handle ties where multipole circuit breakers are indicated. Utilize multipole circuit breakers designed so that an overload on one pole automatically causes all poles to open. Provide circuit breakers meeting the requirements of NEMA AB 1. Circuit breakers shall have a minimum interrupting rating equal to the maximum fault current available at the point of application or they shall be part of an assembly with an integrated equipment short circuit rating at least as great as the fault current available at the point of application. Where circuit breakers are used as service entrance equipment, provide units UL labeled for that use. Provide circuit breakers suitable for use with 75 degrees C wire at full NEC 75 degrees C ampacity.

B. Inverse Time Type:

1. Provide thermal-magnetic circuit breaker, unless otherwise shown, for one- and two-pole breakers, breakers operating at 240V or less, and three-pole branch circuit breakers operating at 480V.
2. Provide solid state trip circuit breakers with an adjustable short-term function, unless another type breaker is required for coordination, for three-pole, 480V feeder circuit breakers with not more than one downstream, 480V, overcurrent protective device, excluding protective devices provided as part of a process equipment package. Such breakers shall be Westinghouse Seltronic Circuit Breakers, Square D, Type ME or PE Circuit Breakers, or equal.

3. Provide solid state trip circuit breakers with at least the following adjustment:
long time pickup, long time delay, short time pickup, short time delay, I-squared t
for circuit breakers not covered by either of the above cases.
- C. Instantaneous Only Type: Instantaneous only circuit breakers shall have only an instantaneous trip element. The breakers shall be used only as part of a listed combination motor starter. Instantaneous only breakers shall be sized with a continuous rating of at least 115 percent of the full-load current of the motor served. The trip setting shall be continuously adjustable from a lowest setting of not more than 700 percent to a highest setting of not less than 1,300 percent of the motor full-load current.
- D. All breakers shall be manufactured by the supplier of the panelboards.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1 and the NECA "Standard of Installation."
- B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.
- C. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- F. Provide engraved plastic nameplates.
- G. Ground and bond panelboard enclosure according to Section 16450 - GROUNDING.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4. Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

3.3 ADJUSTING

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 15 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall furnish and install lighting fixtures and accessories as specified herein, and as shown on the contract drawings.

1.2 RELATED SECTIONS

- A. Section 16050 - Electrical - Basic Materials
- B. Section 16450 - Grounding

1.3 REFERENCES:

- A. UL 50 - Cabinets and Boxes.
- B. UL 67 - Panelboards.
- C. NEMA PB-1 - Panelboards.
- D. Fed. Spec. W-P-115C.
- E. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- F. IEEE - All applicable standards

1.4 REFERENCES

- A. ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
- B. ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications.
- C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).
- D. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 101 - Life Safety Code.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01340, Shop Drawings, Product Data and Samples of these specifications.

The following information shall be submitted to the Engineer:

1. Dimension
2. Ratings
3. Performance data

4. Recommended mounting data
5. Appearance
6. Lamp Data to include the following at a minimum:
 - a. CRI
 - b. Color Temperature
7. Ballast

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 LUMINAIRES

- A. Acceptable manufactures are listed in the lighting fixture schedule shown on the drawings.
- B. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the engineer ten (10) days prior to bid date. All pre-approval request must be made in writing.
- C. Contractor shall verify all requirements as required to give proper installation per the contract documents and per codes.
- D. Fixtures shall be UL Listed

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install suspended luminaires as noted on drawings. Suspend luminaire at height indicated on drawings.
- B. Support luminaires equal to or larger than 2 x 4 foot (600 x 1200 mm) size independent of ceiling framing.
- C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

- D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement. Installation of surface mounted luminaires shall be per manufactures instructions.
- E. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide safety clips to secure fixture to ceiling grid, and locate at opposite corners of fixture.
- F. Install recessed luminaires to permit removal from below.
- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install clips to secure recessed grid-supported luminaires in place. Support directly from building structure.
- I. Install wall mounted luminaires, emergency lighting units and exit signs at height as scheduled.
- J. Install accessories furnished with each luminaire.
- K. Connect luminaires to branch circuit outlets provided under Section 16130, Boxes of these specifications using flexible conduit as indicated.
- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate with air handling equipment to provide lighting layout as specified in drawings.

3.3 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

- A. Aim and adjust luminaires as indicated.
- B. Position exit sign directional arrows as indicated.

3.5 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

3.6 PROTECTION OF FINISHED WORK

- A. Relamp luminaires that have failed lamps at Substantial Completion.

END OF SECTION