POLK COUNTY
LAKELAND, FL

GIBSON OAKS WATER PRODUCTION FACILITY

TECHNICAL SPECIFICATIONS

BID SET

VOLUME 1 of 2

JULY 2020

PCU PROJECT No. 2014-4-30-0
ORACLE No. 6857014

CA No. 8571

CivilSurv Design Group, Inc.
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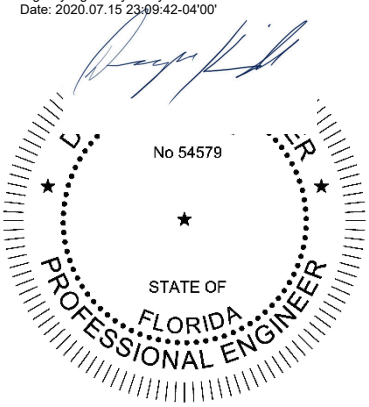
POLK COUNTY

GIBSON OAKS WATER PRODUCTION FACILITY
TECHNICAL SPECIFICATIONS

BID SET FINAL

JULY 2020

Digitally signed by Dwayne R. Kreidler
Date: 2020.07.15 23:09:42-04'00'



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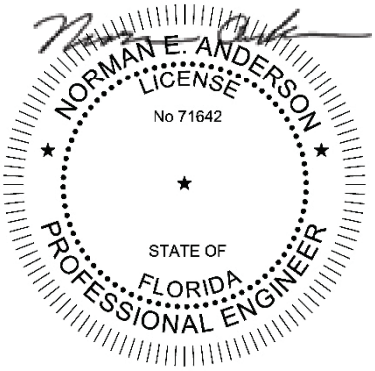
Digitally signed by Norman Anderson
Contact Info: Carollo Engineers, Inc.
Date: 2020.07.20 17:00:01-04'00'



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Digitally signed by Richard C Warner
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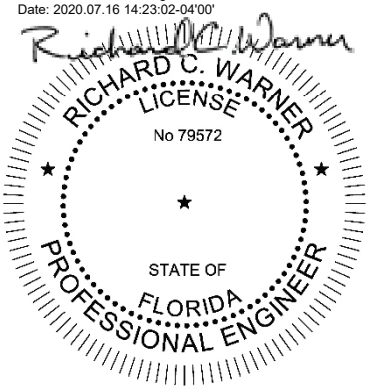
Date: 2020.07.16 14:23:02-04'00'



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POLK COUNTY

GIBSON OAKS WATER PRODUCTION FACILITY
TECHNICAL SPECIFICATIONS

BID SET

JULY 2020

J. Michael Murphey
FL PA AR0009346

Architectural Firm
CA # AAC001165
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P: 863-687-3573

[PLACE SEAL HERE.]

Digitally signed by J. Michael Murphey
Date: 2020.07.14 12:15:19 -04'00'

Responsible for: Divisions 06, 07, 08, 09, 10, and Sections 06100, 06200, 06400, 07212, 07610, 07900, 08100, 08200, 08400, 08700, 08800, 09200, 09300, 09510, 09650, 09900, and 10800.

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POLK COUNTY

GIBSON OAKS WATER PRODUCTION FACILITY

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04100	MORTAR AND MASONRY GROUT	Rich Warner
04220	CONCRETE UNIT MASONRY	Rich Warner

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05190	MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY	Rich Warner
05500	METAL FABRICATIONS	Rich Warner

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07260	BELOW-GRADE VAPOR RETARDER MEMBRANE	J. Michael Murphey
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08200	FLUSH WOOD DOORS	J. Michael Murphey
08400	ALUMINUM ENTRANCES AND STOREFRONTS	J. Michael Murphey

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APPENDIX A

SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.01 GOVERNING PROVISIONS

A. Contractor shall refer to Utility Standards and Specification Manual (USSM), latest revision, for additional technical specifications requirements. In the event of a conflict between the technical specifications and USSM, the USSM shall prevail.

B. Contractor shall refer to the General Conditions for contract provisions. In the event the technical specifications and General Conditions conflict, the General Conditions shall prevail.

C. Contractor shall defer to the FDOT and the USSM, latest revisions, for roadways, drainage, erosion control, sodding, and site restoration requirements.

1.02 SUMMARY

A. Work Under this Contract:
   1. Work included under this contract generally includes but is not limited to the following:
      a. Gibson Oaks Site:
         1) Construct new raw water well pump to the new Gibson Oaks well with associated piping, fittings, valves, electrical equipment, controls and other appurtenances complete as shown on the drawings and specified herein.
         2) Construct a new 1.0 million gallon (MG) pre-stressed ground storage reservoir (GSR) with piping, fittings, valves, electrical equipment, controls and other appurtenances complete as shown in the drawings and specified herein.
         3) Construct a new high service distribution pump station (HSPS) with horizontal split case pumps, piping, fittings, valves, electrical equipment, controls and other appurtenances complete as shown in the drawings and specified herein.
         4) Construct a sodium hypochlorite storage and feed system with a pre-engineered metal roofing system with screen, four pump chemical skid, two double walled polyethylene tanks, piping, fittings, valves, electrical equipment, controls and other appurtenances complete as shown in the drawings and specified herein.
         5) Construct a new concrete masonry unit (CMU) operations building with a separate mechanical and electrical room complete as shown in the drawings and specified herein.
         6) Construct yard and drainage piping throughout the site as shown and specified herein. Coordinate yard piping with off-site distribution and raw water piping under separate contract.
         7) Construct sample points and monitoring locations as shown in the drawings and specified herein.

8) Installation of new SCADA system and controls to monitor and operate the facility as shown in the drawings and specified herein.
9) Installation of cameras for site security as shown in the drawings and specified herein.
10) Construct new roadway, exterior site fence, entrance gate, drainage and grading to provide proper drainage of the overall site as shown in the drawings and specified herein. Use GSR preload material located at the approximate location of the new GSR for site fill as part of the grading and drainage improvements.
11) Demolish and remove existing fencing, existing potable water well for existing residence, trees and other associated items complete from the overall site as shown in the drawings and specified herein.

b. Lake Gibson:
1) Demolish and removal of the existing raw water well pump well and other appurtenances complete as shown in the drawings and specified herein.
2) Construct one new raw water well pump to the existing Lake Gibson well with associated piping, fittings, valves, electrical equipment, controls and other appurtenances complete as shown on the drawings and specified herein.
3) Demolish and removal of the hydro-pneumatic tanks and associated piping, air compressor, electrical, controls and other appurtenances complete as shown in the drawings and specified herein.
4) Reconfigure and modify the well pump room and enclose to convert to climate controlled electrical room as shown in the drawings and specified herein.
5) Installation of new SCADA system and controls to monitor and operate the facility as shown in the drawings and specified herein.
6) Installation of cameras for site security.
7) Construct new barb wire on the exterior fencing.
8) All contractor and subcontractor's personnel assigned to work on the Lake Gibson site shall obtain Polk County School Board access to the site.

c. Sherwood Lakes:
1) Construct two new raw water well pumps to the new Sherwood Lakes wells with associated piping, fittings, valves, electrical equipment, controls and other appurtenances complete as shown on the drawings and specified herein.
2) Demolish and removal of the existing raw water well pump well, piping, valves, fittings and other appurtenances complete as shown in the drawings and specified herein.
3) Demolish and removal of the hydro-pneumatic tanks and associated piping, air compressor, electrical, controls and other appurtenances complete as shown in the drawings and specified herein.
4) Demolish and remove miscellaneous slabs and asphalt areas as shown in the drawings and specified herein.
5) Reconfigure and modify the well pump room and enclose to convert to climate controlled electrical room as shown in the drawings and specified herein.
6) Modify the chemical area to remove vinyl fencing and enclose area with screening as shown in the drawings and specified herein.

7) Construct yard and drainage piping throughout the site as shown and specified herein. Coordinate yard piping with off-site raw water piping.
8) Construct new roadway, drainage and grading to provide proper drainage of the overall site as shown in the drawings and specified herein.
9) Modification and upgrades to the electrical system including a new emergency generator and fuel system.
10) Installation of new SCADA system and controls to monitor and operate the facility as shown in the drawings and specified herein.
11) Installation of cameras for site security.

d. All project permitting and gopher tortoise site survey, clearing and relocation, if any, as required by the Florida Fish and Wildlife Conservation Commission (FWC) (See Environmental Memorandum in Appendix A)
e. Develop close out documents and provide legal descriptions for Lakeland Electric easements for new transformer and incoming power conduits. Provide a legal easement sketch signed and sealed by a Florida Registered Land Surveyor.
f. Refer to geotechnical report in Appendix A for additional information.
g. Refer to the Gibson Oaks Site landscape record drawings in Appendix A for additional information.

1.03 LOCATION OF PROJECT

A. The Work is located at:
1. Gibson Oaks WPF - 8251 East Tom Costine Road, Lakeland, Florida 33809.
2. Lake Gibson Raw Water Site: 7312 N Socrum Loop Rd, Lakeland, Florida 33809.
3. Sherwood Lakes Raw Water Site: 1899 Sherwood Lakes Blvd, Lakeland, Florida 33809.

1.04 ACTIVITIES BY OTHERS

A. Coordination:
1. Other phases of construction may begin before this contract is completed which will interface with this work. Additionally, other projects will be constructed adjacent to the Work during the life of this contract. Coordinate your activities with the other contractors to allow orderly and timely completion of all the work.
2. When access through interfacing and/or overlapping construction areas must be disrupted, provide alternate acceptable access for other contractors. Coordinate your activities in the interface or common areas with these other contractors. Submit to the Engineer a description and schedule as to how the common areas will be utilized, recognizing the required coordination with other contractors.

B. Utilities:
1. Coordinate the activities of all utility companies with equipment in the construction area with the Contractor's and subcontractors' work.

C. Cutting and Patching:
   1. No cutting and patching of new work will be accepted. All work must be new and continuous in its final form.

1.05 SUBCONTRACTORS

A. Contractor shall not employ any subcontractors against who the County or the Engineer may have reasonable objection. The name, address, and experience of the proposed subcontractors shall be submitted by the Contractor to Engineer for Engineer's review prior to any work being performed by the subcontractor.

1.06 WORKING HOURS

A. Refer to the County Supplementary Conditions.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01140

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and plant operations.

1.02 GENERAL CONSTRAINTS ON SEQUENCE AND SCHEDULING OF WORK

A. Gibson Oaks Water Production Facility:
   1. The power on the Gibson Oaks site shall remain until permanent power from the MCC is provided.
   2. Coordinate connections with the offsite raw water and distribution piping for connections with the onsite yard piping as indicated in the Contract Documents.
   3. The Gibson Oaks Water Production Facility and offsite pipelines shall be substantially complete and operational prior to impacting production of the Sherwood Lakes or Lake Gibson sites.
   4. The Sherwood Lakes raw water production improvements shall be operational prior to Lake Gibson modifications.
   5. Work shall be conducted as to not impair the Owner's ability to maintain permitted operational capacity. Do not impair the operational capabilities of the existing facility.
   6. Refer to commissioning and process start-up activities as specified in Section 01756 - Commissioning.

1.03 SHUTDOWN AND CONSTRUCTION CONSTRAINTS

A. General shutdown constraints:
   1. Organize work in order to minimize the potential number of shutdowns.
   2. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.
   3. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
   4. Coordinate all shutdown activities and tie-ins with the Owner and Engineer in writing a minimum of 14 calendar days prior to the event execution.
   5. Final determination of the permitting of shutdowns will be the sole judgment of the Owner. Owner maintains the ability to abort on the day of the scheduled shutdown.
   6. Include necessary constraints and identify anticipated shutdown events within the construction schedule
   7. Unplanned shutdowns due to emergencies are not defined in this Section.

B. Unit process availability work limitations:
   1. Shutdowns and tie-ins to the existing potable and raw water piping shall occur as part of the project construction. It is not anticipated that these tie-ins will require a shutdown. The contractor shall request in writing based on the above time period with each tie-in specified. The tie-in shall be completed within one continuous 4-hour period.

1.04 COMPLIANCE WITH DRINKING WATER PERMIT

A. The existing facility is operating under the terms of a Drinking Water permit issued by the Polk County Health Department/Florida Department of Environmental Protection. This permit specifies the water quality limits that the plant must meet prior to discharge of finished water. A copy of the existing permit is attached to the documents for reference.

B. Perform work in a manner that will not prevent the existing facility from achieving the finished water quality requirements established by regulations.

C. Bear the cost of penalties imposed on the Owner for water quality violations caused by actions of the Contractor.

1.05 OPERATIONS AND MAINTENANCE ACCESS

A. Provide safe, continuous access to process control equipment for plant operations personnel at each facility throughout the project duration.

B. All contractor and subcontractor personnel assigned to work at the Lake Gibson site shall be certified and cleared for access by the Polk County School Board.

1.06 UTILITIES

A. Provide advance notice to and utilize services of Sunshine State One Call system for location and marking of underground utilities operated by utility agencies other than the Owner.

B. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.

C. New yard utilities were designed using existing facility drawings.
   1. Field verification of utilities locations was not performed during design.
   2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
   3. Pipe alignments as indicated on the Drawings.

1.07 WORK SEQUENCE

A. Provide an outline of work sequence to Engineer and Owner to review and approval/acceptance before the start of work. The following is a possible work sequence to accomplish the proposed improvements. Any deviation from this sequence shall be in the work sequence submittal.

1. Perform necessary rough site work and grading. Gibson Oaks shall contain preloading material at the approximate location of the new GSR for use in filling and grading the site. Contractor shall include this effort in the sequence and performance of the work.
2. Perform electrical work to power existing raw water well from new the transformer.
3. Construct new ground storage tank, fill station, chemical storage and feed system, booster pump station, finish water flow meter station and operations/electrical building. The Gibson Oaks system shall be cleared for service, prior to making the off-site tie-ins.
4. The connections to the new potable and raw water piping can be made once available and cleared for service.
5. Provide final site cleanup,restoration and final roadway paving.
6. Modifications of the Sherwood Lakes site can be upgraded with the new raw water well pumps and associated piping and appurtenances concurrent with Gibson Oaks Water Production Facility improvements.
7. The Sherwood Lakes system shall be tested, disinfected, and successful bacteriologically tested with approval prior to opening any valves to the new raw water piping.The connections to the new raw water piping can be made once available and cleared for service.
8. Modifications to the existing Lake Gibson well pump room and demolition will be performed after the Gibson Oaks Water Production Facility and Sherwood Lakes site are operational and approved for service.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01201

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 BASIS OF PAYMENT

A. Items of work under this contract will be paid for on a unit price or lump sum basis as listed in the Bid Form for the quantity of work installed. The amount of payment will be as defined in the Agreement between the Owner and Contractor.

B. The quotations for the work are intended to establish a total price for completing the work in its entirety.

C. All thicknesses, width, and lengths shall be considered minimum.

D. A final inspection shall be arranged by the Contractor with concurrence and participation of the Engineer and Owner to establish project completion for pay purposes and for acceptance by Owner.

E. All construction items approved for payment shall be complete, in place, and accepted by Owner.

F. Additions, deletions, modifications, or changes to the work as defined by this contract will be performed by change order according to the General Conditions and will be paid for on the basis of the Cost of the Work.

1.02 GENERAL

A. All work under this contract shall be included in the pay items list on the Bid Form. Any items for which a specific pay item is not included shall be included in the price of the item to which it pertains or is associated.

B. Any items not shown or omitted that are required for a complete installation shall be furnished and installed by the Contractor at no additional cost to the Owner.

C. The prices shall include all labor, materials, tools, equipment required to complete the work.

D. No additional payment will be made for well pointing or other methods of dewatering excavations.

E. Thrust blocks or mechanical restrains are not separate pay items.

F. Payment for repair and replacement of existing utilities will be included in the unit price or lump sum bid amount for the related new construction bid item.

G. Payment for lump sum items shall be on a percentage of completion of the particular item basis.

1.03 PARTIAL PAY REQUEST

A. The installation of pipe and fittings includes backfilling, compacting, hydrostatic testing, disinfection testing (if potable), flushing, fine grading, property restoration, clean up, and placing the facilities in operation. When measurements of the amount of work constructed each, the above will be considered.

B. No less than 2 percent of the contract price shall be retained until the as-built drawings and Operation and maintenance manuals are delivered and reviewed and accepted by the Engineer.

C. The Contractor will provide the following with each Partial Pay Request:
   1. Current record drawings for the Owners' Review.
   2. Partial release of liens from all Vendors and Subcontractors.
   3. Photos of work completed.
   4. Consent of Survey Company for Partial Payment.

1.04 DESCRIPTION OF PAY ITEMS

A. Described below is a brief summary of the work to be accomplished for the pay items in the Bid Form and the way to measure for payment purposes. Each pay item will include, clean-up, testing, and placing in operation. The summary is not intended to describe all items in detail, but to clarify the items on which the price is to be based. The summary does not relieve the Contractor of his responsibility to supply all items complete.
   1. Base Bid 1:
      a. All work associated with the Gibson Oaks Water Production Facility:
         1) This lump sum pay item includes all labor, materials, supplies and equipment for constructing a new 5.53 million gallon per day (maximum day demand) water production facility including all mobilization, demobilization, shop drawings and sample submittals, as-built drawing submittals, O&M Manual submittals, startup, and testing for a complete operating facility. Refer to Specification Section 01110 - Summary of Work for the overall summary of work.
   2. Base Bid 2:
      a. All work associated with the Lake Gibson site:
         1) This lump sum pay item includes all labor, materials, supplies and equipment for rehabilitating the Lake Gibson water production facility into a raw water well site supplying the new Gibson Oaks Water Production Facility including all mobilization, demobilization, shop drawings and sample submittals, as-built drawing submittals, O&M Manual submittals, startup, and testing for a complete operating raw water well system. Refer to Specification Section 01110 - Summary of Work for the overall summary of work.

b. All work associated with the Sherwood Lakes site:
    1) This lump sum pay item includes all labor, materials, supplies and equipment for rehabilitating the Sherwood Lakes water production facility into a raw water well site supplying the new Gibson Oaks Water Production Facility including all mobilization, demobilization, shop drawings and sample submittals, as-built drawing submittals, O&M Manual submittals, startup, and testing for a complete operating raw water well supply system. Refer to Specification Section 01110 - Summary of Work for the overall summary of work.

3. Contingency for Electrical Work:
    a. This Owner controlled contingency related to additional electrical work efforts requested by the Owner to be completed under this contract. The amount shown in the Bid Form shall be included within the Lump Sum Total. The contingency amount shall not be authorized unless specifically released in writing by the Owner through a Contingency Release. Refer to the General Conditions for additional requirements.
4. Contingency for Site Work:
    a. This Owner controlled contingency related to additional site work efforts requested by the Owner to be completed under this contract. The amount shown in the Bid Form shall be included within the Lump Sum Total. The contingency amount shall not be authorized unless specifically released in writing by the Owner through a Contingency Release. Refer to the General Conditions for additional requirements.
5. Contingency for Instrumentation and Controls:
    a. This Owner controlled contingency related to additional instrumentation and control efforts requested by the Owner to be completed under this contract. The amount shown in the Bid Form shall be included within the Lump Sum Total. The contingency amount shall not be authorized unless specifically released in writing by the Owner through a Contingency Release. Refer to the General Conditions for additional requirements.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01292

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for preparation, format, and submittal of Schedule of Values.

1.02 PREPARATION

A. Prepare a breakdown of all lump-sum bid items into the major and minor portions of work and include material and equipment costs. The breakdown shall be by Process area and specification divisions within each Process area.

B. The prepared breakdown shall be the basis of all progress payments. Fill in amounts or quantities where unit quantities are shown (i.e. LF, CY, SF, etc.). An alternate form may be submitted providing it is at least as detailed as the example at the end of this section.

C. Assign prices to Major Items of Work which aggregate the Contract Price. Base prices on costs associated with scheduled activities based on the Project Schedule for each Major Item of Work.

1.03 SUBMITTALS

A. Submit preliminary schedule of values prior to the notice-to-proceed.

B. Submit corrected schedule of values within 10 days upon receipt of reviewed Schedule of Values, but no later than 10 days prior to anticipated submittal of first Application for Payment.

C. Upon request, support prices with data which will substantiate their correctness.

D. If activities are added or removed from the Progress Schedule revise the Schedule of Values and resubmit.

1.04 SAMPLE SCHEDULE OF VALUES

A. Following is an acceptable form for Schedule of Values:

(SAMPLE ONLY)
SCHEDULE OF VALUES

Activity No.	DESCRIPTION	Contract			This Month		To Date	
		QTY	Percentage	Total Cost of Item	QTY	Amount This Month	QTY	Total Cost of Item
1.	**General Requirements**	**LS**						
1.1	Mobilization/Demobilization	LS						
1.2	Indemnification	LS						
1.3	Permitting	LS						
1.4	Gopher Tortoise Site Clearing	LS						
1.5	Close-Out Documentation	LS						
1.6	Bonds and Insurance	LS						
1.7	General Conditions	LS						
2.	**Gibson Oaks Site Work (Site 00)**	**LS**						
2.1	Demolition	LS						
2.2	Site Grading	LS						
2.3	Roadway Asphalt	LS						
2.4	Roadway Base	LS						
2.5	Stormwater Piping	LS						
2.6	Stormwater Structures	LS						
2.7	Stormwater Pond							
2.8	Fencing	LS						
2.9	Motorized Entrance Gate	LS						
3.	**Gibson Oaks (Site 00) - Yard Piping**	**LS**						
3.1	24-inch FW Piping	LS						
3.2	DR Piping	LS						
3.3	SH Piping	LS						
3.4	Sample Piping	LS						
3.5	16-inch RW Piping	LS						
3.6	12-inch RW Piping	LS						
3.7	8-inch RW Piping	LS						
3.8	PW Piping	LS						
3.9	24-inch tie intooffisite piping (north)	LS						
3.10	24-inch tie into offsite piping (south)	LS						
3.11	16-inch tie into offsite piping (north)	LS						
3.12	12-inch tie into offsite piping (south)	LS						
3.13	Pressure Testing	LS						
3.14	Site Disinfection	LS						
4.1.	Raw Water Well Pump	LS						
4.2	Concrete	LS						
4.3	Piping/Supports	LS						

(SAMPLE ONLY)
SCHEDULE OF VALUES

Activity No.	DESCRIPTION	Contract			This Month		To Date	
		QTY	Percentage	Total Cost of Item	QTY	Amount This Month	QTY	Total Cost of Item
4.4	Valves	LS						
4.5	Chemical, Sampling, Miscellaneous Piping	LS						
4.6	Testing	LS						
5.	**Gibson Oaks (Site 00) – GSR (Process 40)**	**LS**						
5.1	24-inch FW Piping	LS						
5.2	12-Inch Fill Piping	LS						
5.3	Fill Flowmeter Assembly	LS						
5.4	Valves and air release	LS						
5.5	Concrete	LS						
5.6	Earthwork/Trenching	LS						
5.7	Tank/Aerator/Stairs	LS						
5.8	Painting	LS						
5.9	Chemical/Sample Lines	LS						
5.10	PW Piping/Hose Bibbs	LS						
6.	**Gibson Oaks (Site 00) – HSPS (Process 50)**	**LS**						
6.1	Small Pumps	LS						
6.2	Large Pumps	LS						
6.3	Valves and air release	LS						
6.5	Flowmeter Assembly	LS						
6.6	16-inch FW Piping	LS						
6.7	12-inch FW Piping	LS						
6.8	10-inch FW Piping	LS						
6.9	8-inch FW Piping	LS						
6.10	4-inch DR Piping	LS						
6.11	Concrete	LS						
6.12	Earthwork/Trenching	LS						
6.13	Painting	LS						
6.14	Chemical/Sample Lines	LS						
6.15	PW Piping/Hose Bibbs	LS						
7.	**Gibson Oak (Site 00) - Chemical Building (Process 80)**	**LS**						
7.1	Chemical Tanks	LS						
7.2	Pump Skid	LS						
7.3	Analyzers	LS						
7.4	Concrete	LS						

(SAMPLE ONLY)
SCHEDULE OF VALUES

Activity No.	DESCRIPTION	Contract			This Month		To Date	
		QTY	Percentage	Total Cost of Item	QTY	Amount This Month	QTY	Total Cost of Item
7.5	Grating	LS						
7.5	Earthwork	LS						
7.6	Painting	LS						
7.7	Chemical Piping	LS						
7.8	Chemical Building	LS						
8.	**Gibson Oaks (Site 00) - Ops Bldg (Process 90)**	**LS**						
8.1	Earthwork	LS						
8.2	Concrete	LS						
8.3	CMU	LS						
8.4	Trusses/Decking	LS						
8.5	Doors/Windows	LS						
8.6	Coatings/Painting	LS						
8.7	HVAC	LS						
8.8	Lighting/Building Electrical	LS						
8.9	Roofing	LS						
8.10	Rough Carpentry	LS						
8.11	Finish Carpentry/Cabinets	LS						
8.12	Plumbing	LS						
8.13	Flooring	LS						
8.14	Analyzers	LS						
8.15	Ceiling and Insulation	LS						
9.	**Gibson Oaks (Site 00) – Electrical**	**LS**						
9.1	New Generator and Fuel Tank	LS						
9.2	Security Equipment	LS						
9.3	Conduit	LS						
9.4	Wiring	LS						
9.5	Pull boxes	LS						
9.6	Patching	LS						
9.7	VFDs	LS						
9.8	Distribution Panel	LS						
9.9	Lighting	LS						
9.10	Mounting	LS						
9.11	Surge Protection	LS						
9.12	Lightning Protection	LS						
9.13	Studies	LS						

(SAMPLE ONLY)
SCHEDULE OF VALUES

Activity No.	DESCRIPTION	Contract			This Month		To Date	
		QTY	Percentage	Total Cost of Item	QTY	Amount This Month	QTY	Total Cost of Item
9.14	Permitting	LS						
9.15	Testing	LS						
10.	**Gibson Oaks (Site 00) - Instrumentation**	**LS**						
10.1	PLC	LS						
10.2	PLC & HMI Programming	LS						
10.3	Server Reconfig.	LS						
10.4	Fiber Patch Cabinet	LS						
10.5	Training	LS						
10.6	Field Instrumentation	LS						
10.7	Documentation, Submittals	LS						
10.8	Testing	LS						
11..	**Shewood Lakes (Site 01) Site Work**	**LS**						
11.1	Demolition	LS						
11.2	Roadway Asphalt	LS						
11.3	Roadway Base	LS						
11.4	Site Grading	LS						
11.5	Modifications to Existing Well Room	LS						
11.6	Modifications to Existing Chemical Room	LS						
12.	**Shewood Lakes (Site 01) - Yard Piping**	**LS**						
12.1	RW Piping	LS						
12.2	DR Piping	LS						
12.3	SH Piping	LS						
12.4	CLS Piping	LS						
12.5	RW tie into off-site Piping	LS						
13.	**Shewood Lakes (Site 01) – Wells (Process 10)**	**LS**						
13.1	Raw Water Well Pumps	LS						
13.2	Concrete	LS						
13.3	Piping/Supports	LS						
13.4	Valves	LS						
13.5	Chemical, Sampling and Miscellaneous Piping	LS						
13.6	Testing	LS						
14.	**Sherwood Lakes (Site 01) – Electrical**	**LS**						
14.1	New Generator and Fuel Tank	LS						

(SAMPLE ONLY)
SCHEDULE OF VALUES

Activity No.	DESCRIPTION	Contract			This Month		To Date	
		QTY	Percentage	Total Cost of Item	QTY	Amount This Month	QTY	Total Cost of Item
14.2	Security Equipment	LS						
14.3	Conduit	LS						
14.4	Wiring	LS						
14.5	Pull boxes	LS						
14.6	Patching	LS						
14.7	VFDs	LS						
14.8	Distribution Panel	LS						
14.9	Lighting	LS						
14.10	Mounting	LS						
14.11	Surge Protection	LS						
14.12	Lightning Protection	LS						
14.13	Studies	LS						
14.14	Permitting	LS						
14.14	Testing	LS						
15.	**Sherwood Lakes (Site 01) - Instrumentation**	**LS**						
15.1	PLC	LS						
15.2	PLC & HMI Programming	LS						
15.3	Server Reconfig.	LS						
15.4	Fiber Patch Cabinet	LS						
15.5	Training	LS						
15.6	Field Instrumentation	LS						
15.7	Documentation, Submittals	LS						
15.8	Testing	LS						
16.	**Lake Gibson (Site 02) Site Work**	**LS**						
16.1	Demolition	LS						
16.2	Modifications to Fencing	LS						
16.3	Raw water piping connection	LS						
17.	**Lake Gibson Lakes (Site 02) - Wells**	**LS**						
17.1	Raw Water Well Pump	LS						
17.2	Concrete	LS						
17.3	Piping/Supports	LS						
17.4	Valves	LS						
17.5	Chemical and Sampling	LS						
17.6	Testing	LS						
18.	**Lake Gibson (Site 02) – Electrical**	**LS**						

(SAMPLE ONLY) SCHEDULE OF VALUES								
Activity No.	**DESCRIPTION**	**Contract**			**This Month**		**To Date**	
		QTY	**Percentage**	**Total Cost of Item**	**QTY**	**Amount This Month**	**QTY**	**Total Cost of Item**
18.1	Security Equipment	LS						
18.2	Conduit	LS						
18.3	Wiring	LS						
18.4	Pull boxes	LS						
18.5	Patching	LS						
18.6	Distribution Panel	LS						
18.7	Lighting	LS						
18.8	Mounting	LS						
18.9	Surge Protection	LS						
18.10	Lightning Protection	LS						
18.11	Studies	LS						
18.12	Permitting	LS						
18.13	Testing	LS						
19.	**Lake Gibson (Site 02) – Instrumentation**	**LS**						
19.1	PLC	LS						
19.2	PLC & HMI Programming	LS						
19.3	Server Reconfig.	LS						
19.4	Fiber Patch Cabinet	LS						
19.5	Training	LS						
19.6	Field Instrumentation	LS						
19.7	Documentation, Submittals	LS						
19.8	Testing	LS						
20.	**Contingency**							
20.1	Contingency for Electrical Work	LS		$100,000				
20.2	Contingency for Site Work	LS		$50,000				
20.3	Contingency for Instrumentation and Controls	LS		$100,000				

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

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SECTION 01312

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest, and includes the following:
   1. Qualifications of Meeting Participants.
   2. Preconstruction Conference.
   3. Progress Meetings.
   4. Pre-Installation Meetings.
   5. Schedule Update Meetings.
   6. Quality Control Meetings.
   7. Pre-Shutdown Meetings.
   8. Pre-Process Start-up Meetings.
   9. Electrical and Instrumentation Coordination Meetings.
   10. Close-out meeting.
   11. Post Construction Meeting.

1.02 QUALIFICATIONS OF MEETING PARTICIPANTS

A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of entity each represents.

1.03 PRECONSTRUCTION CONFERENCE

A. Upon issuance of Notice to Proceed, or earlier when mutually agreeable, Owner and Engineer will arrange preconstruction conference at the Owner's facility (1011 Jim Keene Blvd, Winter Haven, FL 33880).

B. Preconstruction Conference invitees: Contractor's project manager and superintendent, Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda.

C. Engineer will preside at conference.

D. Purpose of conference: To establish working understanding between parties and to discuss Construction Schedule, shop drawing and other submittals, cost breakdown of major lump sum items, processing of submittals and applications for payment, and other subjects pertinent to execution of the Work.

E. Agenda will include:
   1. Adequacy of distribution of Contract Documents.
   2. Distribution and discussion of list of major subcontractors and suppliers.
   3. Proposed progress schedules and critical construction sequencing.
   4. Major equipment deliveries and priorities.

5. Project coordination.
6. Off-site piping coordination.
7. Designation of responsible personnel.
8. Procedures and processing of:
    a. Field decisions.
    b. Proposal requests.
    c. Submittals.
    d. Change Orders.
    e. Request for Information/Interpretations.
    f. Applications for Payment.
    g. Record Documents.
    h. Construction Sequence Restrictions
9. Use of premises:
    a. Office, construction, and storage areas.
    b. Owner's requirements.
    c. Facility access.
10. Construction facilities, controls, and construction aids.
11. Temporary utilities.
12. Safety and first aid procedures.
13. Security procedures.
14. Housekeeping procedures.

F. Engineer will provide a summary of meeting and distribute electronic copies of minutes within 3 business days of meeting to participants and interested parties.

1.04 PROGRESS MEETINGS

A. Monthly meetings scheduled on days as mutually agreed upon in the preconstruction conference held either at the project site or at the Owner's office.

B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance required: Owner, Engineer, Contractor, Contractor's Project Manager, superintendent, quality control manager, project scheduler, major subcontractors and suppliers as appropriate to agenda topics for each meeting.

D. Additional invitees: Owner utility companies when the Work affects their interests, and others necessary to agenda.

E. Agenda:
1. Review minutes of previous meeting/minutes.
2. Safety and security.
3. Construction schedule summary.
4. Review of 3 week look ahead schedule.
5. Review of off-site fabrication and delivery schedules.
6. Review of submittals schedule and status of submittals.
7. Request for information (RFI's) status.
8. Shutdown/piping connection coordination.
9. Change order management status.
10. Maintenance of quality standards (QA/QC).
11. Field observations, problems, and conflicts.
12. Commissioning and process start-up.

13. General Items.
14. Action items.
15. Next meeting.

F. Engineer will provide a summary and distribute electronically within 5 calendar days after meeting to participants, with copies to Contractor, Owner, and those affected by decisions made.

1.05 PRE-INSTALLATION MEETINGS

A. When required in individual specification sections or requested by Engineer, convene pre-installation meeting at Project site before commencing work of specific section.

B. Require attendance of parties directly affecting, or affected by, Work of specific section.

C. Notify Owner and Engineer 7 calendar days in advance of meeting date.

D. Prepare agenda and preside at meeting:
1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.

E. Engineer will record minutes and distribute electronic copies within 7 calendar days after meeting to participants, with copies to Engineer, Owner, and those affected by decisions made.

1.06 QUALITY CONTROL MEETINGS

A. Contractor will schedule and administer meetings throughout progress of the Work at maximum weekly intervals.

B. Contractor will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance Required: Construction Manager and staff, Contractor's Quality Control Manager and staff.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress and schedule.
3. Review of out-of-compliance inspection or test results.
4. Field observations, problems, and decisions.
5. Review of offsite fabrication and delivery schedules.
6. Planned progress during succeeding work period.
7. Coordination of required inspections and tests.
8. Review 6-week schedule report with upcoming inspections and special tests.
9. Maintenance of quality and work standards.
10. Other business relating to Work.

E. Contractor will record minutes and distribute electronic copies within 5 calendar days after meeting to participants, and those affected by decisions made.

1.07 PRE-SHUTDOWN MEETINGS

A. Shutdowns and other tie-ins require a pre-shutdown meeting at Project site prior to commencing shutdown for tie-in or modification of specific plant systems.

B. Require attendance of parties directly affecting, or affected by shutdown, including Engineer, specific work crews, Owner's construction, operations, and maintenance staff.

C. Notify Owner and Engineer minimum of 5 working days in advance of meeting date in writing. Refer to section 01140 - Work Restrictions for additional time requirements for shutdown and tie-in scheduling.

D. Prepare agenda and preside at meeting:
   1. Review accepted MOP including conditions of shutdown, preparation, and installation procedures.
   2. Review timelines and sequences.
   3. Review responsibilities.
   4. Review dry run plan and schedule, as necessary.
   5. Review coordination with related work.

E. Engineer will record minutes and distribute copies within 5 calendar days after meeting and prior to scheduled shutdown to participants, with copies to Engineer, Owner, and those affected by decisions made.

1.08 PRE-PROCESS START-UP MEETINGS

A. Processes and equipment that requires testing and process start-up also requires a pre-startup meeting at Project site before commencing process start-up of specific plant systems.

B. Require attendance of parties directly affecting, or affected by process start-up and testing, including Engineer, specific work crews, Owner's construction operations, and maintenance staff.

C. Notify Owner and Engineer minimum of 5 working days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review accepted MOP including conditions of process start-up and testing, preparation, and installation procedures.
   2. Review timelines and sequences.
   3. Review responsibilities.
   4. Review dry run plan and schedule, as necessary.
   5. Review coordination with related work.

E. Engineer will record minutes and distribute electronic copies within 5 calendar days after meeting and prior to scheduled process start-up to participants, with copies to Engineer, Owner, and those affected by decisions made.

1.09 CLOSE-OUT MEETING

A. Engineer will schedule close-out meeting.

B. Engineer will make arrangements for meeting, prepare agenda with copies for participants, and preside at meeting.

C. Attendance required: Owner, Engineer, Contractor, Contractor's Project Manager, and Superintendent.

D. Agenda:
   1. Review deficiency list completion.
   2. Transfer of record documents.
   3. Finalize payment.

E. Engineer will record minutes and within 5 business days after meeting distribute electronic copies to participants.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01324C

PROGRESS SCHEDULES AND REPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preparation, submittal, and maintenance of computerized progress schedule and reports, Contract time adjustments, and payment requests, including the following:
   1. Preliminary Schedule.
   2. Baseline Schedule.
   3. Monthly Schedule Updates.
   4. Schedule of Submittals.
   5. Commissioning and Process Start-up Schedule.
   6. As-built Schedule.

B. Refer to General Conditions for additional scheduling requirements, where a conflict between the General Conditions and these specifications, the General Conditions will prevail.

1.02 SCHEDULER

A. Designate, in writing and within 5 calendar days after Notice of Award, person responsible for preparation, maintenance, updating, and revision of all schedules.

B. Qualifications of scheduler:
   1. Authority to act on behalf of Contractor.
   2. 5 years verifiable experience in preparation of complex construction schedules for projects of similar value, size, and complexity.
   3. Knowledge of critical path method (CPM) scheduling utilizing Primavera Project Planner or SureTrak or Microsoft Project software.

1.03 SCHEDULING FORMAT

A. Schedule format: Utilize CPM format.

B. Prepare computerized schedule utilizing Primavera P6 Professional or Microsoft Project, most current version.
   1. At the request of the County or Engineer submit an electronic version of the schedule in the original format.
   2. Provide submittal copies for review in hardcopy or electronic Adobe (.pdf) format.

1.04 SCHEDULE PREPARATION

A. Preparation and submittal of Progress Schedule represents Contractor's intention to execute the Work within specified time and constraints. Failure to conform to requirement may result in termination for cause as specified in the General Conditions.

B. Contractor's bid covers all costs associated with the execution of the Work in accordance with the Progress Schedule.

C. During preparation of the preliminary Progress Schedule, Engineer will facilitate Contractor's efforts by being available to answer questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.

D. Prepare schedule utilizing Precedence Diagramming Method (PDM).

E. Prepare schedule utilizing activity durations in terms of working days. Do not exceed 15 working day duration on activities except concrete curing, submittal review, and equipment fabrication and deliveries. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work. Coordinate holidays to be observed with the Owner and incorporate them into the schedule as non-working days.

F. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Contract. Contract requirements are not waived by failure of Contractor to include required schedule constraints, sequences, or milestones in schedule. Contract requirements are not waived by Owner's acceptance of the schedule. In event of conflict between accepted schedule and Contract requirements, terms of Contract govern at all times, unless requirements are waived in writing by the Owner.

G. Reference schedule to working days with beginning of Contract Time as Day "1."

H. Contract float is for the mutual benefit of both Owner and Contractor. Changes to the project that can be accomplished within this available period of float may be made by Owner without extending the Contract time, by utilizing float. Time extensions will not be granted nor delay damages owed until Work extends beyond currently accepted Contract completion date. Likewise, Contractor may utilize float to offset delays other than delays caused by Owner. Mutual use of float can continue until all available float shown by schedule has been utilized by either Owner or Contractor, or both. At that time, extensions of the Contract time will be granted by Owner for valid Owner-caused or third party-caused delays which affect the planned completion date and which have been properly documented and demonstrated by Contractor.

I. Non-sequestering of float: Pursuant to float sharing requirements of Contract, schedule submittals can be rejected for use of float suppression techniques such as preferential sequencing or logic, special lead or lag logic restraints, extended activity durations or imposed dates.

J. Interim milestone dates, operational constraints. In event there are interim milestone dates and/or operational constraints set forth in Contract, show them on schedule. Do not use Zero Total Float constraint or Mandatory Finish Date on such Contract requirements.

K. Schedule windows for Owner-furnished, Contractor-installed equipment or materials: Immediately after Award of Contract, obtain from Engineer, anticipated delivery dates of Owner furnished equipment or materials. Show these dates in the schedule in same manner indicated by Engineer.

1.05 NETWORK DETAILS AND GRAPHICAL OUTPUT

A. Produce a clear, legible, and accurate calendar based, time scaled, graphical network diagram. Group activities related to the same physical areas of the Work. Produce the network diagram based upon the early start of all activities.

B. Include for each activity, the description, activity number, estimated duration in working days, total float, and all activity relationship lines.

C. Illustrate order and interdependence of activities and sequence in which Work is planned to be accomplished. Incorporate the basic concept of the precedence diagram network method to show how the start of 1 activity is dependent upon the start or completion of preceding activities and its completion restricts the start of following activities.

D. Indicate the critical path for the project.

E. Delineate the specified contract duration and identify the planned completion of the Work as a milestone. Show the time period between the planned and Contract completion dates, if any, as an activity identified as project float unless a Change Order is issued to officially change the Contract completion date.

F. Identify system shutdown dates, system tie-in dates, specified interim completion or milestone dates and contract completion date as milestones.

G. Include, in addition to construction activities:
   1. Submission dates and review periods for major equipment submittals.
   2. Any activity by the Owner or the Engineer that may affect progress or required completion dates.
   3. Equipment and long-lead material deliveries over 8 weeks.
   4. Approvals required by regulatory agencies or other third parties.

H. Produce network diagram on 11-inch by 17-inch sheets with grid coordinate system on the border of all sheets utilizing alpha and numeric designations.

1.06 SUBMITTAL OF PROGRESS SCHEDULES

A. Submit preliminary and baseline schedule.

B. Submit, on a monthly basis, updated schedules with pay application.

C. Submit final schedule update as specified.

D. Submit revised schedules and time impact analyses as specified.

E. Submit schedules in the media and number of copies as follows:
   1. 3 sets of the CPM network and/or bar chart (as specified by the Owner) on D-size sheets. Color-coding to be specified by the Owner.
   2. 3 sets of Tabular reports listing all activities sorted numerically identifying duration, early start, late start, early finish, late finish, total float, and all predecessor/successor information.
   3. 2 sets of CPM Schedule data electronic files in a native backed-up file (.xer) stored on CD/DVD.

1.07 PRELIMINARY SCHEDULE

A. Submit Preliminary Schedule within 14 calendar days after Notice of Award. Include a detailed plan of operations for first 90 calendar days of Work within 14 calendar days after receipt of Notice to Proceed.

B. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule to review and make necessary adjustments. Submit revised preliminary schedule within 5 calendar days after meeting.

C. Incorporate unchanged, the Accepted Preliminary Schedule as first 90 calendar days of activity in Contractor's Baseline Schedule.

D. Update monthly during first 90 calendar days after Notice to Proceed.

1.08 BASELINE SCHEDULE

A. No more than 30 calendar days after Notice of Award, submit the Baseline Schedule for all Work of the project. Show sequence and interdependence of all activities required for complete performance of all Work, beginning with date of Notice to Proceed and concluding with date of final completion of Contract.

1.09 WEATHER DAYS ALLOWANCE

A. Refer to the Supplementary Conditions.

1.10 REVIEW AND ACCEPTANCE OF SCHEDULES

A. Engineer will review Baseline Schedule, Schedule Updates, Schedule Revisions, and Time Impact Analyses to ascertain compliance with specified project constraints, compliance with milestone dates, reasonableness of durations and sequence, accurate inter-relationships, and completeness.

B. Engineer and Owner will issue written comments following completion of review of Baseline Schedule within 20 calendar days after receipt.

C. Written comments on review of Schedule Updates and Schedule Revisions and Time Impact Analyses will be returned to Contractor within 14 calendar days after receipt by Engineer.

D. Revise and resubmit schedule in accordance with Engineer's comments within 5 calendar days after receipt of such comments or request joint meeting to resolve objections.

E. If Engineer requests a meeting, the Contractor and all major subcontractors must participate in the meeting with Engineer.
   1. Revise and resubmit schedule within 5 calendar days after meeting.

F. Use accepted schedule for planning, organizing, and directing the work and for reporting progress.

G. Engineer's submittal review response:
   1. When schedule reflects Owner's and Contractor's agreement of project approach and sequence, schedule will be accepted by Owner.
   2. Engineer's submittal review response for schedule submittal will be "Receipt Acknowledged – Filed for Record" including applicable comments.

H. Acceptance of the schedules by the Owner is for general conformance with the Contract Documents and for Owner's planning information and does not relieve the Contractor of sole responsibility for planning, coordinating, and executing the Work within the contract completion dates. Omissions and errors in the accepted schedules shall not excuse performance less than that required by the Contract Documents. Acceptance by the Owner in no way constitutes an evaluation or validation of the Contractor's plan, sequence or means, methods, and techniques of construction.

1.11 SCHEDULE UPDATES

A. Any update:
   1. Prepare update using most recent accepted version of schedule including:
      a. Actual start dates of activities that have been started.
      b. Actual finish dates of activities that have been completed.
      c. Percentage of completion of activities that have been started but not finished.
      d. Actual dates on which milestones were achieved.
      e. Update activities by inputting percent complete figures with actual dates.
      f. Use retained logic in preparing Schedule Updates.
      g. When necessary, input remaining durations for activities whose finish dates cannot be calculated accurately with a percent complete figure only.
      h. Revisions to the schedule may be included that have been previously approved as specified in this Section under Revisions to Schedule.

B. Monthly updates:
   1. Submit written narrative report in conjunction with each Schedule Update including descriptions of the following:
      a. Activities added to or deleted from the schedule are to adhere to cost and other resource loading requirements.
         1) Identify added activities in manner distinctly different from original activity designations.
      b. Changes in sequence or estimated duration of activities.
      c. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.
      d. Assumptions made and activities affected by incorporating change order work into the schedule.
   2. Submit updated schedule and materials specified under Submittal of Progress Schedules, 5 calendar days before the monthly schedule update meeting.

1.12 REVISIONS TO SCHEDULE

A. Submit Revised Schedule within 5 calendar days:
   1. When delay in completion of any activity or group of activities indicates an overrun of the Contract Time or milestone dates by 20 working days or 5 percent of the remaining duration, whichever is less.

2. When delays in submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
3. When the schedule does not represent the actual progress of activities.
4. When any change to the sequence of activities, the completion date for major portions of the work, or when changes occur which affect the critical path.
5. When Contract modification necessitates schedule revision, submit schedule analysis of change order work with cost proposal.

B. Create a separate submittal for Schedule Revisions.
   1. Comply with schedule updates as specified in this Section.
   2. Do not submit with Schedule Updates.

C. Schedule Revisions will not be reflected in the schedule until after the revision is accepted by the Owner.
   1. This includes Schedule Revisions submitted for the purpose of mitigating a Contractor-caused project delay (Recovery Schedule).

1.13 SUMMARY SCHEDULE

A. Provide Summary Schedule, which consolidates groups of activities associated with Major Items of Work shown on Baseline Schedule. Summary Schedule is intended to give an overall indication of the project schedule without a large amount of detail.

B. Submit updated Summary Schedule at weekly progress meetings and after each Schedule Update or Schedule Revision.

1.14 SCHEDULE OF SUBMITTALS

A. Schedule of Submittals shall include submittals required in the Contract Documents but not limited to Commissioning and Process Start-up Plans, Training Plans, test procedures, operation and maintenance manuals, shop drawings, samples, record documents, and specifically required certificates, warranties, and service agreements.

B. Preliminary Schedule of Submittals:
   1. Due date: After Preliminary Schedule has been submitted and accepted by Owner.
   2. Format:
      a. Include submittals anticipated in the first 90 calendar days after Notice to Proceed using early start dates.
      b. Indicate week and month anticipated for each submittal.
      c. Indicate "Priority" submittals where review time can impact Contractor's schedule.
         1) "Priority" indication will not alter review times specified in Section 01330 - Submittal Procedures.
         2) Engineer will endeavor to provide early review of "Priority" submittals where possible.
   3. Submittal of Preliminary Schedule of Submittals shall be a condition precedent to Owner making progress payments during the first 90 calendar days after Notice to Proceed.

C. Final Schedule of Submittals:
   1. Due date: After Baseline Schedule has been submitted and accepted by Owner.
   2. Format:
      a. Include submittals using early start dates.
      b. Include all submittals, including those required in the preliminary schedule of shop drawings and sample submittals.
      c. Indicate week and month anticipated for each submittal.
      d. Indicate "Priority" submittals where review time can impact Contractor's schedule.
         1) "Priority" indication will not alter review times specified in Section 01330 - Submittal Procedures.
         2) Engineer will endeavor to provide early review of "Priority" submittals where possible.
   3. Submittal of Final Schedule of Submittals shall be a condition precedent to Owner making progress payments after the first 90 calendar days after Notice to Proceed.

D. Provide updated Schedule of Submittals with updated schedules if schedule revisions change listing and timing of submittals.

1.15 COMMISSIONING AND PROCESS START-UP SCHEDULE SUBMITTAL

A. Proposed Commissioning and Process Start-up Schedule:
   1. Due date: As specified in Section 01756 - Commissioning.
   2. Schedule requirements: As specified in Section 01756 - Commissioning.
   3. Engineer response due within 20 calendar days of receipt.
   4. Contractor responsible for updating schedule and resubmitting within 10 calendar days of receipt of Engineer and Owner comments.

B. The Commissioning and Process Start-up Schedule may not be combined with the Detailed Schedule until Engineer acceptance of the Proposed Commissioning and Process Start-up Schedule.

C. Commissioning and Process Start-up Schedule monthly update requirements:
   1. Highlight percentages of completion, actual start and finish dates, and remaining durations, as applicable.
   2. Include activities not previously included in the previously accepted detail work plan Commissioning and Process Start-up Schedule.
   3. Change Order required for any change to contractual dates.
   4. Reviews of these submittals by Engineer will not be construed to constitute acceptance within the time frames, durations, or sequence of work for each added activity.

1.16 FINAL SCHEDULE SUBMITTAL

A. The final Schedule Update becomes the As-Built Schedule.
   1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.

2. Contractor's Project Manager and scheduler sign and certify the As-Built Schedule as being an accurate record of the way the project was actually constructed.

B. Retainage will not be released until final Schedule Update is provided.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements and procedures for submittals.

1.02 REFERENCES

A. NSF International:
   1. NSF 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

A. Certificates: Describe certificates that document affirmations by the Contractor or other entity that the work is in accordance with the Contract Documents.

B. Extra stock materials: Describe extra stock materials to be provided for the Owner's use in facility operation and maintenance.

C. Maintenance material submittals: Use this article to categorize maintenance materials submittals requiring no Engineer action other than confirmation of receipt under an explanatory heading.

D. Manufacturer's instructions: Instructions, stipulations, directions, and recommendations issued in printed form by the manufacturer of a product addressing handling, installation, erection, and application of the product; manufacturer's instructions are not prepared especially for the Work.

E. Product data: Product data usually consists of manufacturers' printed data sheets or catalog pages illustrating the products to be incorporated into the project.

F. Samples: Samples are full-size actual products intended to illustrate the products to be incorporated into the project. Sample submittals are often necessary for such characteristics as colors, textures, and other appearance issues.

G. Spare parts: Describe spare parts necessary for the Owner's use in facility operation and maintenance; identify the type and quantity here but include the actual characteristics of the spare parts in Product as part of the specification of the product.

H. Shop drawings: Shop drawings are prepared specifically for the project to illustrate details, dimensions, and other data necessary for satisfactory fabrication or construction that are not shown in the contract documents. Shop drawings could include graphic line-type drawings, single-line diagrams, or schedules and lists of products and their application.

I. Submittals: Submittals are samples, product data, shop drawings, and others that demonstrate how Contractor intends to conform with the Contract Documents.

J. Tools: Tools are generally defined as items such as special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the Owner's tool kit.

1.04 GENERAL INSTRUCTIONS

A. Certification: Contractor is responsible to determine and verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and check and coordinate each item with other applicable approved shop drawings and all Contract requirements.

B. Provide submittals that are specified or reasonably required for construction, operation, and maintenance of the Work.

C. Where multiple submittals are required, provide a separate submittal for each specification section.
   1. In order to expedite construction, the Contractor may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:
   2. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section.
   3. For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit breakers, even though they are covered in a different specification section.

D. Edit all submittals so that the submittal specifically applies to only the equipment furnished. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.

E. Prepare submittals in the English language. Do not include information in other languages.

F. Present measurements in customary American units (feet, inches, pounds, etc.).

G. Must be clear and legible, and of sufficient size for presentation of information.

H. Minimum page size will be 8-1/2 inches by 11 inches:
   1. Maximum page size will be 11 inches by 17 inches.

I. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.

J. Provide submittal information from only 1 manufacturer for a specified product. Submittals with multiple manufacturers for 1 product will be rejected without review.

K. Indicate project designated equipment tag numbers from P&IDs for submittal of devices, equipment, and assemblies.

1.05 SUBMITTAL ORGANIZATION

A. Fully indexed with bookmarks for every section.

B. Sequentially number pages within the tabbed sections:
   1. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.

C. Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.

D. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is used.

E. Attachments:
   1. Specification section: Include with each submittal a copy of the relevant specification section.
      a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
      b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
   2. Drawings: Include with each submittal a copy of the relevant Drawing, including relevant addendum updates.
      a. Indicate either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
      b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
      c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.

F. Contractor: Prepare submittal information in sufficient detail to show compliance with specified requirements.
   1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.
   2. Coordinate submittal with other submittals and with the requirements of the Contract Documents.
   3. Check, verify, and revise submittals as necessary to bring them into conformance with Contract Documents and actual field conditions.

1.06 SUBMITTAL METHOD AND FORMAT

A. Submittals in electronic media format:
   1. General: Provide all information in PC-compatible format using Windows® operating system as utilized by the Owner and Engineer.
   2. Text: Provide text documents and manufacturer's literature in Portable Document Format (PDF).
   3. Graphics: Provide graphic submittals (drawings, diagrams, figures, etc.) utilizing Portable Document Format (PDF).

1.07 SUBMITTAL PROCEDURE

A. Engineer: Review submittal and provide response:
   1. Review description:
      a. Engineer will be entitled to rely upon the accuracy or completeness of designs, calculations, or certifications made by licensed professionals accompanying a particular submittal whether or not a stamp or seal is required by Contract Documents or Laws and Regulations.
      b. Engineer's review of submittals shall not release Contractor from Contractor's responsibility for performance of requirements of Contract Documents. Neither shall Engineer's review release Contractor from fulfilling purpose of installation nor from Contractor's liability to replace defective work.
      c. Engineer's review of shop drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in Contract Documents.
      d. Engineer's review does not extend to:
         1) Accuracy of dimensions, quantities, or performance of equipment and systems designed by Contractor.
         2) Contractor's means, methods, techniques, sequences, or procedures.
         3) Safety precautions or programs related to safety which shall remain the sole responsibility of the Contractor.
      e. Engineer can Approve or Not Approve any exception at their sole discretion.
   2. Review timeframe:
      a. Except as may be provided in technical specifications, a submittal will be returned within an average 14 days.
      b. When a submittal cannot be returned within the specified period, Engineer will, within a reasonable time after receipt of the submittal, give notice of the date by which that submittal will be returned.
      c. Engineer's acceptance of progress schedule containing submittal review times less than those specified or agreed to in writing by Engineer will not constitute Engineer's acceptance of review times.
      d. Critical submittals:
         1) Contractor will notify Engineer in writing that timely review of a submittal is critical to the progress of Work.
   3. Schedule delays:
      a. No adjustment of Contract Times or Contract Price will be allowed due to Engineer's review of submittals, unless all of the following criteria are met:
         1) Engineer has failed to review and return first submission within the agreed upon time frame.
         2) Contractor demonstrates that delay in progress of Work is directly attributable to Engineer's failure to return submittal within time indicated and accepted by Engineer.
   4. Review response will be returned to Contractor with one of the following dispositions:
      a. Approved:
         1) No Exceptions:
            a) There are no notations or comments on the submittal and the Contractor may release the equipment for production.

2) Make Corrections Noted - See Comments:
   a) The Contractor may proceed with the work; however, all notations and comments must be incorporated into the final product.
   b) Resubmittal not required.
3) Make Corrections Noted - Confirm:
   a) The Contractor may proceed with the work; however, all notations and comments must be incorporated into the final product.
   b) Submit confirmation specifically addressing each notation or comment to the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.

b. Not approved:
1) Correct and resubmit:
   a) Contractor may not proceed with the work described in the submittal.
   b) Contractor assumes responsibility for proceeding without approval.
   c) Resubmittal of complete submittal package is required within 30 calendar days of the date of the Engineer's submittal review response.
2) Rejected - See Remarks:
   a) Contractor may not proceed with the work described in the submittal.
   b) The submittal does not meet the intent of the Contract Documents. Resubmittal of complete submittal package is required with materials, equipment, methods, etc. that meet the requirements of the Contract Documents.

c. Receipt acknowledged: Filed for record:
1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc.

B. Contractor: Prepare resubmittal, if applicable:
1. Clearly identify each correction or change made.
2. Include a response in writing to each of the Engineer's comments or questions for submittal packages that are resubmitted in the order that the comments or questions were presented throughout the submittal and numbered consistent with the Engineer's numbering.
   a. Acceptable responses to Engineer's comments are listed below:
      1) "Incorporated" Engineer's comment or change is accepted, and appropriate changes are made.
      2) "Response" Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.

b. Reviews and resubmittals:
    1) Contractor shall provide resubmittals which include responses to all submittal review comments separately and at a level of detail commensurate with each comment.
    2) Contractor responses shall indicate how the Contractor resolved the issue pertaining to each review comment. Responses such as "acknowledged" or "noted" are not acceptable.
    3) Resubmittals which do not comply with this requirement may be rejected and returned without review.
    4) Contractor shall be allowed no extensions of any kind to any part of their contract due to the rejection of non-compliant submittals.
    5) Submittal review comments not addressed by the Contractor in resubmittals shall continue to apply whether restated or not in subsequent reviews until adequately addressed by the Contractor to the satisfaction of the reviewing and approving authority.
c. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for Revision and Resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.

3. Review costs:
    a. Costs incurred by Owner as a result of additional reviews of a particular submittal after the second time it has been reviewed shall be borne by Contractor.
    b. Reimbursement to Owner will be made by deducting such costs from Contractor's subsequent progress payments.

1.08 SHOP DRAWINGS

A. Contractor to field verify elevation, coordinates, and pipe material for pipe tie-in to pipeline or structure prior to the preparation of shop drawings.

B. Details:
    1. Fabrication drawings: Drawn to scale and dimensioned.
    2. Front, side, and, rear elevations, and top and bottom views, showing all dimensions.
    3. Locations of conduit entrances and access plates.
    4. Component layout and identification.
    5. Weight.
    6. Finish.
    7. Temperature limitations, as applicable.
    8. Nameplate information.

C. Minor or incidental products and equipment schedules:
    1. Details:
        a. Shop Drawings of minor or incidental fabricated products will not be required, unless requested.
        b. Submit tabulated lists of minor or incidental products showing the names of the manufacturers and catalog numbers, with Product Data and Samples as required to determine acceptability.

1.09 PRODUCT DATA

A. Details:
   1. Supplier name and address.
   2. Subcontractor name and address.

B. Include:
   1. Catalog cuts.
   2. Bulletins.
   3. Brochures.
   4. Manufacturer's Certificate of Compliance: Signed by product manufacturer along with supporting reference data, affidavits, and tests, as appropriate.
   5. Manufacturer's printed recommendations for installation of equipment.
   6. Quality photocopies of applicable pages from manufacturer's documents.

C. Motor Data Sheet:
   1. Provide completed Motor Data Sheet as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower, for every motor furnished as part of the associated equipment submittal.

D. Test reports including the following information:
   1. Test description.
   2. List of equipment used.
   3. Name of the person conducting the test.
   4. Date and time the test was conducted.
   5. Ambient temperature and weather conditions.
   6. All raw data collected.
   7. Calculated results.
   8. Clear statement if the test passed or failed the requirements stated in Contract Documents.
   9. Signature of the person responsible for the test.

E. Certificates:
   1. As specified in technical sections.
   2. For products that will be in contact with potable water, submit evidence from a nationally recognized laboratory that the products comply with the requirements of the NSF 61 standard.

1.10 SAMPLES

A. Details:
   1. Submit labeled samples.
   2. Samples will not be returned.
   3. Provide samples from manufacturer's standard colors, materials, products, or equipment lines.
      a. Clearly label samples to indicate any that represent non-standard colors, materials, products, or equipment lines and that if selected, will require an increase in Contract Time or Contract Price.
   4. Provide number of sample submittals as below:
      a. Total: 3 minimum.
         1) Owner: 1.
         2) Engineer: 2.
         3) Contractor: None.

B. Field samples:
   1. As specified in technical sections.

1.11 DESIGN CALCULATIONS

A. Defined in technical sections:
   1. Calculations must bear the original seal and signature of a Professional Engineer licensed in the state where the project is located and who provided responsible charge for the design.

1.12 SCHEDULES

A. Progress schedules: As specified in Section 01324C - Progress Schedules and Reports.
   1. Each schedule submittal specified in these Contract Documents shall be submitted as a native backed-up file (.xer) of the scheduling program as specified in Section 01324C - Progress Schedules and Reports.
   2. The schedule and all required reports shall also be submitted as a PDF file.
   3. Schedule of values: As specified in Section 01292 - Schedule of Values.
   4. Schedule of submittals: As specified in Section 01324C - Progress Schedules and Reports.

A. Progress reports and quantity charts:
   1. As specified in Section 01324C - Progress Schedules and Reports.

1.13 REQUESTS FOR SUBSTITUTIONS (RFS)

A. As specified in Section 01600 - Product Requirements.

1.14 REQUESTS FOR INFORMATION (RFI)

A. As specified in the General and Supplementary Conditions.

1.15 CLOSEOUT SUBMITTALS

A. Provide closeout submittals as specified in Section 01770 - Closeout Procedures.

B. Operation and Maintenance Manuals: final documents shall be submitted as specified in Section 01782 - Operation and Maintenance Data.

C. Extra materials, spare parts, etc.: Submittal forms shall indicate when actual materials are submitted.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

APPENDIX A

CONTRACTOR SUBMITTAL TRANSMITTAL FORM

DOCUMENT 01330
CONTRACTOR SUBMITTAL TRANSMITTAL FORM

Owner:	Polk County Utilities	**Date:**	MM/DD/YYYY
Contractor:	Click here to enter text.	**Project No.:**	XXXXX.XX
Project Name:	Gibson Oaks WPF	**Submittal Number:**	000
Submittal Title:	Click here to enter text.		
To:	Click here to enter text.		
From:	Click here to enter text.	Click here to enter text.	
	Click here to enter text.	Click here to enter text.	

Specification No. and Subject of Submittal / Equipment Supplier			
Spec ##:	Spec ##.	**Subject:**	Click here to enter text.
Authored By:	Click here to enter text.	**Date Submitted:**	XX/XX/XXXX

Submittal Certification

Check Either (A) or (B):

☐ (A) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions.

☐ (B) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the deviations listed on the following sheet to this cover.

Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.

General Contractor's Reviewer's Signature:

Printed Name:

In the event, Contractor believes the Submittal response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.

Firm: Click here to enter text. **Signature:** **Date Returned:** XX/XX/XXXX

PM/CM Office Use	
Date Received GC to PM/CM:	
Date Received PM/CM to Reviewer:	
Date Received Reviewer to PM/CM:	
Date Sent PM/CM to GC:	

SECTION 01340

PHOTOGRAPHIC AND VIDEOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for photographs and videos.

B. The purpose of the photographs and videos is to document the condition of the facilities prior to the Contractor beginning work at the Project site, the progress of the Work, and the Project site after Substantial Completion of the Work.

C. The scope of the photographic and videographic documentation shall be the sole responsibility of the Contractor but shall be acceptable to the Owner and Engineer.

1.02 SUBMITTALS

A. Pre-construction photographs and videos: Submit prior to beginning work at the Project site or prior to the Preconstruction Conference specified in Section 01312 - Project Meetings, whichever occurs earlier.

B. Construction photographs and videos: Submit with each application for payment.

C. Post-construction photographs and videos: Submit with project closeout documents as specified in Section 01770 - Closeout Procedures.

1.03 KEY PLAN

A. Submit key plan of Project site with notation of vantage points marked for location and direction of each photograph.

B. Include the same label information as the corresponding set of photographs.

1.04 PHOTOGRAPHS

A. Provide prints of each photograph for each area of Work.

B. Provide a digital copy of each photograph for each area of Work.
   1. Monthly: Indexed digital CD.
   2. Project record documents:
      a. Catalog and index prints in chronological sequence.
      b. Include typed table of contents.
      c. Provide time and date on each digital photographs.

1.05 PRE-CONSTRUCTION PHOTOGRAPHS AND VIDEOS

A. Provide photographs, aerial photographs, and video of the condition of each site including each area of Work prior to the start of Work.
   1. Areas to be photographed and videoed shall include the location of the Work and all existing facilities, either on or adjoining each Project site, including the interior of existing structures that could be damaged as a result of the Contractor's Work.
   2. Include general condition, structures, vegetation, staging, storing, working, parking areas and excavation areas.

1.06 CONSTRUCTION PHOTOGRAPHS AND VIDEOS

A. Provide photographs, aerial photographs, and videos of construction in each area of Work throughout progress of Work including a key plan designating where each photograph was taken.

B. Take site and interior photographs and videos from differing directions of building demolition, pre-excavation, footing excavation, soil testing, utility crossings, installation of bypass piping, excavation of access pits, installation of lining system in pipes, rehabilitation of manholes, building modifications, utilities, electrical and instrumentation modifications, and other applicable activities indicating relative progress of the work.

C. Take photographs a maximum of 7 calendar days prior to submittal.

D. Take 3 aerial photographs monthly of the Gibson Oaks and Sherwood Lakes sites from the east, south, west, and north directions while work is in progress.

E. Take photographs of all underground installations and crossings of the new piping, conduits, and duct banks. Pictures shall be identified on the site plan As-Built drawings and locate direction of view and date picture was taken. Include as part of the Closeout Documents in 01770 - Closeout Procedures Part 1.06.

1.07 POST-CONSTRUCTION PHOTOGRAPHS AND VIDEOS

A. Provide photographs and aerial photographs of the entire site including each area of Work at the completion of Work.
   1. Include general condition, structures, vegetation, staging, storing, working, parking areas and excavation areas.
   2. Take photos and video from same points in same direction as pre-construction examination.

B. Submittal of photos and videos is a condition of final payment.

PART 2 PRODUCTS

2.01 MEDIA

A. Paper media:
   1. Commercial grade, glossy surface, acid-free photographic paper.
   2. Submit 3 prints of each photographic view within 7 days of taking photographs.

3. Format:
    a. Ground photos: Color, matte finish, 8-1/2-inch by 11-inch size, mounted on soft card stock.
    b. Aerial photos: Color, matte finish, 11-inch by 17-inch size, mounted on soft card stock.
    c. Mount each print in a separate, archival type, non-glare, 3-hole punched protector.
4. Identification: On photograph, provide the following information:
    a. Name of project.
    b. Date stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
    c. Description of vantage point, indicating location and direction by compass point. Provide process number of facility if applicable.
5. Provide a suitably sized 3-ring binder for each set of prints.
    a. Furnish binders in sufficient quantities to hold entire set of prints taken for the duration of the Contract.
    b. Label binder spine and front with project name and separate by site location.
6. Digital media is acceptable over paper media. Refer to 2.01 B. for digital media requirements.

B. Digital media:
1. 120 millimeters, 700-MB, 80-minute CD compatible with current Microsoft Windows.
2. Provide photos as individual, indexed JPG files with the following characteristics:
    a. Compression shall be set to preserve quality over file size.
    b. Highest resolution JPG images shall be submitted. Resizing to a smaller size when high resolution JPGs are available shall not be permitted.
    c. JPG image resolution shall be 5 megapixels at 2,400 by 1,800 or higher.
    d. Images shall have rectangular clean images. Artistic borders, beveling, drop shadows, etc., are not permitted.
3. Maintain descriptive file naming and organization within electronic folders by process facility and site locations.
4. Identification: On photograph, provide the following information:
    a. Name of project.
    b. Site Location
    c. Date stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
    d. Description of vantage point, indicating location and direction by compass point.

C. Videos:
1. DVD compatible, 120 millimeters, formatted for use with PC systems.
2. Video quality shall be 720p HD or greater in MPG, AVCHD, AVI, or MP4 format.
3. Digital color video format.
4. Provide audio portion of the composite CD sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.
5. Identification: On each copy provide a label with the following information:
    a. Name of project.

b. Date video was recorded.
c. Site location.

6. Submit 4 copies of each video within 7 days of recording.

PART 3 EXECUTION

3.01 GENERAL

A. Videos:
1. Display continuous running time.
2. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at each Project site.

B. Delivery:
1. Deliver photographs monthly to accompany each request for progress payment.
2. If the submitted photographs do not meet the requirements of this section, submit another series within one week.

END OF SECTION

SECTION 01351

ENVIRONMENTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for monitoring compliance of endangered species stipulations associated with the Work.

1.02 REFERENCES

A. Florida Fish and Wildlife Conservation Commission (FWC):
   1. Gopher tortoise, Gopherus polyphemus.
      a. Gopher tortoise permitting.

B. U.S. Fish and Wildlife Services (USFWS).

1.03 SUBMITTALS

A. Protection procedures:
   1. Safety training plan for employees, agents, and subcontractors.
   2. Signs to be installed on premises.
   3. Qualifications, including certifications, of environmental monitoring subcontractor and staff.

1.04 QUALIFICATIONS OF MONITORING PERSONNEL (MONITOR)

A. Minimum of 5 years of experience specifically related to gopher tortoise (GT) monitoring, permitting, and relocation.

B. Familiar with the region and specific habitat encountered at and near the Work.

C. FWC permitted biologist to review and clear the each site location prior to construction and install site containment in accordance with FWC permitting guidelines.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 FIELD OR SITE QUALITY CONTROL AND MONITORING

A. Pre-construction:
   1. Provide monitoring on site by the certified environmental scientist to identify site activity.

2. Document on-site training as follows:
    a. Sign-in sheet documenting all in attendance at the training.
    b. Hard copy certificate issued to each attendee certifying completion of the training.
    c. Unique and easily identifiable hard hat sticker issued to each attendee that is to be worn at all times on site by each individual who has completed the training.
    d. Hanging tag or window sticker to be issued to drilling rigs, construction vehicles, Engineer vehicles, Owner vehicles certifying that the operator of tagged vehicle has completed the training.
3. Develop written training materials and project procedures as follows:
    a. Training agenda.
    b. Project procedures including at least the following:
        1) Identification of habitat areas (signage, flagging, etc.).
        2) Access, ingress, and egress to/from GT habitat areas.
        3) Monitor contact information.
        4) Ongoing day-to-day monitoring services and protocols.
4. Develop project sign to be posted at designated staging areas and GT ingress/egress points.
5. Provide training as needed to new employees, vendors, etc. throughout the duration of the project.

B. Field monitoring and inspections:
1. Attend daily safety meetings at the beginning of each day on site.
2. Provide onsite monitoring services in accordance with the project procedures, USFWS requirements, FWC requirements, and as stipulated in the project specific environmental assessment and presence/absence survey documents.

END OF SECTION

SECTION 01355B

STORMWATER POLLUTION PREVENTION CONSTRUCTION ACTIVITY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for preparation and implementation of the Stormwater Pollution Prevention Plan (SWPPP) for the Contractor's construction activities for the purpose of applying and obtaining General Construction Activity Stormwater Permit for the Project.

1.02 REFERENCES

A. United States Code of Federal Regulation (CFR):
   1. Title 40 - Environmental Protection Agency (EPA):
      a. Part 117 - Determination of reportable quantities for hazardous substance.
      b. Part 302 - Designation, reportable quantities, and notification.

B. Civil Drawing 00C09.

1.03 SUBMITTALS

A. Stormwater Pollution Prevention Plan:
   1. Prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) in accordance with Part IV of the General Permit for Discharge from Construction Activities to the Owner for reference.
   2. The SWPPP must detail which measures will be used for (1) Stormwater Controls; (2) Erosion and Sedimentation Controls; (3) Good Housekeeping; (4) Stabilization Practices; and (5) Structural Practices.
   3. Submit to the Owner for reference, a plan detailing the placement of physical controls, such as Best Management Practices (BMPs), required for installation and the methods used to comply with those controls.
   4. The plan shall specifically address and detail the Contractor's preferred techniques and shall show how they will comply with the stated objectives of the General Permit.

B. The entire plan for each site shall be kept and maintained by the Contractor on the construction site during the duration of the project.

C. The Contractor shall be responsible for taking the proper actions to prevent contaminants and sediments from entering the storm sewer drainage system should any unforeseen circumstance occur. The Contractor shall take immediate action if directed by the Owner or Engineer, or if the Contractor observes contaminants and/or sediments entering the storm drainage system, to prevent further stormwater from entering the system.

D. The Contractor shall be responsible for submitting the notice of intent (NOI) and all necessary documentation to appropriate authority of jurisdiction for approval of the SWPPP.

1.04 REGULATORY REQUIREMENTS

A. EPA, State of Florida, Polk County, and other local agency requirements regarding stormwater discharges and management.

B. All authorizations, prohibitions, limitations, and permit conditions of the General Permit.

1.05 STORMWATER POLLUTION PREVENTION PLAN IMPLEMENTATION

A. The Contractor shall implement all activities required by the General Permit and as detailed in the SWPPP.

1.06 NON-STORMWATER MANAGEMENT

A. The SWPPP shall discuss any non-storm water sources (i.e., lake water, landscaping irrigation, pipe flushing, street washing, and dewatering). In addition, the Plan shall include standard observation measures and best management practices, including best available technologies economically achievable, and best conventional pollutant control technologies that are to be implemented in order to reduce the pollutant loading to the waters.

1.07 AMENDMENTS

A. The Contractor shall amend the SWPPP whenever there is a change in construction or operations which may affect the discharge of pollutants to stormwater.

B. The SWPPP shall also be amended if it is in violation of any conditions of the general permit or has not achieved the general objective of reducing pollutants in stormwater discharges.

C. All amendments shall be completed at no additional cost to the Owner.

1.08 NOTICE OF TERMINATION

A. The Contractor shall submit, a Notice of Termination (NOT) upon completion of all construction activities to the Owner and Engineer for review. Contractor shall submit the reviewed NOT to the appropriate authority having jurisdiction.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01424

ABBREVIATIONS AND ACRONYMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Abbreviations and meanings.

1.02 INTERPRETATIONS

A. Interpret abbreviations by context in which abbreviations are used.

1.03 ABBREVIATIONS

A. Abbreviations used to identify reference standards:

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ABC	Associated Air Balance Council
AATCC	American Association of Textile Chemists and Colorists.
ABMA	American Bearing Manufacturers' Association (formerly AFBMA, Anti-Friction Bearing Manufacturers' Association)
ABPA	Acoustical and Board Products Association
ACGIH	American Conference of Government Industrial Hygienists
ACI	American Concrete Institute
ACIL	American Council of Independent Laboratories
ADC	Air Diffusion Council
ABMA	American Bearing Manufacturers' Association (formerly AFBMA, Anti-Friction Bearing Manufacturers' Association)
AGA	American Gas Association
AGC	Associated General Contractors
AGMA	American Gear Manufacturers' Association
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
AI	Asphalt Institute
AIA	American Institute of Architects
AIMA	Acoustical and Insulating Materials Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association International, Inc.
AMG	Arizona Masonry Guild
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers

ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	ASTM International
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWSC	American Welding Society Code
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America
BSI	Building Stone Institute
CFR	United States Code of Federal Regulations
CLFMI	Chain Link Fence Manufacturers Institute
CPSC	U.S. Consumer Product Safety Commission
CRA	California Redwood Association
CRI	Carpet and Rug Institute
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standards
CSA	CSA International
CSI	Construction Specifications Institute
CTI	Ceramic Tile Institute
DHI	Door and Hardware Institute
EIFS	Exterior Insulation and Finish System
EJCDC	Engineers Joint Contract Documents Committee
EPA	United States Environment Protection Agency
FDA	Food and Drug Administration
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FGMA	Flat Glass Marketing Association
FHWA	Federal Highway Administration
FIA	Factory Insurance Association
FM	FM (Factory Mutual) Global
FS	Federal Specifications
FTI	Facing Tile Institute
GA	Gypsum Association
HI	Hydraulic Institute
HMMA	Hollow Metal Manufacturers Association
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
ICC	International Code Council
ICEA	Insulated Cable Engineer’s Association

ICRI	International Concrete Repair Institute
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISA	International Society of Automation
ISO	International Organization for Standardization
JIC	Joint Industrial Council
MAG	Maricopa Association of Governments MIA Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS	Military Specifications
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International
NAPA	National Asphalt Pavement Association
NAVFAC	Department of the Navy Facilities Engineering Command
NBHA	National Builders Hardware Association
NCMA	National Concrete Masonry Association
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NETA	InterNational Electrical Testing Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NMWIA	National Mineral Wool Insulation Association
NPCA	National Paint and Coatings Association
NRCA	National Roofing Contractors Association
NSF	NSF International
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturer's Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PCU	Polk County Utilities
PDCA	Paint and Decorating Contractors of America
PDI	Plumbing and Drainage Institute
PEI	Porcelain Enamel Institute
PS	Product Standard
RCSC	Research Council on Structural Connections
RILEM	International Union of Testing and Research Laboratories for Materials and Structures
RTI	Resilient Tile Institute
SAE	SAE International
SCPA	Structural Clay Products Association

SDI	Steel Door Institute
SFWMD	South Florida Water Management District
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Society for Protective Coatings
TABB	Testing, Adjusting, and Balancing Bureau
TCA	Tile Council of America
UL	Underwriters Laboratories, Inc.
UNS	Unified Numbering System
USDA	United States Department of Agriculture
USACE	U.S. Army Corps of Engineers
USEPA	U.S, Environmental Protection Agency
USSM	Polk County Utility Standards and Specification Manual
VA	Vermiculite Association
WCLA	West Coast Lumberman's Association
WCLIB	West Coast Lumber Inspection Bureau
WPA	Western Pine Association
WPOA	Western Plumbing Officials Association
WRC	Welding Research Council
WSCPA	Western States Clay Products Association
WWPA	Western Wood Products Association

B. Abbreviations used in Specifications and Drawings:

a	year or years (metric unit)
A	ampere or amperes
am	ante meridian (before noon)
ac	alternating current
ac-ft	acre-foot or acre-feet
atm	atmosphere
AWG	American Wire Gauge
bbl	barrel or barrels
bd	board
bhp	brake horsepower
BIL	basic impulse insulation level
bil gal	billion gallons
BOD	biochemical oxygen demand
Btu	British thermal unit or units
Btuh	British thermal units per hour
bu	bushel or bushels
BV	bed volume(s)
C	degrees Celsius
cal	calorie or calories
cap	capita
cd	candela or candelas

cfm	cubic feet per minute
Ci	curie or curies
CIPP	Cured-in-Place Pipe
cm	centimeter or centimeters
cmu	concrete masonry unit
CO	carbon monoxide
Co.	Company
CO_2	carbon dioxide
COD	chemical oxygen demand
Corp.	Corporation
counts/min	counts per minute
cu	cubic
cu cm	cubic centimeter or centimeters
cu ft	cubic foot or feet
cu ft/day	cubic feet per day
cu ft/hr	cubic feet per hour
cu ft/min	cubic feet per minute
cu ft/sec	cubic feet per second
cu in	cubic inch or inches
cu m	cubic meter or meters
cu yd	cubic yard or yards
d	day (metric units)
day	day (English units)
db	decibels
D/d	column diameter to particle diameter ratio
DB	dry bulb (temperature)
dc	direct current
diam	diameter
DO	dissolved oxygen
DS	dissolved solids
EBCT	empty bed contact time
EER	energy efficiency ratio
emf	electromotive force
fpm	feet per minute
F	degrees Fahrenheit
ft	feet or foot
fc	foot-candle or foot candles
ft/day	feet per day
ft/hr	feet per hour
ft/min	feet per minute
ft/sec	feet per second
g	gram or grams
G	gravitational force
gal	gallon or gallons
gal/day	gallons per day
gal/min	gallons per minutes
gal/sec	gallons per second
gfd	gallons per square foot per day

g/L	grams per liter
gpd	gallons per day
gpd/ac	gallons per day per acre
gpd/cap	gallons per day per capita
gpd/sq ft	gallons per day per square foot
gph	gallons per hour
gpm	gallons per minute
gpm/sq ft	gallons per minute per square foot
gps	gallons per second
g/cm^3	grams per cubic centimeter
h	hour or hours (metric units)
ha	hectare or hectares
hp	high point
hp	horsepower
hp-hr	horsepower-hour or horsepower-hours
hr	hour or hours (English units)
Hz	hertz
ID	inside diameter
ihp	indicated horsepower
Inc.	Incorporated
in	inch or inches
in/sec	inches per second
I/O	input/output
J	joule or joules
JTU	Jackson turbidity unit or units
k	kips
K	kelvin
K	thermal conductivity
kA	kiloampere
kcal	kilocalorie or kilocalories
kcmil	thousand circular mils
kg	kilogram or kilograms
kip	kilopound or kilopounds
km	kilometer or kilometers
kN	kilonewton or kilonewtons
kPa	kilopascal or kilopascals
ksi	kips per square inch
kV	kilovolt or kilovolts
kVA	kilovolt-ampere or kilovolt-amperes
kW	kilowatt or kilowatts
kWh	kilowatt hour
L	liter or liters
lb/1000 cu ft	pounds per thousand cubic foot
lb/acre-ft	pounds per acre-foot
lb/ac	pounds per acre
lb/cu ft	pounds per cubic foot
lb/day/cu ft	pounds per day per cubic foot

lb/day/acre	pounds per day per acre
lb/sq ft	pounds per square foot
L/D Ratio	Ratio of filter height to filter media particle diameter
lin	linear, lineal
lin ft	linear foot or feet
lm	lumen or lumens
lmh	liters per square meter per hour
log	logarithm (common)
ln	logarithm (natural)
lx	lux
m	meter or meters
M	molar (concentration)
mA	milliampere or milliamperes
max	maximum
mCi	millicurie or millicuries
meq	milliequivalent
meq/mL	milliequivalents per milliliter
MFBM	thousand feet board measure
mfr	manufacturer
mg	milligram or milligrams
mgd/ac	million gallons per day per acre
mgd	million gallons per day
mg/L	milligrams per liter
mrem	millirem
μF	microfarad or microfarads
Mil	0.001 inch (used for coating thickness)
mile	mile
mil. gal	million gallons
miles	miles
min	minimum
min	minute or minutes
MLSS	mixed liquor suspended solids
MLVSS	mixed liquor volatile suspended solids
mm	millimeter or millimeters
mol wt	molecular weight
mol	mole
Mpa	megapascal or megapascals
mph	miles per hour
MPN	most probable number
MPT	National Pipe Thread, male fitting
mR	milliroentgen or milliroentgens
Mrad	megarad or megarads
mV	millivolt or millivolts
MW	megawatt or megawatts
μg/L	micrograms per liter
μm	micrometer or micrometers
µS/cm	microSeimens per centimeter
N	newton or newtons
N	normal (concentration)
ND	not detected

nm	nanometer
No.	number
Nos	numbers
NPT	National Pipe Thread
NRC	noise reduction coefficient
NTU or ntu	nephelometric turbidity unit
oc	on center
OD	outside diameter
ORP	oxidation-reduction potential
OT	ortho-tolidine
OTA	ortha-tolidine-arsenite
oz	ounce or ounces
oz/sq ft	ounces per square foot
Pa	pascal or pascals
pl	plate or property line
pm	post meridiem (afternoon)
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
pr	pair
psf/hr	pounds per square foot per hour
psf	pounds per square foot
psi	pounds per square inch
psia	pounds per square inch absolute
psig	pounds per square inch gauge
PVC	polyvinyl chloride
qt	quart or quarts
R	radius
R	roentgen or roentgens
rad	radiation absorbed dose
RH	relative humidity
rpm	revolutions per minute
rps	revolutions per second
s	second (metric units)
S	Siemens (mho)
scfh	standard cubic feet per hour
scfm	standard cubic feet per minute
SDI	sludge density index or silt density index
sec	second (English units)
SI	International System of Units
sp	static pressure
sp gr	specific gravity
sp ht	specific heat
sq	square
cm^2 or sq cm	square centimeter or centimeters
sq ft	square feet or foot
sq inch	square inch
sq inches	square inches

km^2 or sq km	square kilometer or kilometers
m^2 or sq m	square meter or meters
mm^2 or sq mm	square millimeter or millimeters
sq yd	square yard or yards
SS	suspended solids
STC	Sound Transmission Class
SVI	sludge volume index
TDS	total dissolved solids
TEFC	totally enclosed, fan-cooled
TKN	total Kjeldahl nitrogen
TLM	median tolerance limit
TOC	total organic carbon
TOD	total oxygen demand
TOW	top of weir
TS	total solids
TSS	total suspended solids
TVS	total volatile solids
U	U Factor/U Value
U	Coefficient of Heat Transfer
U	heat transfer coefficient
UNS	Uniform Numbering System
US	United States
V	volt or volts
VA	volt-ampere or volt-amperes
W	watt or watts
WB	wet bulb
wg	water gauge
wk	week or weeks
WRT	water remediation technologies
wt	weight
yd	yard or yards
yr	year or years (English unit)

C. Refer to additional abbreviations located on the Drawings.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01450

QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Quality control and control of installation.
   2. Tolerances.
   3. References.
   4. Mock-up requirements.
   5. Authority and duties of Owner's representative or inspector.
   6. Sampling and testing.
   7. Testing and inspection services.
   8. Contractor's responsibilities.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

H. When specified, products will be tested and inspected either at point of origin or at Work site:
   1. Notify Engineer in writing well in advance of when products will be ready for testing and inspection at point of origin.
   2. Do not construe that satisfactory tests and inspections at point of origin is final acceptance of products. Satisfactory tests or inspections at point of origin do not preclude retesting or re-inspection at Work site.

I. Do not ship products which require testing and inspection at point of origin prior to testing and inspection.

1.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When Manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.04 REFERENCES

A. ASTM International (ASTM): E329 - Standard for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

B. For products or workmanship specified by association, trades, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

C. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

D. Obtain copies of standards where required by product specification sections.

E. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

1.05 MOCK-UP REQUIREMENTS

A. Tests will be performed under provisions identified in this Section and identified in respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work.

D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Engineer.

1.06 SAMPLING AND TESTING

A. General:
   1. Prior to delivery and incorporation in the Work, submit listing of sources of materials, when specified in sections where materials are specified.
   2. When specified in sections where products are specified:
      a. Submit sufficient quantities of representative samples of character and quality required of materials to be used in the Work for testing or examination.

b. Test materials in accordance with standards of national technical organizations.

B. Sampling:
1. Furnish specimens of materials when requested.
2. Do not use materials which are required to be tested until testing indicates satisfactory compliance with specified requirements.
3. Specimens of materials will be taken for testing whenever necessary to determine quality of material.
4. Assist Engineer in preparation of test specimens at site of work, such as soil samples and concrete test cylinders.

1.07 TESTING AND INSPECTION SERVICES

A. The Owner's independent testing firm will perform tests, inspections and other services specified in individual specification sections and as required by Owner and requested by the Engineer.

B. Reports will be submitted to the Engineer, Contractor, and Owner, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents. 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 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.

C. Limitations of authority of testing Laboratory: Owner's independent testing firm or Laboratory is not authorized to:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

D. The Owner's independent testing firm responsibilities will include:
1. Test samples of mixes submitted by Contractor.
2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
3. Perform specified sampling and testing of products in accordance with specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
6. Perform additional tests required by Engineer.

7. Attend preconstruction meetings and progress meetings, as needed.

E. Owner's independent testing firm individual test reports: After each test, Owner's independent testing firm will promptly submit electronically and three hard copies of report to Engineer and to Contractor. When requested by Engineer, the Owner's independent testing firm will provide interpretation of test results. Include the following:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector.
   4. Date and time of sampling or inspection.
   5. Identification of product and specifications section.
   6. Location in Project.
   7. Type of inspection or test.
   8. Date of test.
   9. Certified test results stamped and signed by a registered Engineer in the State of Florida.
   10. Summary of conformance with Contract Documents.

F. Owner's independent testing firm will provide monthly report of certification to identify all work performed for special inspections and other contract requirements on this project. The following certified monthly report at a minimum will include but not limited to:
   1. Results of testing.
   2. Testing logs.
   3. Outstanding deficiencies.
   4. Various statistical data.
   5. Testing curves (up to 4 types) as required by the Engineer.

1.08 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with Owner's independent testing firm or laboratory personnel and provide access to construction and manufacturing operations.

B. Secure and deliver to Owner's independent testing firm or laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.

C. Provide to Owner's independent testing firm or laboratory and Engineer preliminary mix design proposed to be used for concrete, and other materials mixes which require control by testing laboratory.

D. Furnish electronically and 3 hard copies of product test reports.

E. Furnish incidental labor and facilities:
   1. To provide access to construction to be tested.
   2. To obtain and handle samples at Work site or at source of product to be tested.
   3. To facilitate inspections and tests.
   4. For storage and curing of test samples.

F. Notify Owner's independent testing firm or laboratory 48 hours in advance of when observations, inspections, and testing is needed for laboratory to schedule and perform in accordance with their notice of response time.

G. Testing and employment of an Owner's independent testing firm or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

H. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same Owner's independent testing firm on instructions by Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from the application for payment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

Furnishing, maintaining, and removing construction facilities and temporary controls, including temporary utilities, construction aids, barriers and enclosures, security, access roads, temporary controls, project sign, field offices and sheds, and removal after construction

1.02 REFERENCE

A. American National Standards Institute (ANSI).

B. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

A. General: For products specified to be furnished under this Section, submit product data as specified in Section 01330 - Submittal Procedures.

1.04 TEMPORARY UTILITIES

A. Temporary electrical power:
   1. Arrange with local utility to provide adequate temporary electrical service.
      a. The Contractor is responsible for providing all breakers, switches, transformers, and cables required to provide temporary power.
   2. Provide and maintain adequate jobsite power distribution facilities conforming to applicable Laws and Regulations.
   3. Provide, maintain, and pay for electric power for performance of the Work.

B. Temporary electrical lighting:
   1. In work areas, provide temporary lighting sufficient to maintain lighting levels during working hours not less than lighting levels required by OSHA and state agency which administers OSHA regulations where Project is located.
   2. When available, permanent lighting facilities may be used in lieu of temporary facilities:
      a. Prior to final completion of the Work, replace bulbs, lamps, or tubes used by Contractor for lighting.

C. Temporary heating, cooling, and ventilating:
   1. Heat and ventilate work areas to protect the Work from damage by freezing, high temperatures, weather, and to provide safe environment for workers.
   2. Permanent heating system may be utilized when sufficiently completed to allow safe operation.

D. Temporary water:
   1. Pay for and construct facilities necessary to furnish potable water for human consumption and non-potable water for use during construction. Pay for and install a temporary water meter with backflow preventer.
   2. Remove temporary piping and connections and restore affected portions of the facility to original condition before final completion.
   3. Pay for water used for construction prior to final completion. Owner will provide water for 30-day operational testing.
   4. Development of non-potable water supply (if used):
      a. Post ample signs throughout the work area warning that plant water is not potable.

E. Temporary sanitary facilities:
   1. Provide suitable and adequate sanitary facilities that are in compliance with applicable Laws and Regulations.
   2. Existing facility use is not allowed.
   3. At completion of the Work, remove sanitary facilities and leave site in neat and sanitary condition.

F. Temporary fire protection: Provide sufficient number of fire extinguishers of type and capacity required to protect the Work and ancillary facilities.

G. First aid: Post first aid facilities and information posters conforming to requirements of OSHA and other applicable Laws and Regulations in readily accessible locations.

H. Utilities in existing facilities: As specified in Section 01140 - Work Restrictions.

1.05 CONSTRUCTION AIDS

A. Provide railings, kick plates, enclosures, safety devices, and controls required by Laws and Regulations and as required for adequate protection of life and property.

B. Use construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities of ample size and capacity to adequately support and move loads.

C. Design temporary supports with adequate safety factor to assure adequate load bearing capability:
   1. When requested, submit design calculations by professional registered engineer prior to application of loads.
   2. Submitted design calculations are for information and record purposes only.

D. Accident prevention:
   1. Exercise precautions throughout construction for protection of persons and property.
   2. Observe safety provisions of applicable Laws and Regulations.
   3. Guard machinery and equipment and eliminate other hazards.

4. Make reports required by authorities having jurisdiction, and permit safety inspections of the Work.
5. Before commencing construction work, take necessary action to comply with provisions for safety and accident prevention.

E. Barricades:
1. Place barriers at ends of excavations and along excavations to warn pedestrian and vehicular traffic of excavations.
2. Provide barriers with flashing lights after dark.
3. Keep barriers in place until excavations are entirely backfilled and compacted.
4. Barricade excavations to prevent persons from entering excavated areas in streets, roadways, parking lots, treatment plants, or other public or private areas.

F. Warning devices and barricades: Adequately identify and guard hazardous areas and conditions by visual warning devices and, where necessary, physical barriers:
1. Devices shall conform to minimum requirements of OSHA and State agency which administers OSHA regulations where Project is located.

G. Hazards in public right-of-way:
1. Comply with local jurisdiction standards and requirements for right-of-way barricades and other safety devices.
2. Mark at reasonable intervals, trenches, and other continuous excavations in public right-of-way, running parallel to general flow of traffic, with traffic cones, barricades, or other suitable visual markers during daylight hours:
   a. During hours of darkness, provide markers with torches, flashers, or other adequate lights.
3. At intersections or for pits and similar excavations, where traffic may reasonably be expected to approach head on, protect excavations by continuous barricades:
   a. During hours of darkness, provide warning lights at close intervals.

H. Hazards in protected areas: Mark or guard excavations in areas from which public is excluded, in manner appropriate for hazard.

I. Above grade protection: On multi-level structures, provide safety protection that meets requirements of OSHA and State agency which administers OSHA regulations where Project is located.

J. Protect existing structures, trees, shrubs, and other items to be preserved on Project site from injury, damage, or destruction by vehicles, equipment, worker or other agents with substantial barricades or other devices commensurate with hazards.

K. Fences:
1. When entire or part of site is to be permanently fenced, permanent fence may be built to serve for both permanent and temporary protection of the work site, provided that damaged or defaced fencing is replaced prior final completion. Contractor is responsible for site security.
2. Protect temporary and permanent openings and close openings in existing fences to prevent intrusion by unauthorized persons.
   a. Bear responsibility for protection of plant and material on site of the Work when openings in existing fences are not closed.

3. During night hours, weekends, holidays, and other times when no work is performed at site, provide temporary closures or enlist services of security guards to protect temporary openings.
4. Fence temporary openings when openings are no longer necessary.

1.06 SECURITY

A. Make adequate provision for protection of the work area against fire, theft, and vandalism, and for protection of public against exposure to injury.

1.07 ACCESS ROADS

A. General:
   1. Build and maintain access roads to and on site of the Work to provide for delivery of material and for access to existing and operating plant facilities on site.
   2. Build and maintain dust free roads which are suitable for travel at 20 miles per hour.

B. Off-site access roads:
   1. Build and maintain graded earth roads.
   2. Build roads only in public right-of-way or easements obtained by Owner.
   3. Obtain rights-of-way or easements when electing to build along other alignment.

C. On-site access roads:
   1. Maintain access roads to storage areas and other areas to which frequent access is required.
   2. Maintain similar roads to existing facilities on site of the Work to provide access for maintenance and operation.
   3. Protect buried vulnerable utilities under temporary roads with steel plates, wood planking, or bridges.
   4. Maintain on-site access roads free of mud. Under no circumstances shall vehicles leaving the site track mud off the site onto the public right-of-way.

1.08 TEMPORARY CONTROLS

A. Dust control:
   1. Prevent dust nuisance caused by operations, unpaved roads, excavation, backfilling, demolition, or other activities.
   2. Control dust by sprinkling with water, use of dust palliatives, modification of operations, or other means acceptable to agencies having jurisdiction.

B. Noise control:
   1. Comply with noise and work hours regulations by local jurisdiction.
   2. In or near inhabited areas, particularly residential, perform operations in manner to minimize noise.
   3. In residential areas, take special measures to suppress noise during night hours.

C. Mud control:
   1. Prevent mud nuisance caused by construction operations, unpaved roads, excavation, backfilling, demolition, or other activities.

D. Landscape control
   1. Provide landscape and grass maintenance for the site during the construction activities.

1.09 PROJECT SIGN

A. Refer to detail 3 on 00GM04 in the Drawings.

1.10 FIELD OFFICES AND SHEDS

A. Contractor's field office:
   1. Maintain on Project Site weather tight space in which to keep copies of Contract Documents, progress schedule, shop drawings, and other relevant documents.
   2. Provide field office with adequate space to examine documents and provide lighting and telephone service in that space.

1.11 REMOVAL

A. Remove temporary buildings and furnishings before inspection for Substantial Completion or when directed.

B. Clean and repair damage caused by installation or use of temporary facilities.

C. Remove underground installations to minimum depth of 24 inches and grade to match surrounding conditions.

D. Restore existing facilities used during construction to specified or original condition.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Product requirements; product selection; product options and substitutions; quality assurance; shipping, delivery, handling, and storage; and instructions for spare parts, maintenance products, and special tools.

1.02 REFERENCES

A. American National Standards Institute (ANSI).

B. Florida Administrative Code (FAC).

C. Utilities Standard and Specification Manual (USSM) - Polk County.

D. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.
   2. 372 - Drinking Water System Components - Lead Content.

E. Florida Building Code (FBC).

1.03 DEFINITIONS

A. Products: Inclusive of raw materials, finished goods, equipment, systems, and shop fabrications.

B. Special tools: Tools that have been specifically made for use on a product for assembly, disassembly, repair, or maintenance.

1.04 SUBMITTALS

A. Polk County General Conditions.

B. As specified in Section 01330 - Submittal Procedures.

C. Calculations/certifications in accordance with NSF 61 and 372 for materials in contact with drinking water.

1.05 GENERAL REQUIREMENTS

A. Comply with the USSM, specifications and referenced standards as minimum requirements.

B. Provide products by same manufacturer when products are of similar nature, unless otherwise specified.

C. Provide like parts of duplicate units that are interchangeable.

D. Provide equipment that has not been in service prior to delivery, except as required by tests.

E. When necessary, modify manufacturer's standard product to conform to specified requirements or requirements indicated on the Drawings.

1.06 SUBSTITUTIONS

A. Substitutions shall be in conformance with the Owner's Utility Standards and Specification Manual and acceptable to both the Engineer and Owner.

PART 2 PRODUCTS

2.01 GENERAL

A. Material requirements:
   1. Materials: Conform to USSM, FBC and other reference standards.
   2. Dissimilar metals: Separate contacting surfaces with dielectric material.

B. Edge grinding:
   1. Sharp projections of cut or sheared edges of ferrous metals which are not to be welded shall be ground to a radius required to ensure satisfactory paint adherence.

2.02 PRODUCTS IN CONTACT WITH DRINKING WATER

A. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372.
   1. Certification by an independent ANSI accredited third party, including, but not limited to, NSF International, as being lead free.

2.03 PRODUCT SELECTION

A. Products specified in Polk County USSM take precedence.

B. When products are specified by standard or specification designations of technical societies, organizations, or associations only, provide products that meet or exceed reference standard and Specifications.

C. When products are specified with names of manufacturers but no model numbers or catalog designations, provide:
   1. Products by one of named manufacturers that meet or exceed Specifications.
   2. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.

D. When products are specified with names of manufacturers and model numbers or catalog designations, provide:
   1. Products with model numbers or catalog designations by one of named manufacturers.
   2. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.

E. When products are specified with names of manufacturers, but with brand or trade names, model numbers, or catalog designations by one manufacturer only, provide:
   1. Products specified by brand or trade name, model number, or catalog designation.
   2. Products by one of named manufacturers proven, in accordance with requirements for an "or equal", to meet or exceed quality, appearance and performance of specified brand or trade name, model number, or catalog designation.
   3. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.

F. When Products are specified with only one manufacturer followed by "or Equal," provide:
   1. Products meeting or exceeding Specifications by specified manufacturer.
   2. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.

2.04 SHIPMENT

A. Mandatory requirements prior to shipment of equipment:
   1. Engineer approved shop drawings.
   2. Engineer approved Manufacturer’s Certificate of Source Testing as specified in Section 01756 - Commissioning, when required by specifications.
   3. Draft operations and maintenance manuals, as specified in Section 01782 - Operation and Maintenance Data, when required by specifications.

B. Prepare products for shipment by:
   1. Tagging or marking products to agree with delivery schedule or shop drawings.
   2. Including complete packing lists and bills of material with each shipment.
   3. Packaging products to facilitate handling and protection against damage during transit, handling, and storage.
   4. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.

C. Transport products by methods that avoid product damage.

D. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.

2.05 SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

A. Provide spare parts and maintenance products as required by the USSM and Specifications.

B. Provide one set of special tools required to install or service the equipment.

C. Box, tag, and clearly mark items.

D. Contractor is responsible for spare parts, maintenance products, and special tools until acceptance by Owner.

E. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period.
   1. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.

F. Provide spare parts and special tools inventory list, see Appendix A:
   1. Equipment tag number.
   2. Equipment manufacturer.
   3. Subassembly component, if appropriate.
   4. Quantity.
   5. Storage location.

G. Store large items individually:
   1. Weight: Greater than 50 pounds.
   2. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
   3. Clearly labeled:
      a. Equipment tag number.
      b. Equipment manufacturer.
      c. Subassembly component, if appropriate.

H. Store in spare parts box smaller items:
   1. Weight: Less than 50 pounds.
   2. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
   3. Clearly labeled:
      a. Equipment tag number.
      b. Equipment manufacturer.
      c. Subassembly component, if appropriate.

I. Spare parts and special tools box:
   1. Wooden box:
      a. Size: 24 inches wide by 18 inches high by 36 inches long.
   2. Hinged wooden cover.
      a. Strap type hinges.
      b. Locking hasp.
      c. Spare parts inventory list taped to underside of cover.
   3. Coating: As specified in Section 09960 - High-Performance Coatings.
   4. Clearly labeled:
      a. The words “Spare Parts and/or Special Tools.”
      b. Equipment tag number.
      c. Equipment manufacturer.

PART 3 EXECUTION

3.01 DELIVERY AND HANDLING

A. Handle equipment in accordance with manufacturer's instructions.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

C. Upon delivery, promptly inspect shipments.
   1. Verify compliance with Contract Documents, correct quantities, and undamaged condition of products.
   2. Acceptance of shipment does not constitute final acceptance of equipment.

3.02 STORAGE AND PROTECTION

A. Immediately store and protect products and materials until installed in Work.

B. Store products with seals and legible labels intact.

C. Maintain products within temperature and humidity ranges required or recommended by manufacturer.

D. Protect painted surfaces against impact, abrasion, discoloration, and other damage.
   1. Repaint damaged painted surfaces.

E. Exterior storage of fabricated products:
   1. Place on aboveground supports that allow for drainage.
   2. Cover products subject to deterioration with impervious sheet covering.
   3. Provide ventilation to prevent condensation under covering.

F. Store moisture sensitive products in watertight enclosures.

G. Furnish covered, weather-protected storage structures providing a clean, dry, noncorrosive environment for mechanical equipment, valves, architectural items, electrical and instrumentation equipment and special equipment to be incorporated into this project.
   1. Storage of equipment shall be in strict accordance with the “instructions for storage” of each equipment supplier and manufacturer including connection of heaters, placing of storage lubricants in equipment, etc.
   2. The Contractor shall furnish a copy of the manufacturer’s instructions for storage to the Engineer prior to storage of all equipment and materials.

H. Store loose granular materials on solid surfaces in well-drained area.
   1. Prevent materials mixing with foreign matter.
   2. Provide access for inspection.

I. Payment will not be made for equipment and materials improperly stored or stored without providing Engineer with the manufacturer's instructions for storage.

J. Provide an Equipment Log including, as a minimum, the equipment identification, date stored, date of inspection/maintenance, date removed from storage, copy of manufacturer’s recommended storage guidelines, description of inspection/maintenance activities performed, and signature of party performing inspection/maintenance.

3.03 PROTECTION AFTER INSTALLATION

A. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations.
   1. Remove covering when no longer needed.

2. Replace corroded, damaged, or deteriorated equipment and parts before acceptance of the project.

B. Update Equipment Log on a monthly basis with description of maintenance activities performed in accordance with the manufacturer's recommendation and industry standards and signature of party performing maintenance.

3.04 QUALITY ASSURANCE

A. Employ entities that meet or exceed specified qualifications to execute the Work.

B. Verify project conditions are satisfactory before executing subsequent portions of the Work.

3.05 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.06 CLOSEOUT ACTIVITIES

A. Owner may request advanced delivery of spare parts, maintenance products, and special tools.
   1. Deduct the delivered items from the inventory list and provide transmittal documentation.

B. Immediately prior to the date of Substantial Completion, arrange to deliver spare parts, maintenance products, and special tools to Owner at a location on site chosen by the Owner.
   1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
   2. Owner and Engineer will review the inventory and the itemized list to confirm it is complete and in good condition prior to signing for acceptance.

3.07 ATTACHMENTS

A. Appendix A - Spare Parts, Maintenance Products, and Special Tools Inventory List.

END OF SECTION

APPENDIX A
SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

Owner: Polk County Utilities **Date:** _____

Contractor: _____ **Project No.:** _____

Project Name: Gibson Oaks WPF

Inventory List				
Spec Number: _____		Spec Title _____		
Equipment Tag No.: _____		Equipment Manufacturer: _____		
Quantity	**Subassembly Component**	**Description**	**Manufacturer's Part Number**	**Storage Location**

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SECTION 01614

WIND DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Wind design criteria.

1.02 SYSTEM DESCRIPTION

A. Design requirements:
   1. Building code criteria: Design for wind in accordance with the Florida Building Code (FBC):
      a. Risk category: III
      b. Wind speed, V_{ult}: 148 miles per hour.
      c. Wind speed, V_{asd}: 89 miles per hour.
      d. Exposure category: C.
      e. Topographic factor, K_{zt}: 1.0.
   2. Resist wind forces through direct bearing on anchors and fasteners. Do not design or provide connections that use friction to resist wind loads.
   3. Anchoring and fastening to concrete and masonry:
      a. Provide anchors specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
      b. Use only cast-in and built-in anchors (anchor bolts and welded studs) for anchors at connections that resist wind forces.
      c. Do not use concrete anchors, flush shells, sleeve anchors, flush shells, screw anchors, powder actuated fasteners, or other types of post-installed mechanical anchors unless indicated on the Drawings or accepted in writing by the Engineer.

1.03 SUBMITTALS

A. Shop drawings and calculations: Complete shop drawings and wind design calculations.

B. Calculations shall be signed and stamped by a civil or structural engineer licensed in the state where the Project is located.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

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SECTION 01756

COMMISSIONING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for each Commissioning phase of, the Project equipment/system and/or facility.

1.02 DEFINITIONS

A. Clean Water Facility Testing - Testing of complete facility utilizing clean water for purposes of confirming extended equipment/system operation prior to Process Start-up Phase.

B. Commissioning - The process of planning, testing, and process start-up of the installation for compliance with contract requirements and demonstrating, through documented verification, that the project has successfully met the Contractual requirements. It includes training the Owner's staff to operate the facility.

C. Commissioning Phases - The work activities of facility commissioning are grouped into the phases defined in the table below.

Commissioning		
Planning Phase	**Testing and Training Phase**	**Process Start-Up Phase**
Owner Training Plan and Schedule	Source Testing	Process Start-up
Commissioning Schedule	Owner Training	Process Operational Period
Subsystem Testing Plan	Installation Testing	Instrumentation and Controls Fine-Tuning
Clean Water Facility Testing Plan	Functional Testing	
	Closeout Documentation	

D. Component - A basic building block of equipment, subsystems, and systems that requires installation or functional testing but does not have an electrical connection or internal electronics. (Examples: filter effluent piping and manual isolation valves).

E. Device - A basic building block of equipment, subsystems, and systems that requires installation or functional testing and does have an electrical connection or internal electronics. (Examples: filter level transmitter or water pump pressure transmitter).

F. Equipment - An assembly of component(s) and devices(s) that requires installation or functional testing. (Examples: Pump, motor, VFD, Disinfection System, etc.).

G. Facility - A grouping of process areas, systems, subsystems, equipment, components, and devices (Examples: chemical system pump station, fill assembly, etc.).

H. Functional Testing - Testing performed on a completed subsystem to demonstrate that equipment/system meets manufacturers' calibration and adjustment requirements and other requirements as specified. Functional testing includes operating equipment/system manually in local, manually in remote (or remote manual), and automatically in remote (in remote auto).

I. Installation Testing - Testing to demonstrate that subsystem component (piping, power, networks, devices, etc.) is ready and meets the project requirements in advance of functional testing. Installation testing also includes manufacturers' certification of installation and other requirements as specified to prepare equipment/system for Functional Testing. Also referred to as Field Acceptance Testing.

J. Manufacturer's Certificate of Source Testing - When applicable, the form is used during Source Testing for the manufacturer to confirm that the applicable source tests have been performed and results conform to the Contract Documents. The form is provided at the end of this Section.

K. Manufacturer's Certificate of Installation and Functionality Compliance - The form is used during Installation Testing and Functional Testing. It is submitted at the end of Functional Testing to confirm that the equipment/system is installed in conformance with the Contract Documents and that it meets the Functional Testing requirements defined in the Contract Documents. The form is provided at the end of this Section.

L. Process Area - A grouping of systems, subsystems, equipment, components, and devices that divide a facility into functional areas. (Example: Process 40 - Fill Station and Ground Storage Tank, Process 80 Chemical Area, etc.).

M. Process Operational Period - A period of time after completion of the process start-up set aside for final Operational Testing to verify facility performance meets the Contract Document requirements. This period may specifically limit other construction activities.

N. Process Start-up Phase - Operating the facility to verify performance meets the Contract Document requirements.

O. Process Start-Up - Activities conducted after the testing and training phase that are necessary to place systems or process areas into operational service.

P. Product - A system, subsystem, or component.

Q. Subsystem - A building block of systems made up from a grouping of components, devices, and equipment that perform a definable function. (Examples: Booster Pump Station, Finish Flow Meter Station, etc.).

R. System - A grouping of subsystems, equipment, components, and devices that perform a definable function. (Examples: Process 50 High Service Distribution Pump Station and Finish Flow Meter Station).

1.03 SERVICES OF MANUFACTURER'S REPRESENTATIVES

A. Qualification of manufacturer's representative as specified in the Contract Documents technical Sections include the following:
   1. Authorized representative of the manufacturer, factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
   2. Competent, experienced technical representative of equipment/system manufacturer for assembly, installation, testing guidance, and training.
   3. Additional qualifications may be specified in the individual Sections.
   4. Submit qualifications of the manufacturer's representative no later than 30 days in advance of required observations.
   5. Representative subject to approval by Owner and Engineer.
   6. No substitute representatives will be allowed until written approval by Owner and Engineer has been obtained.

B. Manufacturer is responsible for determining the time required to perform the specified services.
   1. Minimum times specified in the Contract Documents are estimates.
   2. No additional costs associated with performing the required services will be approved.
   3. Manufacturer required to schedule services in accordance with the Contractor's project schedule up to and including making multiple trips to project site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.

C. Manufacturer's on-site services as specified in the Contract Documents include the following:
   1. Assistance during Commissioning Phase and Process Start-Up Phase.
   2. Incorporate copies of manufacturer's representatives field notes and data into the operational and maintenance manuals for the Engineer's and Owner's review.
   3. Other requirements as specified in the Contract Documents.

1.04 PLANNING PHASE

A. Overview of Planning Phase:
   1. Define approach and timing for Commissioning.

B. Owner training plan and schedule:
   1. Training outcomes:
      a. Owner's operations, maintenance, and engineering staff have the information needed to safely operate, maintain, and repair the equipment/systems provided in the Contract Documents.

2. Training objectives:
    a. To instruct personnel in the operation and maintenance of the equipment/system. Instruction shall include step-by-step troubleshooting procedures with all necessary test equipment/system.
    b. To instruct personnel in the removal, inspection, and cleaning of equipment/system as needed.
    c. Training tailored to the skills and job classifications of the staff attending the classes (e.g., operator, maintenance technician, electrician, etc.).
    d. Provide supporting documentation, such as vendor operation and maintenance manuals.
3. Training schedule:
    a. Schedule Owner's staff training within the constraints of their workloads.
4. Training plan:
    a. Coordinate and arrange for manufacturer's representatives to provide both classroom-based learning and field (hands-on) training, based on training module content and stated learning objectives.
    b. Conduct classroom training at location designated by Owner.
    c. Scope and sequence:
        1) Plan and schedule training in the correct sequence to provide prerequisite knowledge and skills to trainees.
            a) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
5. Training scheduling coordination:
    a. Coordinate schedule for training periods with the Owner’s personnel and manufacturer’s representatives (instructors).
    b. Complete Owner training no sooner than 15 calendar days prior to start of process start-up of each system.
6. Meetings:
    a. CC is responsible for setting commissioning coordination meeting dates and times, as well as preparing the agendas and meeting minutes.
    b. CC shall meet with Engineer and Owner's designated training coordinator to develop list of personnel to be trained and to establish expected training outcomes and objectives at least 45 calendar days prior to commissioning of equipment/system.
    c. CC shall conduct commissioning progress meetings throughout construction, to plan, scope, coordinate, and schedule future activities, resolve problems, etc.
        1) Frequency: Monthly minimum. Increase frequency as needed based on complexity and quantity of commissioning activities.
7. Submittals:
    a. Submit Training Plan Schedule 30 calendar days before the first scheduled training session within the Project Progress Schedule
    b. Submit training documentation including the following:
        1) Training plan:
            a) Training modules.
            b) Scope and sequence statement.
            c) Contact information for manufacturer's instructors including name, phone, and e-mail address.
            d) Instructor qualifications.
8. Training sessions:
    a. Provide training sessions for equipment/system as specified in the individual equipment/system Section.

C. Commissioning Schedule:
    1. Commissioning overview:
        a. Comply with Commissioning Roles and Responsibilities Matrix specified at the end of this Section.
    2. Submittal due date:
        a. Submit Commissioning Schedule not less than 30 calendar days prior to planned initial commissioning of each subsystem or system.
    3. Schedule requirements:
        a. Schedule durations and float for commissioning activities to ensure Work does not fall behind schedule due to complications or delays during commissioning.
        b. Provide detailed schedule of commissioning activities including durations and sequencing requirements.
            1) Identify the following activities:
                a) Testing and Training Phase:
                    (1) Source Testing.
                    (2) Owner Training.
                    (3) Installation Testing.
                    (4) Functional Testing.
                    (5) Clean Water Facility Testing.
                    (6) Closeout Documentation.
                b) Process Start-Up Phase:
                    (1) Process Start-Up.
                    (2) Process Operational Period.
                    (3) Instrumentation and Controls Fine-Tuning.
        c. Schedule manufacturer's services to avoid conflict with other on-site testing or other manufacturers' on-site services.
        d. Verify that conditions necessary to allow successful testing have been met before scheduling services.

1.05 TESTING AND TRAINING PHASE

A. Overview of Testing and Training Phase:
    1. General:
        a. Include specified Source Testing, Owner Training, Installation Testing, Functional Testing, and Closeout Documentation required by this Section and the technical sections.
    2. Contractor responsibilities:
        a. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
        b. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.
        c. Acceptable tests: Demonstrate the equipment/system performance meets the requirements stated in the Contract Documents.
            1) When the equipment/system fails to meet the specified requirements, perform additional, more detailed, testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.

B. Installation Testing:
   1. Perform subsystem testing according to approved Subsystem Testing Plans.
   2. Initiate the Manufacturer's Certificate of Installation and Functionality Compliance for all equipment.
      a. Manufacturer's Certificate of Installation and Functionality Compliance certifies the equipment meets the following requirements:
         1) Has been properly installed, adjusted, aligned, and lubricated.
         2) Is free of any stresses imposed by connecting piping or anchor bolts.
         3) Is able to be operated as necessary for Functional Testing.
      b. Form shall be submitted after completion of Functional Testing, as specified in this Section.
   3. Coordinate Installation Testing with restrictions and requirements as specified in Section 01140 - Work Restrictions.
   4. Perform coating holiday testing as specified in Section 09960 - High-Performance Coatings.
   5. Perform pressure and leakage testing as specified in individual component Sections and Section 15956 - Piping Systems Testing.
   6. Perform mechanical equipment Installation Testing: As specified below and in individual equipment Sections:
      a. Remove rust preventatives and oils applied to protect equipment during construction.
      b. Flush lubrication systems and dispose of flushing oils.
         1) Recharge lubrication system with lubricant recommended by manufacturer.
      c. Flush fuel system and provide fuel for testing and start-up.
      d. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
      e. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
      f. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
      g. Perform cold alignment and hot alignment to manufacturer's tolerances.
      h. Adjust V-belt tension and variable pitch sheaves.
      i. Inspect hand and motorized valves for proper adjustment.
         1) Tighten packing glands to ensure no leakage but permit valve stems to rotate without galling.
         2) Verify valve seats are positioned for proper flow direction.
      j. Tighten leaking flanges or replace flange gasket.
         1) Inspect screwed joints for leakage.
      k. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.
   7. Electrical devices and subsystems Installation Testing: As specified below, in Section 16950 - Field Electrical Acceptance Tests, and the technical Sections.
      a. Perform insulation resistance tests on all wiring except wiring and control wiring inside electrical panels.
      b. Perform grounding resistance tests on grounding systems.
      c. Test and set relays and circuit breaker trip units for proper operation.
         1) Settings as documented in approved electrical studies performed as specified in Section 16305 - Electrical System Studies.
      d. Perform direct-current high-potential tests on all cables that will operate at more than 2,000 volts.

e. Motors:
1) Windings energized.
a) Motor resistance measured at the end of the test and recorded.
2) Check motors for actual full-load amperage draw and proper rotation.

8. Instrumentation devices and subsystems Installation Testing: As specified below, in Section 17950 - Testing, Calibration, and Commissioning, and technical Sections.
9. Heating, ventilating, and air conditioning systems Installation Testing: As specified in Drawing 00H02.
a. Perform testing of heating, ventilating, and air conditioning equipment, balancing of distribution systems, and adjusting of ductwork accessories.
b. Test hydronic systems, if required by technical Sections.

C. Functional Testing:
1. Perform subsystem testing according to approved Subsystem Testing Plan.
2. Notify the Engineer 5 days prior to when the Work is ready for Functional Testing.
a. Perform testing in the presence of the Owner.
3. Determine Functional Testing durations with Owner's input.
a. Durations will vary depending on the availability of water for testing.
b. Target minimum Functional Test duration: 8 hours.
1) Identify equipment/system that cannot be tested for a minimum of 8 hours as specified in technical Sections.
4. Perform Functional Testing as specified in technical Sections.
a. Perform Functional Testing in addition to the other tests specified in the technical Sections.
b. Perform Functional Testing to demonstrate that the component equipment functions as an entire system in accordance with the design requirements.
c. Perform Functional Testing to demonstrate that the unit process has operated in a manner necessary to demonstrate equipment/system functions manually in local, manually in remote (or remote manual), and automatically in remote (in remote auto).
d. Repair or replace parts that operate improperly and retest.
e. Submit testing results as specified in the technical Sections to the Owner and Engineer for approval of Functional Testing results.
5. Provide completed Manufacturer's Certificate of Installation and Functionality Compliance forms for all equipment.
a. Manufacturer's Certificate of Installation and Functionality Compliance form is included in this Section.
b. Manufacturer's Certificate of Installation and Functionality Compliance certifies the equipment/system meets the following requirements:
1) Is suitable for satisfactory full-time operation under full-load conditions.
2) Operates within the allowable limits for vibration and noise.
3) Electrical and instrumentation requirements:
a) Electrical equipment, instrumentation, and control panels are properly installed, calibrated, and functioning.
b) Electrical Installation Testing is complete, and test results have been approved by the Engineer.
(1) Noted deficiencies have been corrected.
(2) Relays, circuit breakers, and other protective devices are set.

c) Control logic for start-up, shutdown, sequencing, interlocks, control, and emergency shutdown has been tested and is properly functioning.
d) Motor control is calibrated and tested.

D. Clean Water Facility Testing:
1. Utilize on-site groundwater from new well and potable water.
2. Do not begin Clean Water Facility Testing until Engineer has approved submittals for Functional Testing requirements.
3. Test entire facility with recirculating water supply at the design flow for the largest single process or system train to ensure proper complete facility (equipment/system) hydraulic performance.
4. Perform testing in the presence of the Owner.
5. The purpose of Clean Water Facility Testing is to confirm extended equipment/system operation prior to process start-up.
a. Testing shall occur for a minimum of 7 days with all systems operational to the extent possible.

E. Closeout documentation:
1. Submittals:
a. Provide records generated during Commissioning Phase of Project.
1) Required documents include but are not limited to:
a) Training documentation.
b) Manufacturer's Certificate of Source Testing.
c) Manufacturer's Certificate of Installation and Functionality Compliance.
d) Daily logs of equipment/system testing identifying tests conducted and outcome.
e) Test forms and documentation.
f) Functional Testing results.
g) Logs of time spent by manufacturer's representatives performing services on the job site.
h) Equipment lubrication records.
i) Electrical phase, voltage, and amperage measurements.
j) Insulation resistance measurements.
k) Bearing temperature measurements.
2) Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints. Format: 2 electronic copies and 3 hard copies organized in notebooks.
3) Due date: Within 14 calendar days of Substantial Completion.

1.06 PROCESS START-UP PHASE

A. Overview of Process Start-Up Phase:
1. Operating the facility to verify performance meets the Contract Document requirements.

B. Process Start-Up:
1. Perform process start-up in the presence of the Engineer and Owner.
2. Pre-start-up activities:
a. Commissioning Documentation and Data Review.
b. Start-Up Go/No-Go Decision Criteria.
c. Building and Fire Inspection Compliance Check.
d. Process Start-Up Sequence Review.

1) Submit a Process Start-Up plan for review by Engineer not less than 30 calendar days prior to planned commencement of process start-up activities.
2) Include the following:
a) Pre-start-up activities.
b) Process Start-Up.
c) Process Operational Period.

e. Description of Temporary Testing Arrangement, if applicable.
f. Final Process Start-Up Forms and Documentations.
g. Final Operational Testing Plan.

3. Control loop tuning.
a. Perform control loop tuning during system testing with water to the extent possible.

4. Process area start-ups.
a. Process start-up individual process areas comprised of multiple interdependent systems where possible and beneficial to reduce complexity and risk of complete facility testing.
b. Process area test flows may be limited by upstream and downstream process constraints (i.e., tank and basin volumes) and/or localized recirculation capabilities.

5. Facility-wide process start-up.
a. Upon approved completion of pre-start-up activities, perform entire facility process start-up.
1) Complete control loop tuning during this phase of process start-up.
2) Continue process start-up operations until facility meets or exceeds the Contract requirements.
b. Process control systems testing.
1) Test complete system instrumentation, controls and PLC, HMI, and LOI programming for the facility.
c. HVAC systems start-up and testing.
1) Test complete HVAC system for the facility.
d. Ancillary systems start-up and testing.
1) Test complete security system, phone system, fire alarm system, etc. for the facility.
e. Remaining equipment/system tests:
1) Conduct remaining specified equipment/system performance tests that could not be performed during the Testing and Training Phase due to inter-system and/or treatment process dependencies.

C. Process Operational Period:
1. Prior to beginning the Process Operational Period:
a. Conformance with treatment standards is required prior to Operational Testing, if applicable.
1) Biological processes require time to build up the necessary population of organisms to meet treatment standards, as specified in Section 01140 - Work Restrictions.
b. Correct any outstanding punch list items prior to the Operational Testing.
2. Duration: 30 calendar days.
3. Engineer will be present for process operational period unless such presence is expressly waived in writing.
4. Prove facility conformance with Contract Document requirements.
5. Contractor to provide:
a. Specified start-up materials and operating supplies.

b. Necessary craft of labor assistance, in the event of an emergency equipment failure requiring immediate attention (emergency is defined as a failure of function which precludes the further operation of a critical segment of or the whole of the Work) with a response time of not more than 4 hours from the time of notification.
c. Manufacturer's authorized representative to supervise placing equipment/systems in operation and provide guidance during Operational Testing per applicable Section.
d. Necessary manufacturer's representatives and operating supplies for retesting systems that fail to pass the initial Operational Testing due to deficiencies in products of workmanship at no additional cost to the Owner.
e. List of 24-hour "on-call" representative supervisory persons who will monitor the Operational Testing and serve as liaison for the Engineer and Owner.

6. Owner will provide:
   a. Operations personnel for duration of test.
7. Prior to date of Substantial Completion of Installation, the Contractor's CC shall oversee Process Operational Period.
   a. Owner staff will operate the completed Project construction.
   b. Entire system shall continuously meet performance requirements and shall operate without fault, failure, or defect for a continuous period.
   c. Individual equipment/system failures that are corrected within 24 hours and do not prevent the entire project from continuously satisfying the established operational requirements shall not require the consecutive day test to be restarted unless the failure recurs.
   d. Restart the consecutive test period for any of the following conditions:
      1) Any failure of the complete Project construction to meet operational requirements.
      2) When malfunctions or deficiencies cause shutdown or partial operation of the facility, or results in failure of the complete Project construction to meet operational requirements.
      3) Any individual equipment/system failure that meets any of the following conditions:
         a) Requires more than 24 hours to correct, unless otherwise specified in Section 17950 - Testing, Calibration, and Commissioning.
         b) Recurs within the 24-hour correction period requiring further correction.
      4) Immediately correct defects in material, workmanship, or equipment/system which became evident during Operational Testing.

1.07 INSTRUMENTATION AND CONTROLS FINE-TUNING:

A. After the Process Operational Period, test PCIS system for additional 30 days as specified in Section 17950 - Testing, Calibration, and Commissioning to identify issues and make corrections, as needed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used

END OF SECTION

MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER Polk County Utilities
PROJECT NAME Gibson Oaks WPF
PROJECT NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

EQPT/SYSTEM _____
EQPT TAG NO. _____
EQPT SERIAL NO. _____

Comments: _____

_____

_____

_____

_____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract Documents, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____, 20____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

_____
(Authorized Signature)

If applicable, Witness Name *(print)*: _____

_____
(Witness Signature)

MANUFACTURER'S CERTIFICATE OF INSTALLATION AND FUNCTIONALITY COMPLIANCE

OWNER Polk County Utilities
PROJECT NAME Gibson Oaks WPF
PROJECT NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

EQPT/SYSTEM _____
EQPT TAG NO. _____
EQPT SERIAL NO. _____

I hereby certify that the above-referenced equipment/system has been: (Check Applicable)

- ☐ Installed in accordance with manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical/instrumentation and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functionally tested.
- ☐ System has been performance tested and meets or exceeds specified performance requirements.

NOTES:
Attach test results with collected data and test report.

Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

_____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20 ____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

TRAINING EVALUATION FORM

EQUIPMENT/SYSTEM ITEM: _____

VENDOR/MANUFACTURER: _____

DATE: _____ NAME OF REPRESENTATIVE: _____

1.	Was representative prepared?	Acceptable	Unacceptable	or	N/A
2.	Was an overview description presented?	Acceptable	Unacceptable	or	N/A
3.	Were specific details presented for system components?	Acceptable	Unacceptable	or	N/A
4.	Were alarm and shutdown conditions clearly presented?	Acceptable	Unacceptable	or	N/A
5.	Were step-by-step procedures for starting, stopping, and troubleshooting presented?	Acceptable	Unacceptable	or	N/A
6.	Were routine/preventative maintenance items clearly identified?	Acceptable	Unacceptable	or	N/A
7.	Was the lubrication schedule (if any) discussed?	Acceptable	Unacceptable	or	N/A
8.	Was the representative able to answer all questions?	Acceptable	Unacceptable	or	N/A
9.	Did the representative agree to research and answer unanswered questions?	Acceptable	Unacceptable	or	N/A

10. Comments: _____

_____

_____

_____

11. Overall Rating: Satisfactory Unsatisfactory

Note:

Sessions judged "Unsatisfactory" by a majority of attendees shall be revised and conducted again until a satisfactory rating is achieved.

COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
Source Testing				
1	Source Testing	Review	Lead	Witness, Review
Installation Testing				
2	Electrical Conductor Testing	Review	Lead	Review
3	Electrical Field Acceptance Tests	Review	Lead	Review
4	Instrument Field Calibration	Review	Lead	Review
5	Network Installation Testing	Witness	Lead	Review
6	Loop Testing	Review	Lead	Review
7	Pressure Testing	Review	Lead	Review
8	Leak Testing	Witness	Lead	Review
9	Holiday Testing	Witness	Lead	Review
10	HVAC Testing	Witness	Lead	Review
11	Motor Electrical Testing	Witness	Lead	Review
Functional Testing				
12	Network Operational Testing	Witness	Lead	Review
13	Preliminary Run Testing Local/Manual Control	Witness	Lead	Review
14	PCIS Functional Demonstration Testing - Local/Auto Control Testing - Remote/Manual Contact Testing - Alarm Testing - Control Loop Testing	Witness	Lead	Review
15	Subsystem Start-Up and Testing	Witness	Lead	Review
16	Equipment/System Start-Up and Testing	Witness	Lead	Review
17	HVAC Start-Up and Testing	Witness	Lead	Review
18	Corrosion Control Start-Up and Testing	Witness	Lead	Review
19	Wide Area Network Communications Testing	Support	Lead	Review
20	Manufacturer's Certificate of Installation and Functionality Compliance	No Action	Lead	Review
Clean Water Facility Testing				
21	Test Water Management Plan Finalization	Support	Lead	Review
22	Clean Water Facility Testing	Witness	Lead	Witness, Review

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Process Start-Up Phase				
Process Start-Up				
23	Commissioning Documentation and Data Review	Review	Support	Support
24	Start-Up Go/No-Go Decision Criteria	Lead	Support	Review
25	Building and Fire Inspection Compliance Check	No Action	Lead	Review
26	HVAC Functionality Check	Review	Lead	Review
27	Start-Up Sequence Review	Review	Lead	Review
28	Temporary Testing Arrangement Finalization	Support	Lead	Support
29	Start-Up Forms Finalization	Support	Lead	Support
30	Operation Testing Plan Finalization	Support	Lead	Support
31	Test Water Management Plan Finalization	Support	Lead	Review
32	System Testing	Support	Lead	Review
33	Control Loop Tuning	Support	Lead	Review
34	Process Area Start-Ups	Support	Lead	Witness
35	Facility-Wide Start-Up	Support	Lead	Witness
36	Process Control Systems Testing	Support	Lead	Review
37	HVAC Final Testing, Adjust, and Balancing	Witness	Lead	Review
Process Operational Period				
38	Operational Testing	Support	Lead	Review
39	Final Testing Reports	Support	Lead	Review
40	Water Quality Testing and Documentation	Support	Lead	Review
Instrumentation and Controls Reliability Phase				
Instrumentation and Controls Reliability Period				
41	As specified in Section 17950 - Testing, Calibration, and Commissioning			

Legend:
Lead: Primarily responsible for organization, coordination, and execution of task work product or result.
Support: Assist the lead with organization, coordination, and execution of task work product or result.
Witness: Observe and document completion of task work product or result.
Review: As necessary to accept task work product result.
No Action: Limited or no involvement.

SECTION 01757

DISINFECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Cleaning and disinfection requirements for new and existing facilities affected by the Work.

1.02 REFERENCES

A. Polk County Utility Standards and Specification Manual (USSM).

B. American Water Works Association (AWWA):
   1. C651 - Disinfecting Water Mains.
   2. C652 - Disinfection of Water Storage Facilities.
   3. C653 - Disinfection of Water Treatment Plants.

1.03 SUBMITTALS

A. Submit disinfection test plan which details procedure to be utilized to disinfect the facilities including:
   1. Method and locations of disinfectant application.
   2. Locations of sampling points.
   3. Method of flushing and location of flushing ports (as appropriate for method of chlorination).
   4. Method of dechlorination (as appropriate for method of chlorination).
   5. Disposal location for chlorinated water (as appropriate for method of chlorination).

B. Submit disinfection reports and include the following:
   1. Date issued.
   2. Project name and location.
   3. Treatment subcontractor's name, address, and phone number.
   4. Type and form of disinfectant used.
   5. Time and date of disinfectant injection start.
   6. Time and date of disinfectant injection completion.
   7. Test locations.
   8. Initial and 24-hour disinfectant residuals in milligrams per liter for each outlet tested.
   9. Time and date of flushing start.
   10. Time and date of flushing completion.
   11. Disinfectant residual after flushing in milligrams per liter for each outlet tested.

C. Submit bacteriological reports and include the following:
   1. Date issued.
   2. Project name and location.
   3. Laboratory's name, certification number, address, and phone number.
   4. Time and date of water sample collection.

5. Name of person collecting samples.
6. Test locations.
7. Time and date of laboratory test start.
8. Coliform bacteria test results for each outlet tested.
9. Certification that water conforms or fails to conform to bacterial standards of SDWA.
10. Bacteriologist's signature and bacteriological laboratory's evidence of certification.

1.04 QUALITY ASSURANCE

A. Bacteriological and physical chemistry laboratory: Certified by state in which Project is located.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect chlorine and bacteriological samples against damage and contamination.

B. Maintain caution labels on hazardous materials.

C. Maintain storage room dry and with temperatures as uniform as possible between 60 degrees Fahrenheit and 80 degrees Fahrenheit.

1.06 PROTECTION

A. Provide necessary signs, barricades, and notices to prevent persons from accidentally consuming water or disturbing system being treated.

PART 2 PRODUCTS

2.01 MATERIALS

A. Disinfectant: Free chlorine in liquid, powder, tablet, or gas form in accordance with AWWA C653.

B. Dechlorination agent: Sulfur dioxide, sodium bisulfate, sodium sulfite, or sodium thiosulfite in accordance with AWWA C653.

PART 3 EXECUTION

3.01 PRELIMINARY CLEANING

A. Complete hydrostatic/leakage tests prior to disinfection.

B. Clean all newly constructed and/or modified facilities, including filters and conveyance facilities, such as pipes and channels at the plant, in accordance with AWWA C653 and the following:
1. Remove all debris and material not associated with the structure or process prior to disinfection.
2. Clean all wall, floor, ceiling, and attached surfaces by use of high-pressure water jet, sweeping, scrubbing, or equally effective means.

3. Remove all water, paint flakes, sediment, dirt, and foreign material accumulated during cleaning.
4. Remove by flushing or other means, soil and debris from water pipes and channels in accordance with AWWA C651.
5. Protect surfaces from adverse environmental exposure between the preliminary cleaning and the disinfection stages.

C. Prior to chlorination, clean all newly constructed and/or modified facilities to be disinfected in accordance with AWWA C651, C652, or C653, as applicable.

3.02 SURFACES TO BE DISINFECTED

A. Water storage reservoirs.

B. All wetted surfaces associated with conveyance elements, such as pipes and channels downstream of the filters, basins.

C. Piping systems that are used to convey water, solutions, or chemicals to potable water facilities.

3.03 DISINFECTION OF WATER LINES

A. Cleaning:
1. Remove by flushing or other means, soil and debris from the water tanks in accordance with AWWA C652 prior to chlorination.

B. Inspection:
1. Verify that water system is completed and cleaned of soil and debris prior to chlorination.
2. Start disinfection when conditions are satisfactory.

C. System treatment:
1. Perform disinfection of water lines and structures in accordance with AWWA C651, C652, and C653, and as specified in this Section.
2. Starting at outlet closest to water source, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.
3. Test for disinfectant residual at each of following locations and other locations in accordance with submitted disinfection test plan:
    a. Ends of piping runs.
    b. Remote outlets.
    c. Tanks.
    d. At least 2 outlets on each building floor where directed.
    e. Drain lines.
    f. Filters and effluent channels and piping.
4. Maintain disinfectant in system for appropriate 6-hour or 24-hour interval in accordance with AWWA C652.
5. When disinfectant residual is less than 10 milligrams per liter after 24 hours, repeat system treatment.

6. Stainless steel piping:
    a. Modify procedures for disinfection of stainless steel piping and appurtenances as necessary to avoid causing corrosion, pitting, or attack of stainless steel materials.
        1) Take steps to eliminate chlorinated water trapped in crevices and under gaskets through the following procedures:
            a) Pressurize stainless steel piping systems so that all gaskets and O-rings are seated before introducing chlorinated water into the system.
            b) Flush to displace a minimum of 3 pipe volumes at the conclusion of the disinfection procedure.
            c) Use the continuous-feed method to fill the stainless steel piping system with the minimum chlorine concentration required to provide a 10 milligrams per liter residual after 24 hours of contact time in accordance with AWWA C651.

3.04 DISINFECTION OF WATER RESERVOIRS

A. Perform disinfection of water tank in accordance with AWWA C652 and as specified in this Section.

B. Test for disinfectant residual at locations as specified in Disinfection Test Plan.
    1. Inlet and outlet piping.
    2. Drain line.

C. Maintain disinfectant in system for appropriate 6-hour or 24-hour interval in accordance with AWWA C652.

D. When disinfectant residual is less than 2 parts per million after 24 hours, repeat system treatment.

3.05 REPAIRS OR CONNECTIONS TO EXISTING LINES

A. Clean and sterilize the interior surfaces of new piping, fittings, equipment, and appurtenances to be installed in an existing potable water system or connected to an existing system.

B. Clean and sterilize the existing pipe or facilities for a minimum distance of 3 pipe diameters back from the ends of the pipe. Plug the ends of the line when work is not being performed on the pipe.

C. Perform sterilization by swabbing each item with a concentrated chlorine solution.
    1. Each piece is to be disinfected prior to being assembled for installation in the existing pipe.
    2. Disinfect each piece just prior to assembly to help prevent recontamination.
    3. Plug the ends of the assembly until a new item is to be added to the assembly.
    4. Store disinfected materials on blocks to prevent contact with the ground.

3.06 FLUSHING

A. Remove disinfection water from the facilities as appropriate for the type of disinfectant and method used for disinfection.

B. Flush facilities with potable water containing no more disinfectant residual than the active distribution system or 1.0 milligram per liter, whichever is greater (as appropriate for method of chlorination).

C. Continue flushing until water at designated flushing ports contains disinfectant residual equal to concentration specified above.

3.07 DISPOSAL OF CHLORINATED WATER

A. Dispose of chlorinated water in accordance with the submitted disinfection test plan and applicable requirements of federal, state, county, and city having jurisdiction over disposal of hazardous wastes in location of the Project and disposal site.

B. Chlorinated water may only be disposed of in a sanitary sewer system with the written permission of the Owner. If allowed, discharge the chlorinated water at a low rate so it does not surcharge the sewer line.

3.08 BACTERIOLOGICAL TEST

A. Collect 2 sets of samples per AWWA C651, Section 5.1 and deliver to a certified laboratory within 6 hours of obtaining the samples. Obtain a bacteriologic quality test to demonstrate the absence of coliform organisms in each separate section of pipeline and in each structure after chlorination and refilling.

B. A minimum of 24 hours after flushing system, collect bacteriological quality samples at each of following locations:
   1. Every 1,200 feet of new water/raw water main.
   2. End of pipeline.
   3. Each branch.
   4. each connection to an existing pipeline (two additional samples).
   5. Ends of piping runs.
   6. Drain lines.
   7. Each process structure.
   8. At least 2 outlets on each building floor.
   9. Other locations identified in the submitted disinfection test plan.

C. When bacteriological test proves water quality to be unacceptable, repeat disinfection treatment process until water meets quality standards for disinfection at no additional cost to the Owner.

3.09 WELL DISINFECTION

A. Each well shall be disinfected to remove bacteriological contamination in accordance with AWWA Standards A100-97 and ANSI/AWWA C654. A well shall also be disinfected at any time when work on the well is stopped and not expected to recommence for a period of greater than 5 days.

B. A disinfectant solution shall be prepared and applied so that a minimum concentration of 50 mg/L of available chlorine shall be maintained for the entire depth of each well. An alternative approved disinfectant can be prepared within the recommended concentration range and applied to the entire length of the well. The solution shall be allowed to remain in the well for at least 2 hours or at least the minimum holding time for the alternative disinfectant.

C. A sufficient volume of disinfectant must be applied to the well bore and aquifer to disinfect the well in accordance with the latest revision of Chapter 62-555.315, F.A.C.

D. After a well has been chlorinated and pumped to free flow for a minimum of 15 minutes with zero chlorine residual, duplicate analyses shall be taken not less than 30 minutes apart and the samples tested for the presence of coliform in accordance with Standard Methods for the Examination of Water and Wastewater. Additional samples shall be collected until samples collected on consecutive days do not show the presence of coliform bacteria. Additional samples shall be collected until samples collected on five consecutive days (minimum 10 consecutive samples) do not show the presence of residual chlorine and total coliform. A total of two samples can be collected on each consecutive day, at least six (6) hours apart. When no residual chlorine and total coliforms are present for five consecutive days. Bacteriological test results shall be submitted to the Polk County Department of Health for final approval and completion of disinfection.

E. Chlorinated water from each well must be impounded or neutralized in accordance with Section 3.07.

END OF SECTION

SECTION 01759

WATER LEAKAGE TEST FOR CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Hydrostatic leakage test for concrete water-holding structures.

1.02 REFERENCES

A. Abbreviations and acronyms.

B. Definitions.
   1. Damp spots: Surfaces where visible moisture can be picked up by a dry hand.
   2. Containment structure, lined: Liquid-containing structure with barrier coating or membrane applied to the inside surfaces to prevent leaking of contents to the outside.
   3. Containment structure, unlined: Liquid containing structure where only the concrete structure itself is used to prevent leaking of contents to the outside.

C. Refer to section 13207 - Wrapped Prestressed Concrete Tanks for additional requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination.

B. Pre-installation meetings.

C. Sequencing.

D. Scheduling.

1.04 SUBMITTALS

A. Product data.

B. Shop drawings:
   1. Description and details of each evaporation/precipitation-measuring device anticipated for use during the test.

C. Samples.

D. Certificates.

E. Delegated design submittals.

F. Tests and evaluation reports:
    1. Results of water leakage test for each structure and for each portion of a structure designated for testing.

G. Manufacturer instructions.

H. Source quality control submittals.

I. Field/site quality control submittals.

J. Manufacturer reports.

K. Sustainable design submittals.

L. Special procedure submittals:
    1. Testing plan for each structure, or portion thereof, required to be tested.
        a. Describe methods of obtaining water for testing and of releasing water for disposal, including provisions for dechlorination if required.
        b. Include plans showing locations where measurements will be made and locations of evaporation/precipitation-measuring device.
        c. Indicate plans for filling and draining structure(s).
        d. Include schedule showing duration of test for each structure or cell to be tested, date and time for start of each test, dates and times of observations and measurements during the test, dates and times for closeout of testing procedures, and date for submittal of final results.
    2. Proposed procedures and products for repair of leaks.

M. Qualifications statements.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 GENERAL

A. Test structures and portions of structures listed in the following paragraphs for water leakage.
    1. Unless otherwise specified, the Contractor shall:
        a. Obtain all required permits for discharging testing water.
        b. Provide dechlorination of such water if required by the permits.
        c. Prepare and fill the structures.
        d. Provide access and equipment required for testing and for recording test results.
        e. Take measurements and make observations required for testing.
    2. At all times during testing, the Engineer shall have access to observe measurements by others or to make independent measurements.

B. Test the following concrete structures for water leakage:
    1. Ground Storage Reservoir (Process 40).

C. Required preparation for testing is designated in this Section. Waiver of, or failure to complete preparations shall not change the testing criteria or approval criteria for the areas tested.

D. Retest structures and portions of structures until the evaluation criteria are satisfied.

3.02 TEST WATER SOURCE AND DISPOSAL

A. Water used for the first filling of the tank will be furnished by Contractor.
   1. Contractor shall obtain water for leakage testing from the on-site groundwater well or potable water distribution system, when available. Contractor will coordinate with the Owner prior to obtaining the water source.

B. In the event that retesting is required, Contractor shall bear the cost of refilling the tank for subsequent tests at no additional costs to the Owner

C. After leakage testing is complete, Contractor may dispose of water by discharging to the new stormwater system. Coordinate final disposal with submitted leak testing plan.

3.03 PREPARATION

A. For each structure to be tested, prepare and submit a plan showing schedule and sequence of activities, method of filling, and methods of disposing of test water.

B. Sequencing requirements:
   1. Complete construction of concrete structure and cure concrete to obtain minimum specified 28-day compressive strength as specified in Section 03300 - Cast-In-Place Concrete.
      a. Do not begin tests until all portions of structure are complete and have reached their minimum specified 28-day compressive strength.
      b. Do not begin tests until at least 14 days have passed since completion of the last concrete placement.
   2. Complete tests before:
      a. Covering any surface of the structure with materials that might mask the location of leaks or obscure damp concrete surfaces. Such coverings include, but are not limited to basin bottom grout, masonry veneer, stucco, plaster, and other coatings.
      b. Installation of equipment, unless otherwise approved by the Engineer.
      c. Backfilling structures to elevations above the limits indicated in the following paragraphs.
   3. Liners and coatings:
      a. Install liners that are mechanically locked to the concrete surface during placement of plastic concrete and before leakage testing.
         1) Examine liners for pinholes, tears, and partially fused splices, complete all required liner integrity testing, and make required repairs before commencing leakage testing.
      b. Unless otherwise specified, do not install surface-applied protective or decorative coatings and linings until leakage tests have been completed.

C. Weather requirements:
   1. Tests on structures with tops open to the atmosphere shall not be scheduled for periods when the 10-day weather forecast indicates a substantial change in weather patterns.
   2. Measurements of water surface levels in the structure shall not be scheduled for periods when the weather forecast indicates a difference of more than 35 degrees Fahrenheit between the ambient temperature readings at the times of initial and final measurements.

D. Groundwater requirements:
   1. Maintain groundwater to a level not higher than *2* feet below the bottom of the structure and maintain at that level for the duration of the test.

E. Clean interior of structure:
   1. Remove dirt, contaminants, and construction debris.
   2. Flush floors and sumps to provide clean surfaces.
   3. Remove standing water that would interfere with examination of surfaces, cracks, or joints.
   4. Disinfect interior of structures as specified in Section 01757 - Disinfection.

F. Observe the structure, or portions of the structure being tested, for potential leak locations:
   1. Give particular attention to cracks, open joints, voids, and honeycombed and repaired surfaces.
   2. Visually observe openings, fitting, and pipe penetrations in the structure at both faces, if possible.
   3. Repair potential leak locations in accordance with these Specifications and as approved by the Engineer.
   4. Backfill excavations to the top of the structure foundation. Do not place backfill against water-bearing walls or over footings unless approved in advance by the Engineer.
      a. If requesting backfilling of walls before testing, include a description of methods that will be used to detect leakage in the backfilled areas.
      b. Engineer's approval of backfilling before testing shall not relieve Contractor of the responsibility to conduct leakage tests, to satisfy the leakage acceptance criteria for the structure, or to repair leaking portions of the structure, including those portions below or behind the backfill.
   5. See Drawings and Section 02300 - Earthwork for requirements to provide wall stability before backfilling.

G. Inlets to/outlets from the structure:
   1. Make inlets to and outlets from the structure watertight.
      a. Include valves; stop, sluice, and slide gates; and temporary bulkheads as required.
      b. Inlets and outlets not required to be operable may be temporarily sealed before testing of the compartments to which they open.
      c. Secure inlets used to fill the structure for testing to ensure that no water is entering or leaving the structure once it has been filled to the test level.

2. Adjustments to measured leakage at inlets and outlets based on manufacturer's or Contractor's estimates will not be allowed.
    a. Adjustments to measured leakage may be permitted by the Engineer, and, at his/her discretion, only when the Contractor makes specific measurements of leakage at each individual inlet and outlet using methods approved by the Engineer.

3.04 HYDROSTATIC LEAKAGE TEST FOR OPEN OR COVERED CONTAINMENT STRUCTURES ("HST-100")

A. Isolate sections of water-holding structures that can be isolated in actual operation. Fill and test sections for leakage separately.
    1. Fill structures and sections of structures scheduled for testing to high water levels as indicated on the Drawings.

B. Initial rate for filling of structures shall not exceed 8 feet in 24 hours.

C. HST-100 testing includes 2 parts, "Qualitative Testing," and "Quantitative Testing," as described in the following paragraphs:
    1. HST-100, Part 1 - Qualitative Testing:
        a. During the first 24 hours after structures are filled, examine exposed concrete surfaces for damp spots or flowing water.
            1) Make observations in early morning, at midday, and in late afternoon.
            2) Continue observations through the duration of the Quantitative Testing period.
            3) Pay particular attention to conditions at joints, honeycombed areas, cracks, and repaired portions of the structure.
        b. Evaluation criteria:
            1) The structure shall be considered to have failed these Qualitative Testing requirements if any of the following conditions are observed.
                a) Water droplets or moist areas on an outside surface that could only have originated inside the structure.
                b) Water is flowing or seeping from joints, cracks, or surfaces.
                    (1) Exception: Dampness or wetness on top of a footing, in the absence of flowing water, shall not be considered as failure to meet this criterion.
                c) Moisture can be transferred to a dry hand from the outside surfaces of the filled area.
        c. Repairs and retesting:
            1) Where damp spots or flowing water as described in the preceding paragraphs are observed, mark locations, provide repairs, and retest the structure as specified in subsequent paragraphs.
    2. HST-100 - Part 2: Quantitative Testing:
        a. If approved by the Engineer, Quantitative Testing may begin before repairs are made to areas failing Part 1 of this test; however:
            1) Adjustments to volume loss calculations of Quantitative Testing based on observed leakage will not be permitted.
            2) All defects identified for repair during Qualitative Testing shall be repaired to the satisfaction of the Engineer before approval of the structure.

b. Report the results of Quantitative Testing on "Leakage Test Report" included as Figure A at the end of this Section, or similar form prepared by the Contractor and containing at least the information included in Figure A.
c. Unlined concrete structures:
    1) Fill to the designated water surface elevation. Maintain that level for at least 72 hours before recording initial water levels for leakage test.
    2) Duration of test:
        a) Ground Storage Tank (Process 40): 72 hours.
d. Measurements: Water level:
    1) Record water levels at 24-hour intervals for the full duration of the test period.
    2) Measure water levels at not less than 2 locations on opposite ends of the structure, and preferably at 4 locations spaced equally around the structure. Mark locations on the structure and take measurements at the same locations throughout the duration of the test.
    3) Measure, to an accuracy of 1/16 inch, the vertical distance to the water surface from a fixed point on the structure above.
e. Measurements: Temperatures:
    1) As part of the first and last sets of level measurements, record water temperature at a depth of 18 inches below the water surface. Measure temperature at the same locations where level measurements are taken.
    2) Record ambient temperature at the time of each water level measurement.
f. Measurements: Evaporation and precipitation:
    1) Measure evaporation and precipitation by floating pans inside the structures during testing.
        a) For uncovered structures, measure both evaporation and precipitation.
        b) For covered structures that are well ventilated, measure evaporation.
    2) Measure using specially constructed clear containers:
        a) Provide clear plastic, calibrated, open-top containers not less than 18 inches in diameter and 18 inches deep.
        b) Partially fill containers with water and float inside the structure. Make provisions to hold containers in place at each measurement location, but away from structure walls and items passing overhead, such as beams or pipes.
        c) Measure initial depth of water in each device. Measure changes in water level in each device at the same time measurements of the water level inside the structure are taken.
g. Restart of test:
    1) The Engineer may order a restart of the test when, in the Engineer's opinion, measurements have become unreliable due to unusual precipitation or other factors.
    2) If measurements or observed leakage during the testing period indicate that the allowable leakage requirements will be exceeded, the test may be terminated before completion of the full test period. Take appropriate actions to correct problems before restarting the test.
h. Calculations of leakage test results:
    1) For each section of the structure tested, use water surface level records to calculate average loss of volume per 24-hour interval.

a) For each 24-hour interval during the test, calculate the average of all measured drops in water level around the structure.
b) Use the average drop thus determined to calculate an average loss of volume for each 24-hour interval.

2) Adjustments to leakage calculations:
a) For uncovered basins, calculations shall be corrected for precipitation added to the structure.
b) Calculations may be corrected for evaporation and water temperature.

i. Evaluation criteria:
1) Unless otherwise specified, the average loss of volume during any 24-hour interval shall not exceed the limits shown in Table A.

Table A – Loss of Volume Criteria for Leakage Tests

Structure Type	Maximum Loss of Water Volume
• Structure fully lined prior to leakage test. • Secondary containment areas.	No measurable loss over 72-hour test period.
• Structure with monolithically placed membrane floor slab.	0.0125 percent of volume per 24-hour period.
• Concrete paved canals, drying beds, lagoons, and similar structures.	0.100 percent of volume per 24-hour period.
• Other containment structures.	0.050 percent of volume per 24-hour period.

j. Repairs and retesting:
1) Structures and portions of structures that have satisfied the qualitative requirements of HST-100 but have failed to satisfy the quantitative requirements of HST-100 may be immediately retested for volume loss.
a) If the structure fails the second test for volume loss, the structure shall be drained, and the Contractor shall observe the interior for probable areas of leakage.
b) The structure shall not be retested until repairs to the probable areas of leakage are complete.
2) Repair flowing leaks whether leakage exceeds the allowable leakage or not.

3.05 REPAIRS FOR RETESTING

A. Locations showing damp spots or flowing water:
1. Mark locations of visible leaks and damp spots.
2. Drain structures for repair.
3. Repair defects causing damp spots and flowing water using methods approved by the Owner and Engineer.
a. Repair both interior and exterior surfaces and make structures watertight.
b. Submit proposed repair products and procedures for Engineer's review.
c. Refill structures for retesting.
4. Repeat filling, observations, and repairs until no leaks or damp spots appear.

B. Structures for which loss of water volume loss exceeds the limits specified after adjustments for evaporation, and precipitation:
1. Determine cause of volume loss.

2. Drain structures of water.
3. Repair defects causing loss of water volume using methods approved by the Engineer.
    a. Submit proposed repair products and procedures for Engineer's review.
4. Refill water-holding structures.
5. Repeat testing and repairs until volume loss does not exceed specified limits.

END OF SECTION

FIGURE A

WATERTIGHTNESS TEST REPORT

PROJECT:	Gibson Oaks WPF	SUBMITTED BY:	
STRUCTURE:	GSR (Process 40)	WITNESSED BY:	
AREA:		TEST DATES:	
TEST DURATION:		TEST DURATION:	

Surface area of structure tested:		(square feet)
Volume of structure tested:		(cubic feet)
Volume of structure tested:		(gallons)
Measured loss through gates, etc.:		(gallons / day)
Allowable loss of water volume:		(per day)
Allowable loss of water volume:		(% in 24 hours)
Allowable measured loss over test duration (inches):		
Measured loss of water:		(gallons / day – From E below)
Measured loss of water volume (%):		(in 24 hours – From E below)

Water Temperature: Start of test: °F End of test: °F

			Water Surface Elevation (top of structure to top of water)				
			Location #1	Location #2	Location #3	Location #4	Initials**
Day	Date	Time	(inches)	(inches)	(inches)	(inches)	
1							
2							
3							
4							
5							
Changes in Level:							

A. Average change in level (feet): _____ (Average of total charges for all locations)

B. Correction for precipitation: _____ (Measured from pan)

C. Correction for evaporation: _____ (Measured from pan)

D. Corrected change in level (CL): _____

E. Total days tested: _____

F. Average measured % water loss in 24 hours: _____ = $\frac{\text{(CL) x (surface area) x 100}}{\text{(initial water volume) x (number of test days)}}$

Notes and field observations**

** Place date and initials at the beginning of each entry.

SECTION 01770

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Contract closeout requirements including:
   1. Final cleaning.
   2. Waste disposal.
   3. Touch-up and repair.
   4. Disinfection of systems.
   5. Preparation and submittal of closeout documents.
   6. Certificate of Substantial Completion.

1.02 REFERENCES

A. Refer to General Conditions for additional contract requirements. If a conflict between this section and the General Conditions is determined, the General Conditions shall prevail.

B. Polk County Utility Standards and Specifications Manual (USSM).

C. American Water Works Association (AWWA).

1.03 FINAL CLEANING

A. Perform final cleaning prior to inspections for Final Completion.

B. Employ skilled workers who are experienced in cleaning operations.

C. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.

D. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.

E. Clean roofs, gutters, downspouts, and drainage systems.

F. Broom clean exterior paved surfaces and rake clean other surfaces of site work:
   1. Police yards and grounds to keep clean.

G. Remove dust, cobwebs, and traces of insects and dirt.

H. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.

I. Remove non-permanent protection and labels.

J. Polish waxed woodwork and finish hardware.

K. Wash tile.

L. Wax and buff hard floors, as applicable.

M. Wash and polish glass, inside and outside.

N. Wash and shine mirrors.

O. Polish glossy surfaces to clear shine.

P. Vacuum carpeted and soft surfaces.

Q. Clean permanent filters and replace disposable filters when heating, ventilation, and air conditioning units were operated during construction.

R. Clean ducts, blowers, and coils when units were operated without filters during construction.

S. Clean light fixtures and replace burned-out or dim lamps.

T. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.04 WASTE DISPOSAL

A. Arrange for and dispose of surplus materials, waste products, and debris off-site:
   1. Prior to making disposal on private property, obtain written permission from Owner of such property.

B. Do not fill ditches, washes, or drainage ways which may create drainage problems.

C. Do not create unsightly or unsanitary nuisances during disposal operations.

D. Maintain disposal site in safe condition and good appearance.

E. Complete leveling and cleanup prior to Final Completion of the Work.

1.05 TOUCH-UP AND REPAIR

A. Touch-up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for Substantial Completion.

B. Refinish or replace entire surfaces which cannot be touched-up or repaired satisfactorily.

1.06 CLOSEOUT DOCUMENTS

A. Submit following Closeout Submittals before Substantial Completion:
   1. Deficiency list of items to be completed or corrected with the request for issuance of Substantial Completion.
   2. Evidence of Compliance with Requirements of Governing Authorities.
   3. Project Record Documents.

4. Provide .csv and .dwg electronic files of the Record Drawings to the Owner. Submit signed and sealed hardcopy of surveyor's Record Drawings
5. Approved Operation and Maintenance Manuals.
6. Approved Warranties and Bonds.
7. Keys and Keying Schedule.
8. Completed contract requirements for commissioning and process start-up.
9. Easement description for the final power transformer and conduits for the Lakeland Electric permit closeout.

B. Submit following Closeout Submittals before final completion of the Work and at least 7 days prior to submitting Application for Final Payment:
1. Deficiency list of items have been completed and Engineer and Owner are satisfied that all deficiencies are corrected.
2. Evidence of Payment and Release of Liens or Stop Payment Notices as outlined in Conditions of the Contract.
3. Release of claims as outlined in Conditions of the Contract.
4. Submit certification of insurance for products and completed operations, as specified in the General Conditions.
5. Final statement of accounting.

1.07 EVIDENCE OF COMPLIANCE WITH REQUIREMENTS OF GOVERNING AUTHORITIES

A. Submit and obtain the following:
1. Certificate of Occupancy.
2. Florida Department of Environmental Protection/Florida Department of Health - Notification of Completion.
3. Notification of Environmental Resource Permit Completion

1.08 PROJECT RECORD DOCUMENTS

A. Maintain at Project site, available to Owner and Engineer, 1 copy of the Contract Documents, shop drawings, and other submittals in good order:
1. Mark and record field changes and detailed information contained in submittals and change orders.
2. Record actual depths, horizontal and vertical location of underground pipes, duct banks, and other buried utilities. Reference dimensions to permanent surface features.
3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes. Provide underground pictures as indicated in Section 01340 - Photographic and Videographic Documentation Part 1.06.D.
4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits and filled conduits.
5. Provide schedules, lists, layout drawings, and wiring diagrams.

6. Make annotations in electronic format and in hardcopy format with erasable colored pencil conforming to the following color code:

Additions:	Red
Deletions:	Green
Comments	Blue
Dimensions:	Graphite

B. Maintain documents separate from those used for construction:
   1. Label documents "RECORD DOCUMENTS."

C. Keep documents current:
   1. Record required information at the time the material and equipment is installed and before permanently concealing.
   2. Engineer will review Record Documents weekly to ascertain that changes have been recorded.

D. Affix civil engineer's or professional land surveyor's signature and registration number to Record Drawings to certify accuracy of information shown.

E. Deliver Record Documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

F. Record Documents will be reviewed monthly to determine the percent complete for the monthly pay application.

G. Updated Record Documents are a condition for Engineer’s recommendation for progress payment.

H. Final Schedule Submittal as specified in Section 01324C - Progress Schedule and Reports.

1.09 MAINTENANCE SERVICE

A. Maintenance service as specified in technical specifications and Polk County General Conditions.

1.10 SUBSTANTIAL COMPLETION

A. Obtain Certificate of Substantial Completion. Refer to the Polk County General Conditions.

1.11 FINAL COMPLETION

A. Refer to the Polk County General Conditions for additional requirements.

B. When Contractor considers the Work is complete, submit written certification that:
   1. Work has been completed in accordance with the Contract Document.
   2. Punch list items have been completed or corrected.
   3. Work is ready for final inspection.

C. Engineer will make an inspection to verify the status of completion with reasonable promptness.

D. Should the Engineer consider that the Work is incomplete or defective:
   1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
   2. Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to the Engineer that the Work is complete.
   3. Engineer shall re-inspect the Work.

1.12 FINAL ADJUSTMENT OF ACCOUNTS

A. Refer to the Polk County General Conditions for additional requirements.

B. Submit a final statement of accounting to the Engineer at least 7 days prior to final Application for Payment.

C. Statement shall reflect all adjustments to the Contract amount.
   1. The original Contract amount.
   2. Additions and deductions resulting from:
      a. Change Orders.
      b. Units installed and unit prices.
      c. Setoffs for uncorrected or incomplete Work.
      d. Setoffs for liquidated damages.
      e. Setoffs for re-inspection payments.
      f. Extended engineering and/or inspection services and inspection overtime.
      g. Excessive shop drawings review cost by the Engineer.
      h. Other adjustments.
   3. Total Contract amount, as adjusted.
   4. Previous payments.
   5. Remaining payment due.

D. Engineer will prepare a final Change Order reflecting approved adjustments to the Contract amount which were not previously made by Change Orders.

1.13 FINAL APPLICATION FOR PAYMENT

A. Refer to the Polk County General Conditions for additional requirements.

B. Contractor shall submit the final Application for Payment reflecting the agreed upon information provided in the final statement of accounting.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01782

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preparation and submittal of Operation and Maintenance Manuals.

1.02 GENERAL

A. Submit Operation and Maintenance Manuals as specified in technical sections, Polk County General Conditions and Utility Standards and Specification Manual (USSM).

B. Submit electronic equipment information in compliance with Polk County Utilities Computerized Maintenance Management System

C. Make approved manuals available at project site for use by construction personnel and Owner.

1.03 SUBMITTALS

A. Draft Operation and Maintenance Manuals:
   1. Submit prior to shipment of equipment or system to site.
   2. Shipment will be considered incomplete without the draft Operation and Maintenance Manuals.
   3. Quantity:
      a. Hard copy: 3 sets.
      b. Electronic: 1 CD-ROM or DVD.

B. Final Operation and Maintenance Manuals:
   1. Make additions and revisions in accordance with Owner's and Engineer's review comments on draft manuals.
   2. Submit approved Operation and Maintenance Manuals at least 30 days prior to Functional Testing and at least 60 days prior to Owner Training.
   3. Quantity:
      a. Hard copy: 6 sets.
      b. Electronic: 6 CD-ROM or DVD.

1.04 PREPARATION

A. General requirements:
   1. Provide dimensions in English units.
   2. Assemble material, where possible, in the same order within each volume.
   3. Reduce drawings and diagrams to 8-1/2 by 11-inch size, if possible unless otherwise specified.
   4. Complete forms on computer, handwriting not acceptable.
   5. Delete items or options not provided in the supplied equipment or system.

6. Provide package control system annotated ladder logic for PLC, if applicable.

B. Hard copy requirements:
   1. Binders: 3-ring with rigid covers.
      a. Break into separate binders as needed to accommodate large size.
   2. Utilize numbered tab sheets to organize information.
   3. Provide original and clear text on reproducible non-colored paper, 8-1/2 by 11-inch size, 24-pound paper.
   4. Drawings larger than 8-1/2 by 11 inch:
      a. Fold drawings separately and place in envelope bound into the manual.
      b. Label each drawing envelope on the outside regarding contents.

C. Electronic requirements:
   1. File format:
      a. Entire manual in PDF format.
         1) Include text and drawing information.
         2) Provide a single PDF file even if the hard copy version is broken into separate binders due to being large.
         3) Create PDF from the native format of the document (Microsoft Word, graphics programs, drawing programs, etc.)
            a) If material is not available in native format and only available in paper format, remove smudges, fingerprints, and other extraneous marks before scanning to PDF format.
            b) Hard copy record drawing requirements:
               (1) Provide a single multipage PDF file of each set of the scanned drawings.
               (2) Page 1 shall be the cover of the drawing set.
            c) At file opening, display the entire cover.
               (1) Scan drawings at 200 to 300 dots per inch (DPI), black and white, Group IV Compression, unless otherwise specified.
               (2) Scan drawings with photos in the background at 400 dots per inch (DPI), black and white, Group IV Compression.
         4) Pagination and appearance to match hard copy.
         5) Searchable.
         6) Scanned images are not acceptable.
         7) Bookmarks:
            a) Bookmarks shall match the table of contents.
            b) Bookmark each section (tab) and heading.
            c) Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
            d) At file opening, display all levels of bookmarks as expanded.
         8) Thumbnails optimized for fast web viewing.
      b. Drawing requirements.
         1) Provide additional copy of drawings in most current version of AutoCAD format.
         2) Drawings shall have a white background.
         3) Drawing shapes shall not degrade when closely zoomed.
         4) Screening effects intended to de-emphasize detail in a drawing must be preserved.
         5) Delete items or options not provided in the supplied equipment or system.

2. Media:
    a. CD-ROM or DVD-ROM compatible with Microsoft Windows.
    b. Flash drive.
    c. Secure Electronic File Transfer (SEFT).
3. Label media with the following information:
    a. Operation and Maintenance Manual.
    b. Equipment name.
    c. Specification Section Number
    d. Equipment tag number.
    e. Owner's name.
    f. Project number and name.
    g. Date.
4. If multiple submittals are made together, each submittal must have its own subdirectory that is named and numbered based on the submittal number.

1.05 CONTENTS

A. Label the spines:
    1. Equipment name.
    2. Tag number.
    3. Project name.
    4. Owner name.

B. Cover page:
    1. Operation and Maintenance Manual.
    2. Equipment name.
    3. Specification Section Number
    4. Equipment tag number.
    5. Owner's name.
    6. Project number and name.
    7. Date.

C. Table of Contents: General description of information provided within each tab section.

D. Equipment Summary Form: Completed form as specified in Appendix A of this Section.

E. Equipment Maintenance Summary Form: Completed form as specified in Appendix B of this Section.

F. Electric Motor Technical Data Form: Completed form as specified in Appendix C of this Section.

G. Description of equipment function, normal operating characteristics, and limiting conditions.

H. Manufacturer's product data sheets:
    1. Where printed material covers more than 1 specific model, indicate the model number, calibrated range, and other special features.

I. Assembly, installation, alignment, adjustment, and checking instructions.

J. Storage instructions: Control diagrams:
   1. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer-based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.
   2. Complete set of 11-inch by 17-inch drawings of the control system.
   3. Complete set of control schematics.

K. Programming: Copies of Contractor furnished programming.

L. Start-up procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.

M. Operating procedures:
   1. Step-by-step instructions including but not limited to the following:
      a. Safety precautions.
      b. Guidelines.
      c. Manual keyboard entries.
      d. Entry codes.
      e. System responses.
      f. Other information as needed for safe system operation and maintenance.
   2. Modes:
      a. Startup.
      b. Routine and normal operation.
      c. Regulation and control.
      d. Shutdown under specified modes of operation.
      e. Emergency operating shutdown.

N. Preventative maintenance procedures:
   1. Recommended steps and schedules for maintaining equipment.
   2. Troubleshooting.

O. Lubrication information: Required lubricants and lubrication schedules.

P. Overhaul instructions: Directions for disassembly, inspection, repair, and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.

Q. Parts list:
   1. Complete parts list for equipment including but not limited to the following information:
   2. Catalog data: Generic title and identification number of each component part of equipment.
   3. Include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
   4. Availability.
   5. Service locations.

R. Spare parts list: Recommended number of parts to be stored at the site and special storage precautions.

S. Engineering data:
   1. Drawings: Complete set of 11-inch by 17-inch equipment drawings.
   2. Exploded view or plan and section views with detailed callouts.
   3. Outline, cross-section, and assembly drawings.
   4. System drawings: Provide interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.
   5. Packaged equipment system drawings: Provide instrumentation loop drawing, control schematic diagrams, interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.
   6. System drawings and data sheets: Include drawings and data furnished by the Engineer and the Supplier; provide "as installed" version.
   7. Provide electrical and instrumentation schematic record drawings.

T. Test data and performance curves, when applicable.

U. Manufacturer's technical reference manuals.

V. Source (factory) Test results: Provide copies of Source Tests reports as specified in technical sections.

W. Functional Test results: After Functional Tests are completed, insert Functional Test reports as specified in technical sections.

1.06 ARCHIVAL DOCUMENTATION

A. Typically does not require updating to remain valid and should be stored in a format that preserves the document and limits one's ability to make changes.

B. Types of archival documents include the following:
   1. Record drawings.
   2. Reports.
   3. Specifications.
   4. Shop drawings.
   5. Vendor Equipment O & M Manuals.
   6. Photos.
   7. Demonstration and training videos.
   8. Other.

1.07 LIVING DOCUMENTATION

A. Requires periodic updates to remain valid and should be stored in formats that are easy to update.

B. Types of living documents include the following:
   1. Facility O&M Manuals.
   2. Standard Operating Procedures.
   3. Other.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

APPENDIX A
EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT IDENTIFICATION NUMBER(S) _____
(maps equipment number)

4. LOCATION OF EQUIPMENT _____

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

_____

_____

_____

6. NAMEPLATE DATA -
   - Horsepower _____
   - Amperage _____
   - Voltage _____
   - Service Factor (S.F.) _____
   - Speed _____
   - ENC Type _____
   - Capacity _____
   - Other _____

7. MANUFACTURER'S LOCAL REPRESENTATIVE

   Name _____

   Address _____

   Telephone Number _____

8. MAINTENANCE REQUIREMENTS _____

_____

_____

9. LUBRICANT LIST _____

_____

10. SPARE PARTS (recommendations) _____

11. COMMENTS _____

APPENDIX B
EQUIPMENT MAINTENANCE SUMMARY

1. Equipment Item: _____
2. Manufacturer: _____
3. Serial No. (if applicable): _____
4. Manufacturer's Order No. (if applicable): _____
5. Nameplate Data (horsepower, voltage, speed, etc.): _____

   _____
6. Manufacturer's Local Representative:

   Name: _____

   Address: _____

   Telephone: _____
7. Maintenance Requirements:

Maintenance Operation	Frequency	Lubricant (if applicable)	Comments
(List each operation required. Refer to specific information in Manufacturer's Manual, if applicable)	(List required frequency of each maintenance operation)	(Refer by symbol to lubricant list as required)	

8. Lubricant List:

Reference Symbol	Conoco Phillips	Exxon/Mobil	BP/Amoco	Other (List)
(Symbols used in Item 7 above)	(List equivalent lubricants, as distributed by each manufacturer for the specific use recommended)			

9. Spare Parts: (Include recommendation on what spare parts should be kept on the job):

_____

_____

APPENDIX C
ELECTRIC MOTOR TECHNICAL DATA

Technical Data for Each Motor:

Application: _____

Manufacturer: _____

Frame No.: _____ Type: _____

Code Letter: _____ Design Letter: _____

Rating:

Horsepower: _____Voltage: _____ Phase: _____

Cycles: _____Full Load rpm: _____

(wound rotor secondary)

Volts: _____ Amperes: _____

Full Load Current: _____ amperes

Locked Rotor Current: _____ amperes

Locked Rotor or Starting Torque (percent of full load): _____ percent

Full Load Torque: _____ ft-lb

Breakdown Torque: _____ percent

Efficiency:		Power Factor:	
Full Load:	_____ percent	Full Load	_____ percent
3/4 Load:	_____ percent	3/4 Load:	_____ percent
1/2 Load:	_____ percent	1/2 Load:	_____ percent

Insulation:

Type: _____

Class: _____

Temperature Rise: _____ Above Ambient: _____

Enclosure: _____

Net Weight: _____ lbs

Wk^2: _____ lbs/sq ft

Type of Bearings: _____

Service Factor: _____

Noise Level in Decibels: _____

Heaters: _____ kW, _____ Phase, _____ volts

Altitude: _____

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SECTION 01783

WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Warranty and bonds requirements.

B. Refer to General Conditions for additional contract requirements. If a conflict between this section and the General Conditions is determined, the General Conditions shall prevail.

1.02 SUBMITTALS

A. For each item of material or equipment furnished under the Contract:
   1. Submit form of manufacturer's warranty prior to fabrication and shipment of the item from the manufacturer's facility.
   2. Submit form of manufacturer's special warranty when specified.

B. Provide consolidated warranties and bonds within 15 calendar days of Substantial Completion.
   1. Contents
      a. Organize warranty and bond documents:
         1) Include Table of Contents organized by specification Section number and the name of the product or work item.
      b. Include each required warranty and bond in proper form, with full information, are certified manufacturer as required, and are properly executed by Contractor, or subcontractor, supplier, or manufacturer.
      c. Provide name, address, phone number, and point of contact of manufacturer, supplier, and installer, as applicable.
   2. Hardcopy format:
      a. Submit 6 copies.
      b. Assemble in 3 D-side ring binders with durable cover.
      c. Identify each binder on the front and spine with typed or printed title "Warranties and Bonds"; Project Name or Title, and the Name Address and Telephone Number of the Contractor.
   3. Electronic copy in PDF format.
      a. Submit 1 copy.

1.03 OWNER'S RIGHTS

A. Owner reserves the right to reject warranties.

B. Owner reserves the right to refuse to accept Work for the project if the required warranties have not been provided.

1.04 RELATIONSHIP TO GENERAL WARRANTY AND CORRECTION PERIOD

A. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, both Contractor's general warranty and the correction period requirements.

B. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty, nor does such affect or limit Contractor's performance obligations under the correction period.

1.05 MANUFACTURER'S WARRANTY MINIMUM REQUIREMENTS

A. Written warranty issued by item's manufacturer.

B. Project-specific information, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Owner.

C. Covers all costs associated with the correction of the defect, including but not limited to removal of defective parts, new parts, labor, and shipping.
   1. When correcting warranted Work that has failed, remove and replace other Work that had been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

D. Provides a timely response to correct the defect.
   1. Manufacturer shall provide, in a timely fashion, temporary equipment as necessary to replace warranted items requiring repair or replacement, when warranted items are in use and are critical to the treatment process, as defined by Owner.
   2. In the case that Owner has to provide temporary equipment to replace function of warranted item requiring repair or replacement, manufacturer shall reimburse Owner for such costs associated with the temporary equipment.

E. Warranty commence running on the date of substantial completion.
   1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of warranty period.

F. Duration of Warranty: 2 years.

1.06 MANUFACTURER'S SPECIAL WARRANTY

A. Manufacturer's special warranty is a written warranty published by the manufacturer which includes the requirements specified in the Section where the item is specified.
   1. Includes Project-specific information and requirements, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Owner. Technical sections indicate Project-specific requirements that differ from the minimum warranty requirements for that item.
      a. Examples include extending the duration of manufacturer's warranty or to provide increased rights to Owner.
   2. Manufacturer's warranties commence on the date that the associated item is certified by Engineer as substantially complete.

1.07 WARRANTY WORK

A. Contractor's responsibilities:
   1. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the product, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

B. Replacement cost:
   1. Upon determination that work covered by warranty has failed, replace or rebuild the work to an acceptable condition complying with requirement of the Contract Documents.
      a. Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether Owner has benefited from the use of the work through a portion of its anticipated useful service life.

C. Related damages and losses:
   1. When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

D. Owner's recourse:
   1. Written warranties are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitation on time in which Owner can enforce such other duties, obligations, rights, or remedies.

E. Reinstatement of warranty:
   1. When work covered by a warranty has failed and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement.
      a. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

1.08 IMPLIED WARRANTIES

A. Warranty of title and intellectual rights:
   1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
   2. Provisions on intellectual rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.

B. Implied warranties: Duration in accordance with Laws and Regulations.

1.09 BONDS

A. Bond requirements as specified in the technical sections.

B. Bonds commence running on the date of substantial completion.
   1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of bond period.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02050

SOILS AND AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Limerock base course.
   2. Stabilized sub-base.
   3. Gravel and crushed rock base.
   4. Structural fill and backfill.
   5. Select sand fill.
   6. Pipe backfill.
   7. Common fill.
   8. Unsuitable material.
   9. Sand-Cement slurry backfill.
   10. Drain material.
   11. Water for compaction.
   12. Filter fabric.
   13. Drainpipe.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
   2. D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
   3. D3744 - Standard Test Method for Aggregate Durability Index.
   4. D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.03 SUBMITTALS

A. Product data:
   1. Material source.
   2. Gradation.
   3. Testing data.

B. Quality control.
   1. Test reports.
   2. Certificates of Compliance.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide material having maximum particle size not exceeding 4 inches and that is free of trash, lumber, debris, leaves, grass, roots, stumps, and other organic matter.

B. Materials derived from processing demolished or removed asphalt concrete are not acceptable.

C. Refer to Polk County Utility Standards and Specification Manual (USSM), latest revision.

2.02 LIMEROCK BASE COURSE

A. Consists of hard, durable particles or fragments of stone or gravel; crushed to required size and grading; and free from vegetable matter, lumps or balls of clay, alkali, adobe, or other deleterious matter in sufficient quantity as to be detrimental to the proper bonding, finishing, or strength of the limerock base.

B. When sampled and tested in accordance with specified test methods, material shall comply with following requirements:
   1. Plasticity index: Shall be non-plastic when tested in accordance with ASTM D4318.
   2. Liquid limit: Shall not be more than 35 percent when tested in accordance with ASTM D4318.
   3. Asbestos: Less than 1 percent by weight asbestos.
   4. Limerock:
      a. Carbonates of calcium and magnesium: Minimum percentage of 70.
      b. Water-sensitive clay mineral: Maximum percentage of 3.

C. Grading:
   1. Grading Percent by Weight Passing 3-1/2 inch sieve: 97 percent.
   2. Material shall be graded uniformly down to dust.
   3. Fine material shall consist entirely of dust of fracture.
   4. Crushing or breaking-up which might be necessary in order to meet such size requirements shall be done before the material is placed on the road.

2.03 STABILIZED SUB-BASE

A. Description:
   1. This section includes materials, testing, and construction of a firm and unyielding stabilized sub-base.

B. Materials
   1. Use local or hauled-in clean sand or sand and clay.

C. Stabilizers
   1. Use high-bearing-value soil, sand-clay, or rock screenings.
   2. Do not use muck, trash, hardpan, material having a plasticity index of more than 10 or a liquid limit greater than 40.

2.04 GRAVEL AND CRUSHED ROCK BASE

A. Description
   1. This includes materials, testing, and installation of gravel and crushed rock bases for structures such as manholes and vaults.

B. Testing for Compaction:
   1. The Contractor will test for compaction or relative density as described below.
      a. Determine the density of gravel and rock in place by the sand cone method, ASTM D1556 or 2167.
   2. Determine the relative density of gravel and rock in accordance with ASTM D4253 and D4254.
   3. Sample backfill materials in accordance with ASTM D75.
   4. Compaction shall be deemed to comply with the specifications when no more than one test of any three consecutive tests falls below the specified relative compaction. The one test shall be no more than three percentage points below the specified compaction. The Contractor shall pay the costs of retesting work not conforming to the specifications.

C. Durability Index: Minimum 40 in accordance with ASTM D3744.

D. Gradation:
   1. Refer to the USSM, latest revision.

Sieve Size	Percent Passing by Weight
1-1/2 inches	100
3/4 inch	90 to 100
No. 4	35 to 55
No. 30	10 to 30
No. 200	0 to 5

2.05 STRUCTURAL FILL BACKFILL

A. Structural backfill shall consist of clean, fine to medium sand, contain less than 1 percent by weight asbestos or organic matter (peat, humus, leaves, and carbon compounds), and conform to the following gradation requirements:

Sieve Size	Percent Passing by Weight
3/8 inch	100
No. 4	90 - 100
No. 200	<10
Organic Matter	<1%

B. Excavated native material may be used for structural backfill provided it conforms to the above specifications for structural backfill material.

2.06 AGGREGATE BASE COURSE

A. Crushed gravel.

B. Consists of hard durable particles of fragments of stone or gravel; screened or crushed to required size and grading; and free from organic matter, lumps or balls or clay, alkali, or other deleterious matter.

C. When sampled and tested in accordance with specified test methods, material shall comply with following requirements:
   1. Plasticity index: Not be more than 5 when tested in accordance with ASTM D4318.

D. Aggregate base course for structures:
   1. Consists of crushed or fragmented particles.
   2. Grade within the following limits when tested in accordance with ASTM C117 and ASTM C136:

Sieve Size	Percent Passing by Weight
1 inch	100
1/2 inch	79 - 91
Number 4	49 - 61
Number 16	27 - 35
Number 200	7 - 11

2.07 SELECT SAND FILL, INCLUDING IMPORTED SAND FOR PIPE ZONE AND PIPE BEDDING IN PIPE TRENCHES

A. Select sand fill includes imported sand for pipe zone and pipe bedding in pipe trenches.

B. The material used for the select sand fill shall consist of less than 1 percent by weight asbestos or organic matter (peat, humus, leaves, and carbon compounds), and conforming to the following gradations requirements:

Sieve Size	Percent Passing by Weight
3/8 inch	100
No. 4	90 - 100
No. 200	<12
Organic Matter	<1%

C. Sand shall have a coefficient of permeability greater than 0.014 centimeters per second measured in accordance with ASTM D2434. Native material may be used in lieu of imported sand if it is shown by the Contractor that it is in compliance with the aforementioned requirements.

D. Excavated native material may be used for select sand fill provided it conforms to the above specifications for select sand fill.

2.08 PIPE BACKFILL

A. The material used for pipe backfill of the trench zone shall consist of less than 1 percent by weight asbestos or organic matter (peat, humus, leaves, and carbon compounds), and conform to the following gradation requirements:

Sieve Size	Percent Passing by Weight
3/8 inch	90 - 100
No. 4	80 - 100
No. 200	<15
Organic Matter	<1

B. Excavated native material may be used for pipe backfill provided it conforms to the above specifications for pipe backfill.

2.09 COMMON FILL

A. The material used for common fill shall consist of less than 1 percent by weight asbestos and conform to the USSM, latest revision.

B. Excavated native material may be used for common fill provided it conforms to the requirements for common fill.

2.10 UNSUITABLE MATERIAL

A. The following gradation is for the classification of unsuitable material encountered during the Work:

Sieve Size	Percent Passing by Weight
1/2 inch	<10
No. 200	>30
Organic soils	>20

B. Material encountered that meets any of the criteria noted in the gradation table above shall be determined to be unsuitable material.

C. When unsuitable material is encountered, it is to be excavated to a satisfactory limit until suitable material is reached for the purpose of the Work being performed at hand.

D. Unsuitable material is to be excavated, hauled and legally disposed.

2.11 SAND-CEMENT SLURRY BACKFILL

A. Refer to the USSM, latest revision.

2.12 DRAIN MATERIAL

A. Drain rock, or crushed rock, shall consist of hard, durable particles of stone, crushed to the required gradation below per AASHTO T 27 or ASTM C136, and shall be free from vegetable matter, lumps of clay, and other deleterious matter size:

Sieve Size	Percent Passing by Weight
1 inch	100
3/4 inch	90-100
1/2 inch	30-60
3/8 inch	0-20
No. 4	0-5

2.13 WATER FOR COMPACTION

A. Water shall be free of organic materials and shall have a pH of 7.0 to 9.0. Provide temporary piping, valves, and trucks to convey water from the source to the point of use. Provide any meters if the water is taken from the Owner's pipeline.

2.14 FILTER FABRIC

A. Filter fabric shall be manufactured from polyester, nylon, or polypropylene material; shall be of woven construction; and shall meet the following requirements:

B. Grab tensile strength (ASTM D1682): 100 pounds minimum for a 1-inch grip.

C. Equivalent open sizes (UFGS-02373).

D. Filter fabric shall be Mirafi, manufactured by Mirafi Inc., Charlotte, North Carolina; or equal.

2.15 DRAINPIPE

A. Underdrain or back of wall drainpipe shall be ABS or PVC.

PART 3 EXECUTION

3.01 EXCAVATION

A. Refer to the USSM, latest revision.

B. Excavation is unclassified. Perform excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction. Do not operate excavation equipment within 3 feet of existing structures or newly completed construction. Excavate with hand tools in these areas.

C. Excavations shall have sloping, sheeting, shoring, and bracing conforming with current State and/or Federal OSHA requirements and the General Conditions.

D. After the required excavation has been completed, the Owner will observe the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the structure where unacceptable subgrade materials exist at the exposed subgrade. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the structure or within a zone outside and below the structure defined by a line sloping at 1 horizontal to 1 vertical from 1 foot outside the edge of the footing. Refill the overexcavated areas with structural backfill material.

E. The Contractor will not receive any additional payment for refill material used for his convenience.

3.02 LIMITS OF FOUNDATION EXCAVATION

A. Excavate to the depths and widths needed to accomplish the construction. Allow for forms, working space, structural backfill, and site grading. Do not excavate for footings, slabs, or conduits below elevations indicated. Unless unacceptable material is encountered and overexcavation is authorized by the Owner, backfill overexcavations with compacted structural backfill material. Correct cuts below grade by trimming adjoining areas and creating a smooth transition. The Contractor shall bear all costs for correcting unauthorized overexcavated areas.

3.03 PREPARATION OF FOUNDATION SUBGRADE

A. The existing location shall be cleared, stripped, and grubbed as specified within to the USSM, latest revision.

B. The finished subgrade shall be within a tolerance of ±0.08 of a foot of the grade and cross section indication, shall be smooth and free from irregularities, and shall be at the specified relative compaction. The subgrade shall extend over the full width and area extending a minimum of 5 feet beyond the edges of the foundations.

C. Scarify the final subgrade surface and compact the top 24 inches of the subgrade to a minimum density equivalent to 98 percent of the maximum modified Proctor dry density (ASTM D1557) to a depth of 24 inches below the bottom elevation of the foundation.

D. Remove soft material encountered and replace with structural backfill. Fill holes and depressions to the required line, grade, and cross sections with structural backfill.

E. If rock is encountered at final grade, overexcavate to a depth of 6 inches and place structural backfill to establish final grade.

3.04 PREPARATION FOR PLACING STRUCTURAL FILL AND BACKFILL

A. After excavation of existing material or removal of unacceptable material at the exposed subgrade, scarify the final subgrade surface to a depth of 12 inches and compact to a minimum density equivalent to 98 percent of the maximum modified Proctor dry density (ASTM D1557).

B. Remove foreign materials and trash from the excavation before placing any fill material. Obtain the specified compressive strength and finish of concrete work per Section 03300 - Cast-in-Place Concrete before backfilling.

3.05 PLACING AND COMPACTING FILL AND STRUCTURAL FILL

A. Excavated material may be used for fill providing all deleterious materials have been removed from the stockpiled material.

B. Place backfill in maximum 8-inch lifts and compact each lift to a minimum density equivalent to 98 percent of the maximum modified Proctor dry density (ASTM D1557).

C. Where fill is to be constructed on slopes steeper than 3:1, bench the fill into competent undisturbed materials as the fill progresses up the slope. Benches shall be sloped at least 2 percent into the slope and shall be of a width at least equal to the height of fill lift.

3.06 PLACING AND COMPACTING STRUCTURAL BACKFILL

A. Place structural backfill material around piping, structures, channels, and other areas, including authorized overexcavation areas, to the lines and grades shown or specified. Do not exceed loose lifts of 8 inches in depth.

B. Limits of Structural Backfill: Limits of structural backfill shall be a minimum of 5 feet from edge of foundation and shall extend at a 1:1 slope to the finish grade.

C. Compact each lift to a minimum density equivalent to 98 percent of the maximum modified Proctor dry density (ASTM D1557). Stop structural backfill at least 6 inches below finished grade in all areas where topsoil is to be replaced.

D. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides. Comply with backfill preparation around concrete structures as specified in Section 03300 - Cast-in-Place Concrete.

E. Do not backfill the walls of structures that are laterally restrained or supported by suspended slabs or slabs on grade until the slab is poured and the concrete has reached the specified compressive strength.

F. Do not operate earthmoving equipment within 7 feet of walls of concrete structures. Place and compact fill or backfill adjacent to concrete walls with hand-operated tampers or other equipment that will not damage the structure.

G. Backfill adjacent to water-holding basins and channels only after leakage tests have been conducted as specified in Section 01759 - Water Leakage Test for Concrete Structures.

H. Monitor concrete structures during all backfill operations and stop work if there is damage to or a resultant reaction observed within structure.

3.07 MOISTURE CONTROL OF BACKFILLS AND EMBANKMENTS

A. During the compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of the backfill material. Maintain uniform moisture content throughout the lift. Insofar as practicable, add water to the material at the site of excavation. Supplement by sprinkling the backfill material. At the time of compaction, the water content of the material shall be at optimum water content or within 2 percentage points above optimum. Aerate material containing excessive moisture by blading, discing, or harrowing to hasten the drying process.

3.08 SITE GRADING

A. Perform earthwork to the lines and grades shown in the drawings. Shape, trim, and finish slopes of channels to conform with the lines, grades, and cross sections as shown. Remove exposed roots and loose rocks exceeding 3 inches in diameter. Round tops of banks to circular curves of not less than a 3-foot radius. Neatly and smoothly trim rounded surfaces. Do not overexcavate and backfill to achieve the proper grade.

3.09 VAPOR BARRIER INSTALLATION

A. Place vapor barrier with adjacent sheets bonded per manufacturer's requirements.

B. Lay vapor barrier sheets directly over the compacted subgrade just before sand cushion is placed and concrete is poured. Carefully install to avoid puncture or tear. Patch punctures and tears occurring during subsequent operations. Lap edges at least 4 inches and lap end joints at least 6 inches, with laps continuously sealed with tape. Carry barrier over any pipes laid on the fill and seal in waterproof manner to any pipes or conduits which penetrate the fill. Turn up membrane a minimum of 2 inches at the edges and secure to exterior wall foundations or footings with adhesive. Apply vapor barrier to walls with the same adhesive. Do not place stakes through vapor barrier membranes for screeding of concrete slabs.

3.10 LIMEROCK BASECOURSE

A. Transporting limerock:
   1. Transport limerock to the point where it is to be used, over rock previously placed and dumped on the end of the preceding spread. In no case shall rock be dumped directly on the subbase.

B. Spreading limerock:
   1. Spread limerock uniformly. Remove and replace all segregated areas of fine or coarse rock with well-graded rock. Place limerock 12 inches minimum outside of asphalt width.
   2. Construct base in courses between 4 inches and 6 inches in thickness.
      a. For double-course base, spread rock in 2 courses. Thickness of the first course shall be approximately one-half the total thickness of the finished base, or enough additional to bear the weight of the construction equipment without disturbing the subgrade.

C. Compacting and finishing grade:
   1. For double-course base, blade the first course if necessary to secure a uniform base and compact to the density specified below immediately prior to spreading the second course. No other finishing of this course is required.
   2. After spreading is completed, scarify the entire surface and shape to produce the specified grade and cross section after compaction. For double-course bases, scarifying shall penetrate by at least 1/2-inch the surface of the first course.
   3. As soon as proper moisture conditions are attained, compact the material to an average density of 98 percent of the maximum density obtainable under AASHTO Method T-180 (modified). Take density readings after grading and cross sectioning have been completed.
   4. "Hard-plane" the surface with a blade immediately prior to the application of prime coat to remove thin-glazed or cemented surface, leaving a granular or porous condition that will allow free penetration of prime material. Remove materials planed from the base area.
   5. If at any time, the subbase material becomes mixed with the base course material, excavate and remove the mixture, reshape and compact the subbase, and replace the materials removed with clean base material, shaped and compacted as specified above.

D. Testing surface:
   1. Check the finished surface of the base course with a templet cut to the required cross section and with a 15-foot straight edge laid parallel to the center line of the road or other approved testing devices. Correct all irregularities greater than +1/4 inch by scarifying and removing or adding rock, as may be required, after which the entire areas shall be compacted as specified herein.
   2. During final compacting operations, if blading of any areas is necessary to obtain the true grade and cross section, complete the compacting operations for such areas prior to making the density tests on the finished grade.

E. Thickness testing:
   1. After the base is completed, test holes or cores shall be taken by an independent testing laboratory at intervals of not more than 300 feet in roadways or 2,400 square feet in area paving.
      a. The average thickness of three consecutive holes must be equal to at least the specified thickness.
      b. Where the base is more than 1/2 inch deficient in thickness, or does not meet the average thickness requirement, rework the area covered by this deficient base by scarifying to a depth of at least 3 inches and adding more base material, so that after proper compacting the thickness and shape will conform to the plans.

F. Density testing:
   1. After the base is completed, the density shall be checked at intervals of not more than 300 feet of roadway or 2,400 square feet of area paving. If any field density tests are below the specified density, rework and recompact the area until the minimum density is achieved.

2. Make at least 3 density determinations on each day's final compaction operations on each course.
    a. The density determinations shall be made at more frequent intervals if deemed necessary by the Engineer.

3.11 PLACEMENT OF CRUSHED ROCK OR GRAVEL

A. Place crushed rock or gravel base beneath structures where shown in the drawings, 6 inches thick unless otherwise indicated. Excavate below the required grade for the bottom of the structure and refill with crushed rock or gravel as specified above. The rock base shall extend a minimum of 12 inches beyond the structure base, floor slab, or footing.

B. Compact base as follows unless otherwise indicated:
    1. Lower Lift: 80 percent relative density.
    2. Upper Lifts: 85 percent relative density.

C. Place base material in maximum lifts of 12 inches.

3.12 STABILIZED SUB-BASE PLACEMENT

A. Required Bearing Value
    1. Unless otherwise specified or shown in the plans, stabilized sub-base shall have a minimum Florida Bearing Value of 50.
    2. If the natural in-place soils do not meet the required stability, uniformly mix to depth shown in plans sufficient borrow material for stabilization with the in-place soils to produce the required bearing value.

B. Compact the stabilized sub-base in both cuts and fills to a density of 98 percent of the maximum density as required by AASHTO T-180 (modified).

C. Shape the sub-base to within 1/4 inch of the cross-section grade shown in the plans prior to making the density tests.

D. Make the density tests before other work proceeds.

E. Maintain the required density and cross section until the base or pavement has been laid or until the aggregate materials for the base or pavement course have been spread in place.

F. Tests
    1. Density and bearing value tests shall be made by an independent testing laboratory at intervals not more than 300 feet in roadways or 2,400 square feet in area paving.
    2. If any test results are unsatisfactory, re-excavate and re-compact the sub-base until the desired compaction is obtained.
    3. Make additional tests on each side of an unsatisfactory test to determine the extent of re-excavation, re-mixing and re-compaction necessary.

END OF SECTION

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SECTION 02051

EQUIPMENT, PIPING, AND MATERIALS DEMOLITION

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes demolition, removal, and replacement of existing mechanical and electrical equipment and piping.

B. Refer to Polk County Utility Standards and Specification Manual (USSM) for additional requirements.

PART 2 MATERIALS

2.01 GENERAL

A. Refer to other sections of these specifications for material to be used in removing, replacing, and/or abandoning in place equipment.

PART 3 EXECUTION

3.01 GENERAL

A. Perform removal, replacement, and demolition work specified and indicated in the drawings. Prepare remaining surfaces to receive new scheduled and specified materials and finishes or finish to match adjacent surfaces if no additional work is scheduled or indicated.

B. Removal:
   1. Remove equipment and structures indicated in the drawings.

C. Replacement:
   1. Replace equipment indicated in the drawings or listed herein. Unload the removed equipment and store it in the location designated by the Owner. Install the new equipment in locations as indicated in the drawings and as summarized below.

D. Salvage:
   1. Equipment salvaged from the premises is the property of the Owner. Clean and prepare the equipment for storage as designated by the Owner, including but not limited to flushing, draining of fluids, lubrication, etc. Carefully remove and handle the equipment. Place the equipment on pallets or other means to enable future relocation by forklift. Wrap the equipment in shrink wrap or other means as designated by the Owner to protect it. Tag, label or identify the equipment in a manner as designated by the Owner. Unload the equipment within a storage location as designated by the Owner. The Contractor shall develop a log in MS Excel of salvaged equipment using an alpha-numerical

designation to document the location, identification tags, and other pertinent information as designated by the Owner.

a. The following are major equipment elements that shall be salvaged as part of the project. Not all the equipment to be salvaged within the project is identified herein. Reference the drawings for further elements to be salvaged.

Major Salvaged Equipment
Disconnect Panels
Control Panels
Well Pump and associated equipment
Air Compressor and associated equipment

b. Contractor shall deliver all salvaged equipment to the County at:

1) 35 Vaughn Road, Winter Haven, FL 33880.

E. Existing piping and electrical utilities:

1. Shut off or disconnect utilities affecting demolition work. Schedule shutdowns with the Owner; notify the Owner in accordance with Section 01140 - Work Restrictions of any shutdown that is required to perform the work. The Owner will open/close valves on piping, and electrical disconnects required for the shutdowns.

F. Removal or relocation of electrical materials and equipment:

1. Unless otherwise noted, remove existing electrical materials and equipment from areas indicated for demolition or where equipment is to be relocated. Disconnect circuits at their source. Remove materials no longer used, such as studs, straps, and conduits. 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. Remove existing unused wires.
2. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface.

G. Patching:

1. Patching shall mean the restoration of a surface or item to a condition as near as practicable to match the existing adjoining surfaces unless otherwise noted, detailed, or specified.
2. When patching involves painting, special coating, vinyl fabric, or other applied finish, refinish the entire surface plane (i.e., wall or ceiling), unless complete refinishing of the entire space is scheduled or specified.
3. Patching includes cleaning of soiled surfaces.

H. Demolition:
   1. Structures, boxes, pipes, and other items are to be removed, altered, salvaged, and disposed of as specified herein or indicated in the drawings. Remove and dispose of all portions of these items that interfere with project construction.
   2. Remove and dispose offsite facilities to be demolished in their entirety including belowground footings, foundations, and other associated appurtenances, as shown in the drawings or as specified herein. Backfill and compact all site areas disturbed by demolition work with earth backfill or gravel material in accordance with Section 02050 - Soils and Aggregates for Earthwork.
   3. Perform the work in a manner that will not damage parts of the structure not intended to be removed or to be salvaged for the Owner. If, in the opinion of the Owner, the method of demolition used may endanger or damage parts of the structure or affect the satisfactory operation of the facilities, promptly change the method when so notified by the Owner. No blasting will be permitted.
   4. All equipment, material, and piping, except as specified to be salvaged for the Owner, or removed by others, within the limits of the demolition, excavations, and backfills, will become the property of the Contractor and shall be removed from the project site. The salvage value of this equipment, materials, and piping shall be reflected in the contract price of the demolition work.
   5. Do not reuse material salvaged from demolition work on this project, except as specifically shown.

END OF SECTION

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SECTION 02200

SITE CLEARING

PART 1 GENERAL

1.01 SUMMARY

A. Section describes the work included in: clearing, grubbing, stripping and preparing the project site for preloading the ground storage reservoir (GSR).

1.02 DEFINITIONS

A. Clearing: Consists of removal of natural obstructions and existing foundations, buildings, fences, lumber, walls, stumps, brush, weeds, rubbish, trees, boulders, utility lines, and any other items which interferes with construction operations or are designated for removal.

B. Stripping: Includes the removal and disposal of all organic sod, topsoil, grass and grass roots, and other objectionable material remaining after clearing from the areas designated to be stripped.

C. Grubbing: Consists of the removal and disposal of wood or root matter below the ground surface remaining after clearing and stripping. This effort includes stumps, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a depth of 12 inches below the ground surface.

1.03 QUALITY ASSURANCE

A. Regulatory requirements: Verify and comply with applicable regulations regarding those governing noise, dust, nuisance, drainage and runoff, fire protection, and disposal. Refer to the PCU USSM and Polk County Land Development Code. Comply with all requirements.

1.04 PROJECT CONDITIONS

A. Trees and Shrubbery
   1. Existing trees, shrubbery, and other vegetative material may not be shown in the drawings. Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein.

B. Preservation of Trees, Shrubs, and Other Plant Material
   1. Save and protect plant materials (trees, shrubbery, and plants) beyond the limits of clearing and grubbing from damage resulting from the work. No filling, excavating, trenching, or stockpiling of materials will be permitted within the drip line of these plant materials. The drip line is defined as a circle drawn by extending a line vertically to the ground from the outermost branches of a plant or group of plants. To prevent soil compaction within the drip line area, no equipment will be permitted within this area.

2. When trees are close together, restrict entry to area within drip line by fencing. In areas where no fence is erected, protect the trunks of trees 2 inches or greater in diameter by encircling the trunk entirely with boards held securely by 12-gauge wire and staples. This protection shall extend from ground level to a height of 6 feet.
3. Cut and remove tree branches where necessary for construction. Remove branches other than those required for a balanced appearance of any tree. Treat cuts with a tree sealant.

1.05 SEQUENCING AND SCHEDULING

A. Perform site preparation in advance of grading operations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine site and verify existing conditions for beginning work.

3.02 PREPARATION

A. Protect existing improvements from damage by site preparation work.

3.03 INSTALLATION

A. Clearing:
   1. Clear areas where construction is to be performed and other areas as indicated on the Drawings, or specified in this Section, of fences, lumber, walls, stumps, brush, roots, weeds, trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with proper performance or completion of the work, would impair its subsequent use, or form obstructions.
   2. Do not incorporate organic material from site preparation operations in surcharge material.
   3. Contractor's temporary construction facilities: Fill or remove pits, fill, and other earthwork required for erection of facilities, upon completion of the work, and level to meet existing contours of adjacent ground.

B. Stripping:
   1. Remove soil material containing sod, grass, or other vegetation to depth of 6 inches and 5 feet outside the limits of the surcharge area and future pond bottom excavation.
   2. Deposit stripped material on site at a location acceptable to PCU. Legally dispose of material not being reused.

C. Grubbing:
   1. From excavated areas: Grub stumps, roots, and other obstructions 3 inches or over in diameter to depth of not less than 18 inches below finish grade.
   2. In surcharge areas or other areas to be cleared outside construction area: Grub stumps or roots 3 inches or over in diameter to 18 inches below original grade.
   3. Backfill and compact cavities left below subgrade elevation by removal of stumps or roots to density of adjacent undisturbed soil.

END OF SECTION

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SECTION 02224

PROTECTING EXISTING UNDERGROUND UTILITIES

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes materials and procedures for protecting existing underground utilities.

B. Refer to the Polk County Utility Standards and Specification Manual (USSM), latest revision, for additional requirements.

PART 2 MATERIALS

2.01 REPLACEMENT IN KIND

A. Except as indicated below or as specifically authorized by the Owner's Representative, reconstruct utilities with new material of the same size, type, and quality as that removed.

PART 3 EXECUTION

3.01 GENERAL

A. Replace in kind street improvements, such as curbs and gutters, barricades, traffic islands, signalization, fences, signs, etc., that are cut, removed, damaged, or otherwise disturbed by the construction.

B. Where utilities are parallel to or cross the construction but do not conflict with the permanent work to be constructed, follow the procedures given below. Notify the utility owner 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility owner's requirements. For utility crossings not shown in the drawings, refer to the General Conditions and the instructions of the Owner's Representative for guidance.

C. Determine the true location and depth of utilities and service connections which may be affected by or affect the work. Determine the type, material, and condition of these utilities. In order to provide sufficient lead time to resolve unforeseen conflicts, order materials, and take appropriate measures to ensure that there is no delay in work.

3.02 PROCEDURES

A. Protect in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified in the drawings or in the specifications.

B. Cut and Plug Ends: Cut abandoned utility lines and plug the ends. Plug storm drains and sewers with an 8-inch wall of brick and mortar. Cap waterlines with a cast-iron cap or install a 3-foot-long concrete plug. Dispose of the cut pipe as unsuitable material.

C. Remove and Reconstruct: Where so indicated in the drawings or as required by the Owner's Representative, remove the utility and, after passage, reconstruct it with new materials. Provide temporary service for the disconnected utility.

3.03 COMPACTION

A. Utilities Protected in Place: Backfill and compact under and around the utility so that no voids are left.

B. Utilities Reconstructed: Prior to replacement of the utility, backfill the trench and compact to an elevation 1 foot above the top of the ends of the utility. Excavate a cross trench of the proper width for the utility and lay, backfill, and compact.

C. Alternative Construction--Sand Slurry: Sand slurry consisting of one sack (94 pounds) of portland cement per cubic yard of sand and sufficient moisture for workability may be substituted for other backfill materials to aid in reducing compaction difficulties. Submit specific methods and procedures for the review of the Owner's Representative prior to construction.

3.04 SPECIAL CONSTRUCTION

A. Reinforced Concrete Beam: Where indicated in the drawings or as determined by the Owner's Representative, support utilities by a reinforced concrete beam. The primary purpose of the beam is to prevent settlement of the utility line after construction. The Contractor is responsible for the protection of the utility during construction and shall incorporate the beam as part of the protection.

B. Concrete Support Wall: Where indicated in the drawings or as determined by the Owner's Representative, support the utilities by a concrete support wall as shown on the utility support details in the drawings. The purpose of the concrete support wall is to prevent settlement of the utility line after construction. The Contractor is responsible for the protection of the utility during construction.

3.05 THRUST BLOCKS ON WATERLINES

A. The Contractor's attention is called to thrust blocks for pipelines throughout the project whose thrust is in the direction of the new excavation and, therefore, may be affected by the construction. These pipelines are owned and operated by the Owner. Protect thrust blocks in place or shore to resist the thrust by a means accepted by the Owner's Representative and reconstruct. If the thrust blocks are exposed or rendered to be ineffective in the opinion of the Owner's Representative, reconstruct them to bear against firm unexcavated or backfill material or restrain pipe mechanically.

B. Provide firm support by backfilling that portion of the trench for a distance of 2 feet on each side of the thrust block to be reconstructed from the pipe bedding to the pavement subgrade, with either:
    1. Sand-cement slurry (94 pounds of cement per cubic yard).
    2. The native material compacted to a relative compaction of 95 percent.
        a. Then excavate the backfill material for construction of the thrust block.
        b. Test compaction of the backfill material before pouring any concrete thrust block. Use Class A concrete per Section 03300 - Cast-in-Place Concrete for reconstruction.

END OF SECTION

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SECTION 02240

DEWATERING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Installation and maintenance of dewatering systems.
   2. Disposal of water entering excavation or other parts of the work.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. Refer to the Polk County Utility Standard and Specification Manual (USSM), latest revision, for additional requirements.

1.02 SYSTEM DESCRIPTION

A. Design requirements:
   1. Keep excavations reasonably free from water. Draw down static groundwater level to minimum of 2 feet below anticipated bottom of excavations before the excavation reaches bottom elevation.
   2. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation.
   3. Dewatering design analysis. Include following:
      a. Evaluation of anticipated subsurface conditions.
      b. Required well spacing.
      c. Diameter of wells.
      d. Depth to screen, screen height, and mesh size.
      e. Backfill and filter pack.
      f. Pump size.
      g. Drawdown duration.
      h. Drawdown and steady state flow rates.
      i. Plans for de-silting of groundwater before discharge.
      j. Expected settlements.
   4. Include water drawdown curves in dewatering calculations.
   5. Coordinate dewatering design with excavation and shoring design. Excavation and shoring design shall consider changes in groundwater conditions and associated earth pressures.
   6. Do not place concrete or masonry foundations or concrete slabs in water. Do not allow water to rise over these elements until concrete or mortar has set for at least 24 hours.

7. Maintain operation of dewatering system until complete structure -- including walls, slabs, beams, struts, and other structural elements -- has been constructed; concrete has attained its specified compressive strength; and backfill has been completed to 3 feet above normal static groundwater level at the site.
8. Provide standby power to ensure continuous dewatering in case of power failure.

B. Dewatering shored excavations:
1. Dewater from within shoring.
2. Use impermeable shoring system to minimize lowering of groundwater outside shoring.
3. Extend impermeable shoring below bottom of excavation sufficient amount to:
   a. Minimize lowering of groundwater outside shoring.
   b. Prevent unstable excavation due to piping and heave.
4. To minimize settlement outside shoring due to dewatering, do not lower groundwater outside shoring more than 1 foot. Provide groundwater recharge if required to maintain this groundwater elevation outside of shoring.
5. Provide monitoring wells located outside shoring for monitoring groundwater elevation.

C. Locate dewatering facilities where they will not interfere with utilities and construction work to be performed by others.

D. Discharge.
1. Discharge water to the on-site stormwater system.

1.03 SUBMITTALS

A. Dewatering plan:
1. Required permits.
2. Type and sizes of filters.
3. Identify proposed alignment, support, and protection for discharge pipe. Identify location of discharge and provide details for that location.

B. Regulatory requirements:
1. Obtain required water discharge permits.

PART 2 EXECUTION

2.01 INSTALLATION

A. During construction, provide and maintain ample means and devices to promptly remove and properly dispose of water entering excavation or other parts of the work, whether water is surface water or underground water.

B. Keep excavations reasonably free of water.

C. Make provisions to maintain continuous dewatering.
    1. Provide standby power to maintain dewatering during power outages and interruptions.
    2. Provide 24-hour monitoring by personnel skilled in operation and maintenance of the system, and capable of providing or obtaining work required to maintain system operation.

D. Disposal of water:
    1. Dispose of water from the work in suitable manner without damage to adjacent property.
    2. Do not drain water into work built or under construction.
    3. Dispose of water in such manner that it will not be a menace to public health or safety.
        a. Obtain and comply with applicable regulations and permitting requirements.

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SECTION 02261

TEMPORARY EXCAVATION SUPPORT SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. Design, furnish and install temporary excavation support systems as required to maintain lateral support, prevent loss of ground, limit soil movements to acceptable limits and protect from damage existing and proposed improvements including, but not limited to, pipelines, utilities, structures, roadways, railroads and other facilities.

B. Common types of excavation support system include but are not limited to singular or multiple stages comprised of cantilevered or internally braced soldier piles and lagging, steel sheetpile wall, timber sheetpile wall, trench box, or combinations thereof. Trench box temporary excavation support system is only acceptable for pipe or utility trench excavations. Temporary unsupported open cut excavation with stable sloping sides is allowed where applicable.

C. Wherever the word "sheeting" is used in this section, it shall be in reference to any type of excavation support system specified except trench box.

D. Construction of the temporary excavation support systems shall not disturb the existing structures or the completed proposed structures. Damage to such structures shall be repaired by the Contractor at no additional cost to the Owner.

E. Adjacent structures are those that bear upon soils above the proposed excavation depth and within a distance equal to twice the total depth of the excavation away from the closest edge of the excavation. Monitor and protect adjacent structures as specified and indicated.

F. Vibration monitoring for excavation support systems will be performed by Contractor's vibration consultant and monitoring firm. Vibration due to Contractor's operations shall not exceed specified limits stated in Paragraph D.5.

G. Use only pile driver hammers with mufflers capable of significantly reducing noise and use barriers or shielding techniques to comply with applicable federal, state, and local ordinances.

H. The Contractor shall bear the entire cost and responsibility of correcting any failure, damages, subsidence, upheaval or cave-ins as a result of improper installation, maintenance or design of the temporary excavation support systems. The Contractor shall pay for all claims, costs and damages that arise as a result of the work performed at no additional cost to the Owner.

1.02 REFERENCES

A. Florida Trench Safety Act.

B. OSHA Standards and Interpretations: "Part 1926 Subpart P - Excavation, Trenching, and Shoring,"

C. ASTM International (ASTM):
   1. A36: Standard Specification for Structural Steel.
   2. A416: Standard Specification for Strand Steel, Uncoated Seven-Wire for Prestressed Concrete.
   3. A572: Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel.
   4. A722: Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete.
   5. A615: Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
      a. American Wood-Preserves Association (AWPA) Standards.
      b. American Welding Society (AWS) Code: D1.1.
      c. Federal Standard, FS TT-W-571: Wood Preservation and Treating Practices.
      d. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29: Subpart P - Excavations, Trenching, and Shoring.
      e. American Concrete Institute (ACI)
      f. ACI 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

D. Refer to the Polk County Utility Standard and Specification Manual, latest revision, for additional requirements.

1.03 SUBMITTALS

A. Submit the following in accordance with the General Conditions, Section 01330 - Submittal Procedures, and the following:
   1. Submit the following qualifications 4 weeks prior to the construction:
      a. Qualifications of independent vibration consulting and monitoring firm as specified in Paragraph D.4. Qualifications of Contractor's temporary excavation support system designer as specified in Paragraph D.7.
      b. Qualifications of Contractor's temporary excavation support system installer as specified in Paragraph D.8.
      c. Qualifications of Contractor's independent tieback testing laboratory as specified in Paragraph D.9, if a tieback system is utilized.
      d. Qualifications of Contractor's temporary excavation support system installation supervisor as specified in Paragraph D.10.
      e. Qualifications of vacuum excavation subcontractor as specified in Paragraph D.6, if DMPs for utilities are utilized.

2. Provide the Owner and Engineer a record of the temporary excavation support plan and calculations sealed and signed by a Registered Professional Structural Engineer in the State of Florida. The copy is to be provided at least 4 weeks prior to start of the construction of the respective work where the support will be required. The copy will be for documentation of temporary excavation support plan for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. This information will not be reviewed or accepted by the Owner and Engineer in any manner so as to relieve the Contractor from sole responsibility from maintaining the temporary excavation support systems. The Contractor shall remain responsible for the adequacy and safety of the means, methods, and sequencing of construction. The plan shall include the following items as a minimum:
    a. Proposed temporary excavation support system(s), details, location, layout, depths, extent of different types of support relative to existing features and the permanent structures to be constructed, and methods and sequence of installation and removal.
    b. Certificate of Design: Provide submittals signed and sealed by the responsible design professional, for each produce and system specifically assigned to Contractor to be designed or certified by a design professional. Indicate that products and systems comply with performance and design criteria in the contract documents. Include list of codes, loads, and other factors used in performing these services.
    c. A list of all design assumptions, including safety factors used for the temporary excavation support system(s) and all lateral pressures used for each system.
    d. If utilizing a tieback system, include tieback installation procedures and criteria for acceptance of tiebacks for performance and proof tests. Submit the tieback testing results to the Engineer for information only.
    e. Requirements of dewatering during the construction.
    f. Minimum lateral distance from the edge of the excavation support system for use for vehicles, construction equipment, and stockpiled construction and excavated materials.
    g. List of equipment used for installing the excavation support systems.
3. Monitoring schedule, installation procedures, and location plans for movement monitoring, vibration/noise monitoring, geotechnical instrumentation (deformation monitoring points, inclinometers, etc.) and observation wells/ piezometers to monitor ground, excavation support system, adjacent structures and groundwater fluctuation during the entire construction period. The monitoring plan shall include the survey of the temporary support systems by a Registered Professional Surveyor in the State of Florida. The surveyor and structural engineer are to determine a monitoring plan and identify it within the monitoring plan. The monitoring plan shall also include a Construction Contingency Plan for addressing inclement weather and hurricane(s).
4. Submit a Construction Contingency Plan specifying the methods and procedures to maintain temporary excavation support system stability if the allowable movement of the adjacent ground and adjacent structures is exceeded.

5. The Owner's Representative and Engineer shall be provided with the following information to provide reasonable assurance that the Contractor is successfully maintaining the temporary excavation support system. This information will not be reviewed or accepted by the Owner and Engineer in any manner so as to relieve the Contractor from sole responsibility from maintaining the temporary excavation support systems. Monitoring data is to be provided within 1 calendar day of data collection from surveyor, vibration, and noise recording equipment, observation wells, deformation monitoring points, and offset lines. At a minimum the data shall include:
    a. Horizontal and vertical movements by surveyor, geotechnical instruments, and groundwater readings.
    b. New movements since the initial readings of the geotechnical instruments and surveyor.
    c. Weekly summary in tabular and/or graphic form.
    d. A schematic plan of excavation and/or relevant construction activities at the time of monitoring.
6. For excavation support systems left in place, submit the following as-built information prior to backfilling and covering the excavation support systems:
    a. Survey locations of the temporary excavation support systems, including coordinates of the ends and points of change in direction.
    b. Type of the temporary excavation support system.
    c. Elevations of top and bottom of the excavation support systems left in place.
7. Prior to preparation of the temporary excavation support plan, the Contractor shall perform subsurface utility exploration in all areas where sheeting is proposed. The temporary excavation support plan shall include the provisions for avoidance of the existing utilities.

1.04 QUALITY ASSURANCE

A. The Contractor is responsible for controlling the quality of work, including work of its subcontractors and suppliers and for assuring the quality specified is achieved. Means and methods of construction and installation processes are the responsibility of the Contractor, and at no time is it the intent of the Engineer or Owner to supersede or void that responsibility.

B. Conform to the requirements of the OSHA Standards and Interpretations: "Part 1926 Subpart P - Excavation, Trenching, and Shoring," and all other applicable laws, regulations, rules, and codes.

C. Construction operations to conform to noise regulations provided in the Noise Control Plan and this Section.

D. Retain the services of an independent vibration consulting firm with the following in-house personnel to conduct the following vibration monitoring requirements:
    1. Preparing, reviewing and signing of monitoring plans and daily reports, and overseeing of the monitoring and interpretation of the vibration data shall be performed by personnel with the following qualifications:
        a. Be a Registered Professional Structural Engineer in the State of Florida.
        b. Have a minimum of 5 years’ experience in the vibration consulting field.

c. Have successfully completed at least 5 projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.
    1) Assist Contractor in selecting pile driving equipment which will generate the lowest vibration and noise levels.
    2) Installation, monitoring and interpretation of monitoring equipment shall be performed by personnel with the following qualifications:
        a) Have at least 3 years of experience in the operation of monitoring equipment proposed for use and interpretation of records produced by such equipment.
        b) Have installed, operated, monitored and interpreted equipment and records on at least 3 projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.

E. The peak particle velocity for pile driving, or other vibration-inducing operations, shall not exceed the following:

Type of Concrete	Age of Concrete, hrs	Peak Particle Velocity in/sec
Mass Concrete (footings, mats, Slab-on-grade, fill concrete, etc.)	0-11	1.0
	11 and over	2.0
Concrete Structures (walls, columns, elevated slabs, etc.)	0-11	0.5
	11-24	1.0
	24 and over	2.0
Existing Structures, residences or utilities	-	0.5

F. If utilizing deformation monitoring points (DMPs) for utilities, vacuum excavation shall be performed by subcontractor having 5 years of experience in non-destructive vacuum excavation methods for utilities.

G. Prepare design, including calculations and drawings, under the direction of a Professional Structural Engineer licensed in the State of Florida having the following qualifications:
    1. Not less than 10 years' experience in the design of specific temporary excavation support systems to be used.
    2. Completed not less than 5 successful temporary excavation support system projects of equal type, size, and complexity within the last 5 years.

H. Temporary Excavation Support System Installer's Qualifications:
    1. Not less than 3 years of experience in the installation of similar types and equal complexity as the proposed system.
    2. Completed not less than 3 successful excavation support systems of similar type and equal complexity as the proposed system.

I. If utilizing a tieback system, employ an independent testing laboratory to test the tieback system with the following qualifications:
   1. Be accredited by the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program.
   2. Employ personnel conducting testing who are trained in the methods and procedures to test and monitor tieback systems of similar type and equal complexity, as the proposed system.
   3. Have not less than 5 years' experience in testing of tieback systems of similar type and equal complexity as the proposed system.
   4. Have successfully tested at least 3 tieback systems of similar type and equal complexity as the proposed system.

J. Install all temporary excavation support systems under the supervision of a supervisor having the following qualifications:
   1. Not less than 5 years' experience in installation of systems of similar type and equal complexity as the proposed system.
   2. Completed at least 5 successful temporary excavation support systems of similar type and equal complexity as the proposed system.

K. All welding shall be performed in accordance with AWS D1.1.

L. Design Criteria:
   1. Design of temporary excavation support systems shall meet the following minimum requirements:
      a. Support systems shall be designed for earth pressures, hydrostatic pressure, equipment, temporary stockpiles, construction loads, roadways, railroads, and other surcharge loads.
      b. Design a bracing system to provide sufficient reaction to maintain stability.
      c. Limit movement of ground adjacent to the excavation support system to be within the allowable ground deformation as specified.
      d. Design the embedment depth below bottom of excavation to minimize lateral and vertical earth movements and provide bottom stability. Toe of braced temporary excavation support systems shall not be less than 5 feet below the bottom of the excavation.
      e. Design temporary excavation support systems to withstand an additional 2 feet of excavation below proposed bottom of excavation without redesign except for the addition of lagging and/or bracing.
      f. Maximum width of pipe trench excavation shall be as indicated on the Drawings.
      g. Do not cast permanent structure walls directly against excavation support walls.
      h. The design location of the excavation support wall shall be determined such that the installed wall and bracing system components are all located outside the limits of the permanent structure. Construction tolerances (e.g. wall verticality) shall be considered in determining the plan location.

M. Delivery, Storage and Handling:
   1. Store sheeting and bracing materials to prevent sagging which would produce permanent deformation. Keep concentrated loads which occur during stacking or lifting below the level which would produce permanent deformation of the material.

N. Project/Site Conditions:
   1. Subsurface Conditions: Refer to Appendix A. The geotechnical criteria provided in Appendix A is for general reference information only and not intended to be utilized for the design of the Temporary Excavation Support System. The Structural Engineer responsible for the development of the Temporary Excavation Support System shall utilize geotechnical information as required and procured by the Structural Engineer for purposes of development of the Temporary Excavation Support System.

PART 2 PRODUCTS

2.01 MATERIALS

A. Structural Steel: All soldier piles, wales, rakers, struts, wedges, plates, waterstop, and accessory steel shapes shall conform to ASTM A36.

B. Steel Sheet Piling: ASTM A572, continuous interlocking type.

C. Timber Lagging Left in Place: Pressured treated per appropriate AWPA standards.

D. Tieback Tendons: Tieback tendons shall be high strength steel wire strand cables conforming to ASTM A416, or bars conforming to ASTM A722. Splicing of individual cables shall not be permitted.

E. Raker Ties: ASTM A615 Grade 60.

F. Cement Grout Materials and Admixtures For Tieback Anchorages: Grout cube strength shall be a minimum 3500 psi at 7 days and 5000 psi at 28 days.

G. Concrete: Section 03300 - Cast-in-Place Concrete.

H. Tamping tools adapted for backfilling voids after removal of the excavation support system.

I. Provide specific trench box sizes for each pipe and utility excavation with structural capacity of retaining soil types as described in OSHA's 29 CFR Part 1926 Subpart P.

2.02 EQUIPMENT

A. Provide equipment, materials and manpower necessary for installing the temporary sheet piling providing that such operations do not exceed vibration/noise requirements and meet all laws and codes.

PART 3 EXECUTION

A. Installation:
   1. Installation of the temporary excavation support systems shall not commence until the related earth excavation and dewatering submittals have been reviewed by the Engineer with all Engineer's comments satisfactorily addressed.

2. Install excavation support systems in accordance with the temporary excavation support plan.
3. If utilizing a tieback system, all performance and proof tests shall be conducted in the presence of the Engineer. Testing performed without the Engineer present will not be accepted. Repeat testing in the Engineer's presence at no additional cost to the Owner.
4. Do not drive sheeting within 100 feet of concrete less than 7 days old.
5. Carry out program of temporary excavation support in such a manner as to prevent undermining or disturbing foundations of existing structures of work ongoing or previously completed.
6. Bottom of the trench box excavation support system shall be above the pipe invert prior to installing the pipe.
7. Install and read geotechnical instrumentation in accordance with the temporary excavation support plan. Notify the Owner's Representative immediately if any geotechnical instrumentation is damaged. Repair or replace damaged geotechnical instrumentation at the sole option of the Engineer and at no additional cost to the Owner.
8. Continuously monitor movements of the ground adjacent to excavation support systems and adjacent structures. In events of the measured movements approaching or exceeding the allowable movements, take immediate steps to arrest further movement by revising procedures such as providing supplementary bracing, filling voids behind the trench box, supporting utilities, or other measures (Construction Contingency Plan) as required.
9. Notify the Owner's Representative if existing utilities interfere with the temporary excavation support system. Modify the existing utility with the Owner's permission or have the Owner make the modifications at no additional cost to Owner.
10. If existing utilities span the excavation, the Structural Engineer responsible for the development of the Temporary Excavation Support System shall provide the Contractor the design criteria and details for temporary support of the existing utilities.

3.02 GROUND DEFORMATION ADJACENT TO EXCAVATION SUPPORT SYSTEMS

A. Allowable Vertical (heave/settlement) and Lateral Movements: 2 inches maximum for the trench box excavation support system, and 1 inch maximum for other types of excavation support systems at any location behind the excavation support system.

B. Monitoring personnel shall use a procedure for reading and recording geotechnical instrumentation data which compares the current reading to the last reading during data collection to eliminate spurious readings.

C. Plot the observed ground deformation readings versus time. Annotate the plots with construction loading and excavation events having an impact on the readings. Evaluate plots by means of secondary rate-of-change plots to provide early warning of accelerating ground movements.

D. Notify the Owner immediately when the allowable ground deformation is exceeded.

E. Implement Construction Contingency Plan under direction of Structural Engineer who is in Responsible Charge for the temporary excavation support system.

3.03 REMOVAL OF EARTH RETENTION SYSTEM:

A. Unless required to perform the work in accordance with the Contract Documents, the sheeting shall be left in place.

B. In cases where sheeting must be removed, remove the temporary excavation support system without endangering the constructed or adjacent structures, utilities, or property. Immediately backfill all voids left or caused by withdrawal of temporary excavation support systems with bank-run gravel, screened gravel or select borrow by tamping with tools specifically adapted for that purpose.

C. When tiebacks are used, release tension in tiebacks as the excavation is backfilled. Do not leave tensioned tieback in place at the completion of the work.

D. The excavation support system left-in-place shall be cut-off a minimum of 2 feet below the bottom of the next higher foundation level or a minimum of 5 feet below finished grade, or as directed by the Structural Engineer responsible for the Temporary Excavation Support System.

E. Conduct survey of the locations and final cut-off elevations of the excavation support systems left in place.

3.04 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01770 - Closeout Procedures and General Conditions.

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SECTION 02282

CONNECTIONS TO EXISTING BURIED PIPELINES

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes materials and installation of connections to existing buried utilities; including connections by hot tap, line stop and connections to existing Prestressed Concrete Cylinder Pipe (PCCP).

B. Refer to the Polk County Utility Standard and Specification Manual, latest revision, for additional requirements.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions, Section 01330 - Submittal Procedures, and the following.

B. Submit appropriate reference material and documentation as specified herein.

C. Submit manufacturer's catalog data for tapping sleeves and appurtenances. Show coatings. Submit materials of construction for all components indicating ASTM standards with which they comply

D. Submit confirmation of field investigation of the existing pipeline material, size, and condition, as specified herein and illustrated in the Drawings.

E. Submit the qualifications and reference material of the Contractor, or Subcontractor, who will be performing the hot taps and line stops on the Project.

F. Submit the qualifications and reference material of the Engineer who the Contractor, or Subcontractor, is required to retain for detailing each of the respective line stops and hot taps illustrated in the Drawings.

G. Submit the qualifications and reference material of the Engineer who the Contractor, or Subcontractor, is required to retain for detailing the connections between the existing Prestressed Concrete Cylinder Pipe (PCCP) and the new sections of Welded Steel Cylinder Pipe (WSP) and Ductile Iron Pipe (DIP).
   1. The Contractor's, or Subcontractor's, Engineer preparing the detailed shop drawings for each line stop and hot tap shown in the Drawings shall include the following at a minimum. The submittal shall be signed and sealed by that Engineer:
      a. Dimensional Drawings of each location with identification of all respective fittings, valves, and appurtenances required.
      b. Details of the existing utility as determined from field exploration; including but not limited to depth, size, and material, method of restraint and current service condition.

c. Calculations for the sizing of and the dimensional drawings illustrating the limits of the encasement for the tapping sleeve.
d. Calculations for the determination and dimensional drawings illustrating the method of restraint of the existing piping including mechanical restraint devices and/or concrete thrust collars or blocks.
e. Bypass piping arrangement.
f. Shoring/Sheeting or means of maintaining the excavation in compliance with the Trench Safety Act.
g. Method of support of the existing utility within the excavation if required.
h. Schedule and sequence for the execution of the Work.

2. For all connections with existing utilities, the Contractor, or Subcontractor, shall prepare an Emergency Contingency Plan if the existing pipeline is damaged or fails during the anticipated operation. At a minimum it shall include the process that will be used for spill protection, maintaining service within the existing pipeline and/or emergency bypass. The Owner's Representative and Engineer shall be provided with this information as reasonable assurance that the Contractor or Subcontractor is prepared in the event an emergency should arise.

1.03 QUALIFICATIONS

A. The Contractor, or Subcontractor, performing the line stop and hot taps shall meet the following minimum experience requirements:
1. Completed not less than 25 successful hot taps and/or line stops of similar type, size, and complexity performed within the last 10 years, from the date that Bids are opened, and located within the United States of America.
2. Submit references for projects of equal type, size, and complexity to demonstrate experience. Include Work type, size, and contact information for Owner 4 weeks prior to the construction.

B. The Contractor's, or Subcontractor's Engineer, preparing the detailed shop drawings for each line stop and hot tap shown in the Drawings shall meet the following minimum experience requirements. The Engineer shall be a Registered Professional Engineer in the State of Florida:
1. Designed not less than 10 hot taps and/or line stops of similar type, size, and complexity which were constructed within the last 5 years, from the date that Bids are opened, and located within the United States of America.

C. The Contractor's, or Subcontractor's Engineer, preparing the detailed shop drawings for detailing the connections between the existing Prestressed Concrete Cylinder Pipe (PCCP) and the sections of Welded Steel Cylinder Pipe (WSP) and Ductile Iron Pipe (DIP) shall meet the following minimum experience requirements. The Engineer shall be a Registered Professional Engineer in the State of Florida:
1. Designed not less than 4 similar connections with PCCP within the last 10 years, from the date that Bids are opened, and located within the United States of America.

PART 2 MATERIALS

2.01 UTILITY EXPLORATION AND MATERIALS VERIFICATION

A. Expose all existing pipelines at points of construction to confirm size, material and condition, prior to procurement or preparation of submittals. Determine if each existing pipeline is mechanically restrained. All existing piping requiring a new connection is to be mechanically restrained. Support the pipeline in a manner that will not damage the pipe and provide Temporary Excavation Support Systems per Section 02261 - Temporary Excavation Support Systems.

2.02 VERIFICATION OF PIPE O.D. AND CONDITION

A. Expose the existing pipeline and determine the pipe diameter and wall thickness prior to ordering the line stop materials. Utilize pipe thickness testing using ultrasonic technology or other no destructive means.

2.03 TAPPING SLEEVES FOR DUCTILE-IRON, AND PVC (CAST-IRON O.D.) PIPES

A. Refer to Polk County USSM, latest revision.

B. For potable water service, tapping sleeve shall be NSF 61 certified.

2.04 TEST PLUG

A. Test plug shall be 3/4-inch NPT Type 304 stainless steel. Coat threads to prevent galling.

2.05 GASKETS FOR WATER SERVICE

A. For potable water service, gaskets shall be NSF 61 certified. Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a water pressure of 200 pounds per square inch at a temperature of 180 degrees Fahrenheit. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Blue-Gard 3330 or equal.

2.06 GASKETS IN OTHER THAN POTABLE WATER

A. Gaskets shall be full face, 1/8-inch thick, Buna-N having a hardness of 55 to 65 durometer. Gaskets shall be suitable for a water pressure of 200 pounds per square inch at a temperature of 250 degrees Fahrenheit. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Provide Garlock Style 9122 or equal.

2.07 COATING FOR TAPPING SLEEVES

A. Coat with fusion-bonded epoxy per AWWA C213 for steel and AWWA C116 for ductile iron.

2.08 TAPPING GATE VALVES

A. Per PCU USSM, latest revision.

2.09 BOLTS AND NUTS

A. Bolts and nuts shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

2.10 RUBBER STOPPER FOR LINE STOP

A. Fully expandable rubber, minimum 100 pounds per square inch pressure rating or carbon steel pivoting head with Buna-N sealing element, minimum 100 pounds per square inch pressure rating.

B. For potable water service, provide NSF 61 certification.

PART 3 EXECUTION

A. Owner Representative Notification

B. Following the acceptance of the respective submittal for a connection to an existing utility, submit a Construction Administration Request (CAR) to the Owner's RPR to schedule the Work. The request shall be made a minimum of 14 calendar days prior to performing the Work. This request shall include the following:
   1. Copy of the accepted submittal.
   2. The Contractor's, or Subcontractor's, Emergency Contingency Plan.
   3. Scheduled date and time to have meeting with the RPR(s) to discuss the Work, at a minimum of 5 days prior to performing the Work.

C. Connections shall only be made on the agreed upon date and time. If the work is not performed in the agreed upon manner or schedule, the work shall be rescheduled by following the above procedure.

3.02 GENERAL PROCEDURE – HOT TAPS

A. Follow the procedure outlined within the accepted submittals for a respective location. The following is intended as a general procedure for performing a hot tap procedure:
   1. All existing piping requiring a new connection shall be restrained prior to the connection being made.
   2. Install mechanical restraint devices on the existing pipelines or place reinforced concrete thrust collars against undisturbed soil on either side of collars by keeping over-excavation to a minimum. Allow all concrete to reach design strength (4,000 pounds per square inch).
   3. Support the pipeline in a manner that will not damage the pipe.
   4. Provide Temporary Excavation Support Systems per Section 02261 - Temporary Excavation Support Systems.
   5. Excavate around the pipe at the proposed line stop or hot tap location. Limit excavation to area immediately beyond the limits of the tapping sleeve. Clean the existing pipeline and smooth any roughness that may inhibit sealing with the tapping sleeve.
   6. Install the tapping sleeve.
   7. Install reinforced concrete encasement around the pipe and tapping sleeve. Allow all concrete to reach design strength (4,000 pounds per square inch).
   8. Install the tapping valve.

9. Tap pipeline, remove coupon, close tapping valve and remove tapping machine.
10. Connect the new utility to the tapping valve and perform respective pressure testing requirements for the new utility.
11. Repair damage that occurs due to the Contractor's, or Subcontractor's, work at the Contractor's, or Subcontractor's expense.
12. Dispose of the reclaimed water and existing pipe at no additional cost to the Owner. Comply with FDEP permit requirements.

3.03 GENERAL PROCEDURE – LINE STOPS

A. Follow the procedure outlined within the accepted submittal for a respective location. The following is intended as a general procedure for performing a line stop procedure:
   1. All existing piping requiring a new connection shall be restrained prior to the connection being made.
   2. Install mechanical restraint devices on the existing pipelines or place reinforced concrete thrust collars against undisturbed soil on either side of collars by keeping over-excavation to a minimum. Allow all concrete to reach design strength (4,000 pounds per square inch).
   3. Support the pipeline in a manner that will not damage the pipe.
   4. Provide Temporary Excavation Support Systems per Section 02261 - Temporary Excavation Support Systems.
   5. Excavate around the pipe at the proposed line stop or hot tap location. Limit excavation to area immediately beyond the limits of the tapping sleeve. Clean the existing pipeline and smooth any roughness that may inhibit sealing with the tapping sleeve.
   6. Install the tapping sleeve.
   7. Install reinforced concrete encasement around the pipe and tapping sleeve. Allow all concrete to reach design strength (4,000 pounds per square inch).
   8. Install the tapping valve.
   9. Tap pipeline, remove coupon, close tapping valve and remove tapping machine.
   10. Attach the line stop valve, connect the bypass or new pipeline, and close the line stopping valve.
   11. Construct the new in-line isolation valve, cap, or appurtenance as illustrated within the Drawings.
   12. Repair damage that occurs due to the Contractor's, or Subcontractor's, work at the Contractor's, or Subcontractor's expense.
   13. Dispose of the reclaimed water and existing pipe at no additional cost to the Owner. Comply with FDEP permit requirements.

END OF SECTION

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SECTION 02300

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Loosening, excavating, filling, grading, borrow, hauling, preparing subgrade, compacting in final location, wetting and drying, and operations pertaining to site grading for buildings, basins, reservoirs, boxes, roads, and other facilities.
   2. Backfilling and compacting under and around structures.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. Refer to the Polk County Utility Standard and Specification Manual, latest revision, for additional requirements

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
   2. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN m/m^3)).
   3. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 DEFINITIONS

A. Backfill adjacent to structure: Backfill within volume bounded by the exterior surfaces of structure, the surface of undisturbed soil in the excavation around structure, and finish grade around structure.

B. Embankments: Dikes, levees, berms, and similar facilities.

C. Excavation: Consists of loosening, removing, loading, transporting, depositing, and compacting in final location, wet and dry materials, necessary to be removed for purposes of construction of structures, ditches, grading, roads, and such other purposes as are indicated on the Drawings.

1.04 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Where mud or other soft or unstable material is encountered, remove such material and refill space with stabilization material. Wrap stabilization material with stabilization fabric.
   2. Obtain acceptable import material from other sources if surplus or borrow materials obtained within Project site does not conform to specified requirements or are not sufficient in quantity.
   3. No extra compensation will be made for hauling of fill materials nor for water required for compaction.

1.05 SUBMITTALS

A. Copy of Property Owner's Agreement allowing placement of surplus soil material on their property.

B. Excavation plan.

C. Testing lab: Submit Contractor's proposed testing laboratory capabilities and equipment.

D. Test reports:
   1. Submit certified test reports of all tests specified to be performed by the Contractor.
   2. Sign and seal test reports by a registered Geotechnical Engineer or Civil Engineer who practices geotechnical engineering registered in Florida.

1.06 QUALITY ASSURANCE

A. Initial compaction demonstration:
   1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
      a. 50 cubic yards of backfill adjacent to structures.
      b. 100 cubic yards of embankment work.
      c. 100 cubic yards of fill.
      d. 50 cubic yards of roadway base material.
      e. 100 cubic yards of road fill.
   2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
   3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

B. Contractor shall perform all work related to this Section in accordance with the approved Stormwater Pollution Prevention Plan (SWPPP) and as specified in Section 01355B - Stormwater Pollution Prevention Construction Activity.

1.07 SEQUENCING AND SCHEDULING

A. Schedule earthwork operations to meet requirements specified in this Section for excavation and uses of excavated material.

B. If necessary, stockpile excavated material in order to use it at specified locations.

C. Excavation, backfilling, and filling: Perform excavation, backfilling, and filling during construction in manner and sequence that provides drainage at all times.

PART 2 PRODUCTS

2.01 MATERIALS

A. Water for compacting: Use water from source acceptable to Engineer.

B. Soil and rock materials:
   1. General:
      a. Provide soils and aggregate as specified in Section 02050 - Soils and Aggregates for Earthwork where specified or indicated on the Drawings.
      b. If suitable surplus materials are available, obtain native material and select material from cut sections or excavations or from borrow areas or imported materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Character and quantity of material:
      a. Verify character and quantity of rock, gravel, sand, silt, water, and other inorganic or organic materials to be encountered in work to be performed.
      b. Determine gradation, shrinkage, and swelling of soil, and suitability of material for use intended in work to be performed.
      c. Determine quantity of material, and cost thereof, required for construction of backfills, cuts, embankments, excavations, fills, and roadway fills, whether from onsite excavations or imported materials and include in cost of work to be performed.
      d. Sufficient earthwork material to complete the work is not available at the site.
         1) Secure source of material and permits to complete the project requirements.
      e. Include wasting of excess material, if required, in cost of work to be performed.
         1) No prearranged disposal site or related permits have been determined or secured by the Owner.

3.02 PREPARATION

A. Backfills:
   1. After clearing and excavation are completed, scarify entire areas that underlie backfills or structures to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified before placing backfill material or concrete.
   3. Do not place backfill against walls until:
      a. Walls have been cast full height of structure and concrete has reached the specified strength.
      b. Connecting slabs and beams have been cast, and concrete has reached the specified strength.
   4. Prior to backfilling:
      a. Remove all forms.
      b. Clean all trash and debris from the excavation site.
   5. After inspection of foundation, walls, and pipes, place backfill symmetrically around structures to prevent eccentric loading of structures.

B. Embankments:
   1. After clearing is completed, scarify entire areas that underlie embankments to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified for embankments before placing of embankment material.

C. Fills:
   1. After clearing is completed, scarify entire areas that underlie fill sections or structures to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified for compacted fills before placing of fill material or concrete.

D. Roadway fills:
   1. After clearing is completed, scarify entire areas that underlie roadway fills to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified for roadway fills before placing of roadway fill material.

E. Sloped surfaces for fill or foundations:
   1. Foundations for fill having slopes in excess of 1 vertical to 4 horizontal:
      a. Bench or terrace to adequately key existing ground and fill built thereon.
   2. Slopes of original hillsides and old fills: Bench minimum of 10 feet horizontally as fill is placed.
   3. Provision of new benches:
      a. Start new bench wherever vertical cut of next lower bench intersects existing grade.
      b. Recompact material thus cut out along with new embankment material at no additional cost to the Owner.

3.03 INSTALLATION

A. General:
   1. Dispose of excavated materials that are not required or are unsuitable for fill and backfill in lawful manner.
   2. Dispose of surplus material on private property only when written permission agreement is furnished by owner of property. Submit copies of such agreements.
   3. Rocks, broken concrete, or other solid materials larger than 4 inches in greatest dimension: Remove from project site at no additional cost to the Owner.
   4. Stabilization of subgrade: Provide materials used, or perform work required, to stabilize subgrade so it can withstand loads that may be placed upon it by Contractor's equipment.

B. Borrow area: There is no borrow area on Project site.
   1. Where material is required, import material from source located off Project site selected by the Contractor and subject to acceptance by the Owner or Engineer.

C. Compaction:
   1. Provide specified compaction for backfills, cuts, embankments, fills, roadway fills, and other earthwork on each lift or layer.
   2. Perform confirmation tests to verify and confirm that work has complied, and is complying at all times, with compaction requirements specified in this Section for initial compaction demonstration and field quality control testing.
   3. In-place density of compacted backfills, cuts, embankments, fills, and roadway fills determined in accordance with ASTM D1556, or with ASTM D6938.
   4. Maximum density obtained in laboratory when tested in accordance with ASTM D1557.
   5. Determine laboratory moisture-density relations of soils per ASTM D698.
   6. Determine the relative density of cohesionless soils per ASTM D4253 and D4254.
   7. Sample backfill materials per ASTM D75.
   8. "Relative compaction" is the ratio, expressed as a percentage, of the in-place dry density to the laboratory maximum dry density.
   9. To prevent damage to structures due to backfilling operations, place backfill with equipment that does not exceed H-20 loading, within a distance from the face of the structure of not less than 1/2 the depth of backfill. The depth of backfill is the distance between the level being compacted and the bottom of the excavation. Outside this distance, heavier compaction equipment may be used.
   10. Compact to percentage of maximum density as follows:
       a. Backfill adjacent to structures: 95 percent.
       b. Backfilling voids: 95 percent.
       c. Other areas: 85 percent.
       d. Under present and future structures: 95 percent.
       e. Under roadways, parking and storage areas, curbs, and sidewalks: 95 percent.
       f. Upper 6 inches of cuts: 95 percent.
       g. Fills: 95 percent.

D. Dewatering: As specified in Section 02240 - Dewatering.

E. Excavation:
   1. Blasting: Not permitted.
   2. Excavations for structures:
      a. Provide excavations conforming to dimensions and elevations indicated on the Drawings for each structure, including trenching for piping and all work incidental thereto.
      b. After clearing is complete, excavate for the structure, down to the elevation indicated on the Drawings. Unless directed by Engineer, do not carry excavations below elevation indicated on the Drawings.
      c. Where soil is encountered having unsuitable bearing value, Engineer may direct in writing that excavation be carried to elevations below those indicated on the Drawings.
      d. Where excavations are made below elevations indicated on the Drawings, adjust elevations of excavations in accordance with the following requirements:
         1) Under slabs: Restore to proper elevation in accordance with procedure specified for backfill in this Section.
         2) Under footings: Restore to the proper elevation using one of the following:
            a) Structural fill.
      e. Excavation width:
         1) Extend excavations at least 2 feet clear from walls and foundations of structures to allow for placing and removal of forms, installation of services, and inspection.
         2) Do not undercut slopes.
      f. Difficulty of excavation: No extra compensation will be made for removal of rock or any other material due to difficulty of excavation.
   3. Excavation of lined channels:
      a. Excavations in open cut for lined channels may be made so as to place concrete directly against excavated surfaces providing faces of excavations are:
         1) Firm and unyielding.
         2) Will stand or can be made to stand without sloughing.
      b. Excavations to provide subgrade for lined channel or subdrainage material: Excavate to lines and grades indicated on the Drawings.
   4. Excavation of unlined channels and basins:
      a. Excavate to lines and grades indicated on the Drawings.
      b. Perform excavation and grading so that finish surfaces are in uniform planes with no abrupt breaks in surface.
   5. Excavation of ditches and gutters:
      a. Cut ditches and gutters accurately to cross sections and grades indicated on the Drawings.
      b. Take care not to excavate ditches and gutters below grades indicated on the Drawings.
      c. Backfill excessive ditch and gutter excavations to grade with suitable material acceptable to the Engineer.
      d. Do not deposit any material within 3 feet of edge of ditch unless otherwise indicated on the Drawings.

6. Necessary over excavation:
    a. Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, backfill voids remaining after removal as specified in backfilling of voids below, or as acceptable to the Engineer.
    b. Backfill voids with material acceptable to the Engineer:
        1) With acceptance of the Engineer, backfill with one of the following:
            a) Aggregate base course.
            b) Controlled low-strength material.

F. Materials for backfills, embankments, fills, and roadway fills:
1. General:
    a. Obtain import material from other sources if surplus materials from cuts and excavations obtained from within Project site do not conform to specified requirements or are not sufficient in quantity for construction of Project.
2. Backfills:
    a. Backfill adjacent to structures, slabs, or walls: Native material or imported material meeting the requirements of unless otherwise specified or indicated on the Drawings.
    b. Backfill material under concrete structures: Aggregate base course material, except in areas where controlled low-strength material or concrete encasement are indicated on the Drawings.
    c. Extend backfill in any area under concrete structures from undisturbed soil or rock to the bottom aggregate base course material layer.
3. Embankments:
    a. Native material or imported material meeting the requirements of native material, unless otherwise specified or indicated on the Drawings.
4. Fills:
    a. Native material or imported material meeting the requirements of native material unless otherwise specified or indicated on the Drawings.
    b. Extend fill in any area under concrete structures from undisturbed soil or rock to the bottom aggregate base course material layer.
5. Roadway fills: One of the following, unless otherwise specified or indicated on the Drawings:
    a. Aggregate base course material.
    b. Native material or imported material meeting the requirements of native material.

G. Placement:
1. General:
    a. Lines and grades:
        1) Construct backfills, embankments, fills, and road fills, at locations and to lines and grades indicated on the Drawings.
        2) Overbuild all permanent fill slopes by at least 1 foot and then cut to final grade to provide adequate compaction of the remaining fill.
2. Backfills:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
    c. Defective compacted backfills: Remove and recompact.

3. Fills:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
    c. Defective compacted fills: Remove and recompact.
4. Embankments:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
    c. Defective compacted embankments: Remove and recompact.
5. Roadway fills:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
    c. Defective compacted roadway fills: Remove and recompact.

3.04 FIELD QUALITY CONTROL

A. Tests:
1. Confirmation tests:
    a. Contractor's responsibilities:
        1) Accomplish specified compaction for backfills, fills, and other earthwork.
        2) Control operations by confirmation tests to verify that compaction work complies, and is complying at all times, with requirements specified in this Section concerning compaction, control, and testing.
        3) Cost of confirmation tests: Paid for by the Contractor.
        4) Qualifications of Contractor's testing laboratory: Perform confirmation testing by soils testing laboratory acceptable to the Engineer.
        5) Copies of confirmation test reports: Submit promptly to the Engineer.
    b. Frequency of confirmation testing:
        1) Perform testing not less than the following:
2. Compliance tests:
    a. Periodic compliance tests will be made by the Engineer to verify that compaction is meeting requirements previously specified.
    b. Remove overburden above level at which the Engineer wishes to test. Backfill and recompact excavation after testing is completed.
    c. If compaction fails to meet specified requirements, perform remedial work by one of the following methods:
        1) Remove and replace materials at proper density.
        2) Bring density up to specified level by other means acceptable to the Engineer.
    d. Retesting:
        1) Contractor bears the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
        2) Contractor's confirmation tests during performance of remedial work: Double the normal rate specified.

B. Tolerances:
   1. Finish grading of backfills, cuts, embankments, fills, and roadway fills:
      a. Perform fine grading under concrete structures such that finish surfaces are never above the grade or cross section indicated on the Drawings and are never more than 0.10 foot below.
      b. Provide finish surface for areas outside of structures that are within 0.10 foot of grade or cross section indicated on the Drawings.
   2. Unlined channels and basins:
      a. In both cut and fill, and levee and access roadside slopes in cut: Vertical tolerance of none above and 3 inches below grade indicated on the Drawings on bottom and side slopes.
      b. On top surface of levee and access road in both cut and fill, and levee and access roadside slopes in fill: Vertical tolerance of none below and 3 inches above grade indicated on the Drawings.
   3. Areas which are not under structures, concrete, asphalt, roads, pavements, sidewalks, dikes, and similar facilities:
      a. Provide finish graded surfaces of either undisturbed soil, or cohesive material not less than 6 inches deep.
      b. Intent of proceeding is to avoid sandy or gravelly areas.
   4. Finish grading of surfaces:
      a. Reasonably smooth, compacted, and free from irregular surface changes.
      b. Provide degree of finish that is ordinarily obtainable from blade grader operations, except as otherwise specified.
      c. Uniformly grade areas that are not under concrete.
      d. Finish ditches and gutters so that they drain readily.

3.05 ADJUSTING

A. Finish grades of excavations, backfills, and fills:
   1. Repair and reestablish grades to required elevations and slopes due to any settlement or erosion that may occur from action of the elements or any other cause prior to final acceptance.

3.06 PROTECTION

A. Finish grades of backfills, cuts, excavations, and fills:
   1. Protect newly graded areas from erosion and deterioration by action of the elements.

B. Ditches and gutters:
   1. Maintain ditches and gutters free from detrimental quantities of debris that might inhibit drainage until final acceptance.

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SECTION 02318

TRENCHING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Trench excavation, fine grading, pipe bedding, backfilling, and compaction for the following, including requirements for ditch crossings:
   1. Pipes.
   2. Direct buried electrical and control conduits.
   3. Electrical and control duct banks.
   4. Manholes, valves, or other accessories.
   5. Potable water pipe appurtenances.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
   2. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

B. Refer to the Polk County Utility Standard and Specification Manual, latest revision, for additional requirements.

1.03 SUBMITTALS

A. Lab certification.

B. Confirmation test reports.

1.04 QUALITY ASSURANCE

A. Initial compaction demonstration:
   1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
      a. 200 linear feet of trench backfill.
   2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
   3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

PART 2 PRODUCTS

2.01 MATERIALS

A. Soil and rock materials:
   1. Limerock base course material: As specified in Section 02050 - Soils and Aggregates for Earthwork.
   2. Gravel and crushed rock base: As specified in Section 02050 - Soils and Aggregates for Earthwork.
   3. Select sand fill: As specified in Section 02050 - Soils and Aggregates for Earthwork.
   4. Pipe backfill: As specified in Section 02050 - Soils and Aggregates for Earthwork.

PART 3 EXECUTION

3.01 PREPARATION

A. General:
   1. Embankment condition:
      a. Exists where width of trench exceeds limits specified in this Section.
      b. Before laying pipes in fill, place fill and compact it to not less than 2 feet above top of pipe.
      c. After placing and compacting fill, excavate pipe trench through fill.

B. Protection: Stabilize trench excavations as specified in Polk County USSM and the Trench and Safety Act.

3.02 GENERAL REQUIREMENTS

A. Trench Zone:
   1. The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas.

B. Trench width:
   1. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings.
      a. In such case, width of trench shall be such that there is at least 2 feet between the top edge of the trench and the structure or footing.
   2. Minimum clear width of trench for pipe (measured at top of pipe):
      a. For pipe sizes 4 inches to and including 24 inches: Not less than outside diameter of pipe plus 18 inches.
      b. For pipe sizes larger than 24 inches: Not less than outside diameter of pipe plus 24 inches.
   3. Maximum clear width of trench for pipe (measured at top of pipe):
      a. For pipe sizes 4 inches to and including 24 inches: Not to exceed outside diameter of pipe plus 24 inches.
      b. For pipe sizes larger than 24 inches: Not to exceed outside diameter of pipe plus 36 inches.

c. For manholes, valves, or other accessories:
1) Provide excavations sufficient to leave at least 12 inches clear between their outer surfaces and sides of trench or shoring.

4. Under sidewalk, pavement, and curbs: Minimum equal to required trench width at ground surface.
5. If, because of soil conditions, safety requirements, or other reasons, trench width at top of pipe is increased beyond width specified in this Section, upgrade laying conditions or install stronger pipe designed in conformance with Specifications for increased trench width, without additional cost to Owner.

3.03 EXCAVATION

A. Excavate bottom of trench to depth indicated on the Drawings. The bottom of the trench excavation shall be firm and dry.

B. Overexcavation for the convenience of the Contractor will not receive any additional payment.

C. The trench may be excavated by machinery to the grade indicated on the Drawings provided that the soil material remaining in the bottom of the trench is no more than slightly disturbed.

D. Rock:
1. Pipe: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of fine grading material.
a. Backfill overcut with limerock base course material compacted to 95 percent of maximum density up to bottom of fine grading material.
2. Direct buried electrical and control conduits: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of conduit bedding material. Backfill overcut with limerock base course material up to bottom of conduit bedding material.
3. Electrical and control duct banks: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of concrete duct bank. Backfill overcut with limerock base course material up to bottom of concrete duct bank.
4. Overcut of trench bottom: Where the bottom of the trench is excavated below the depth indicated on the Drawings, restore trench bottom to proper grade by back filling with limerock base course material compacted to 95 percent of maximum density, at no additional cost to Owner.

E. Location of Excavated Material:
1. During trench excavation, place the excavated material only within the working area or within the areas shown in the drawings.
a. Do not obstruct any roadways or streets.

b. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.
2. Remove and store excavated topsoil separately.
   a. Replace topsoil in the top 24 inches of the trench zone.
3. Locate trench spoil piles at least 15 feet from the tops of the slopes of trenches.
   a. Do not operate cranes and other equipment on the same side of the trench as the spoil piles.

F. Trench Excavation in Backfill and Embankment Areas:
1. Construct and compact the embankment to an elevation of 1 foot minimum over the top of the largest pipe or conduit to be installed.

G. Foundation Stabilization:
1. Engineer will inspect the completed trench excavation to examine the exposed subgrade to identify unacceptable materials and define the need for any additional excavation in a change order.
2. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline to a width 24 inches greater than the pipe outside diameter and to the depth required.
3. Backfill the trench to subgrade of pipe base with limerock base course for foundation stabilization.
   a. Place the foundation stabilization material over the full width of the trench and compact in layers not exceeding 8 inches deep to the required grade.

3.04 PIPE INSTALLATION

A. Concrete cradle: Where indicated on the Drawings, cradle pipe in concrete.

B. Installing Buried Piping:
1. Mechanically restrain buried piping.
   a. Mechanically restrain existing piping requiring a new connection.
2. No pipe deflection of buried piping is allowed unless approved by the Engineer.
   a. Approval will be on a case by case basis.
3. Handle pipe in such a manner as to avoid damage to the pipe.
   a. Do not drop or dump pipe into trenches under any circumstances.
4. Inspect each pipe and fitting before lowering the buried pipe or fitting into the trench.
   a. Inspect the interior and exterior protective coatings.
   b. Patch damaged areas in the field with material recommended by the protective coating manufacturer.
   c. Clean ends of pipe thoroughly.
   d. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.
5. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness.
   a. Remove hard spots that would prevent a uniform thickness of bedding.
   b. Place the specified thickness of pipe base material over the full width of trench.

c. Grade the top of the pipe base ahead of the pipelaying to provide firm, continuous, uniform support along the full length of pipe, and compact to the relative compaction specified herein.
d. Before laying each section of the pipe, check the grade and correct any irregularities.

6. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, in maximum 8-inch lifts, keeping the level of backfill the same on each side.
   a. If no pipe zone material is specified or indicated, use pipe backfill as specified in Section 02050 - Soils and Aggregates for Earthwork.
   b. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe.
   c. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.
   d. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe.
   e. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.
   f. Do not operate heavy equipment over the pipe until at least 3 feet of backfill has been placed and compacted over the pipe.
7. Compact each lift to the relative compaction specified in this Section.

3.05 TRENCH REQUIREMENTS

A. Potable water pipe appurtenances:
   1. Lay in trenches separate from those used for sewers.
   2. Unless otherwise specified or indicated on the Drawings, lay in trenches having cover of not less than 3 feet below surface of ground and located at distance of not less than 10 feet from any parallel sewer trench.

B. At road crossings or existing driveways:
   1. Make provision for trench crossings at these points, either by means of backfills, tunnels, or temporary bridges.

3.06 DEWATERING

A. As specified in Section 02240 - Dewatering.

3.07 PIPE FINE GRADING

A. Schedule fine grading material as specified in this Section and Polk County USSM.

B. For pipes 16 inches in nominal diameter and under.
   1. Place 4 inches of fine grading material below bottom of pipe.
   2. Place fine grading material at uniform density, with minimum possible compaction.

C. For pipe over 16 inches in diameter.
   1. Place 4 inches, or 1/12 the outside diameter of pipe, whichever is greater, of fine grading material below bottom of pipe.
   2. Place fine grading material at uniform density, with minimum possible compaction.

D. Bell or coupling holes:
   1. Dig holes after trench bottom has been graded.
   2. Provide holes of sufficient width to provide ample room for grouting, banding, or welding.
   3. Excavate holes only as necessary for making joints and to ensure that pipe rests upon prepared trench bottom and not supported by any portion of the joint.

E. Depressions for joints, other than bell-and-spigot:
   1. Make in accordance with recommendations of joint manufacturer for particular joint used.

3.08 PIPE BEDDING

A. The pipe base or bedding shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded.

B. Thickness of pipe base shall be as follows unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed.
   1. Pipe diameter 16 inches or smaller: 4 inches thickness.
   2. Pipe diameter 18 inches and larger: 6 inches thickness.

3.09 PIPE ZONE

A. The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level above the top of the pipe, as specified below.

B. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level above the top of the highest or topmost pipe.

C. Thickness of pipe zone above the highest top of pipe shall be as follows unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed.
   1. Pipe diameter 6 inches or smaller: 6 inches thickness.
   2. Pipe diameter 8 inches and larger: 10 inches thickness.

D. Schedule bedding material as specified in this Section.

E. After pipe laid:
   1. Place bedding material under and around pipe in 6-inch maximum lifts of bedding material, to level 12 inches above top of pipe. Compact to 90 percent of maximum density.

F. Pipe displacement:
   1. Take necessary precautions in placement and compaction of bedding material to prevent displacement of piping.
   2. In event there is movement or floating of the piping, re-excavate, re-lay, and backfill the pipe.

G. Trench backfill above pipe bedding, electrical and control conduit bedding, and electrical and control duct banks:
   1. Under structures:
      a. Backfill trench up to underside of structure with limerock base course material as specified in Section 02050 - Soils and Aggregates for Earthwork compacted to 95 percent of maximum density
   2. Street Zone:
      a. The street zone is the top 30 inches of the trench immediately below the pavement zone in paved areas.
   3. Pavement Zone:
      a. The pavement zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.
   4. Cuts across roadways and paved streets:
      a. Backfill trench to underside of pavement with aggregate base course material as specified in Section 02050 - Soils and Aggregates for Earthwork compacted to 95 percent of maximum density.
   5. Under and parallel to roadways, paved areas, or storage areas:
      a. Backfill trench up to within 2 feet of finish grade with native material compacted to 95 percent of maximum density.
      b. Then backfill from 2 feet below finish grade to finish grade, or underside of limerock base course or pavement as indicated on the Drawings with limerock base course material as specified in Section 02050 - Soils and Aggregates for Earthwork, compacted to 95 percent of maximum density.
   6. In areas outside the improved section of roadways or in open country:
      a. Backfill to finish grade with native material as specified in Section 02050 - Soils and Aggregates for Earthwork compacted to 90 percent of maximum density.
   7. Through earth slopes adjacent to, or supporting structures:
      a. Backfill to finish grade with limerock base course material or select material compacted to 95 percent of maximum density.

H. Under existing intersecting pipes or conduits larger than 3 inches in diameter:
   1. Backfill from bottom of new pipe trench to spring line of intersecting pipe or conduit with limerock base course material, as specified in Section 02050 - Soils and Aggregates for Earthwork, compacted to 90 percent of maximum density.
   2. Extend limerock base course material as specified in Section 02050 - Soils and Aggregates for Earthwork two feet on either side of intersecting pipe or conduit to ensure that material remains in place while other backfill is being placed.
   3. Backfill remainder of trench as specified in "Trench backfill above pipe bedding, electrical and control conduit bedding, and electrical and control duct banks" above.

3.10 BACKFILL

A. Compact trench backfill to the specified relative compaction.

B. Compact by using mechanical compaction or hand tamping.
   1. Do not use high impact hammer-type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

C. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.

D. Do not use any axle-driven or tractor-drawn compaction equipment within 3 feet of building walls, foundations, and other structures.

E. Backfilling of manhole excavation: Conform to backfilling requirements as specified for trenches in this Section.

F. Backfill under manholes, vaults, tanks, or valves with limerock base course material. Do not backfill with soil.

G. Fill any unauthorized excess excavation below elevation indicated on the Drawings for foundation of any structure with limerock base course material as specified in Section 02050 - Soils and Aggregates for Earthwork at no additional cost to Owner.

H. Consolidation:
   1. Do not use water settling methods such as flooding, poling, or jetting.

I. In-place density of compacted trench backfill, and bedding determined in accordance with ASTM D1557 and ASTM D6938.

J. Excess material:
   1. Remove excess excavated material from the Project site as specified in Section 02300 - Earthwork and dispose of legally off site.

3.11 FIELD QUALITY CONTROL

A. Tests:
   1. Confirmation tests:
      a. Contractor's responsibilities:
         1) Accomplish specified compaction of trench backfill.
         2) Control operations by confirmation tests to verify and confirm that compaction work complies, and is complying at all times, with requirements specified in this Section concerning compaction, control, and testing.
         3) Cost of confirmation tests: Paid for by the Contractor.
         4) Qualifications of Contractor's testing laboratory: Acceptable to Engineer. Provide lab certification.
         5) Copies of confirmation test reports: Submit promptly to the Engineer.
      b. Frequency of confirmation testing:
         1) Perform testing not less than as follows:
            a) For trenches: At each test location include tests for each type or class of backfill from bedding to finish grade.
            b) In open fields: 2 every 1,000 linear feet.
            c) Along dirt or gravel road or off traveled right-of-way: 2 every 500 linear feet.
            d) Crossing paved roads: 2 locations along each crossing.
            e) Under pavement cuts or within 2 feet of pavement edges: 1 location every 400 linear feet.

2. Compliance tests:
    a. Frequency of testing: Periodic compliance tests will be made by the Engineer to verify that compaction is meeting requirements previously specified.
    b. If compaction fails to meet specified requirements: Perform remedial work by one of the following methods:
        1) Remove and replace backfill at proper density.
        2) Bring density up to specified level by other means acceptable to the Engineer.
3. Retesting:
    a. Costs of retesting: Contractor is responsible for the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
    b. Contractor's confirmation tests during performance of remedial work:
        1) Performance: Perform tests in manner acceptable to the Engineer.
        2) Frequency: Double amount specified for initial confirmation tests.

B. Piping system testing:
    1. As specified in Sections 01756 - Commissioning and 15956 - Piping Systems Testing.

3.12 SCHEDULES

A. Pipe fine grading materials:
    1. Fine grading material shall be the same as bedding material.

B. Bedding materials:
    1. Pipes:
        a. For pipe less than 16-inch nominal size: Except as otherwise specified, use select sand fill or limerock base course material.
        b. For pipe from 16-inch to 48-inch nominal size: Except as otherwise specified, use select sand fill or limerock base course material.
        c. For pipe over 48 inches: Except as otherwise specified, use limerock base course material.
        d. For polyvinyl chloride or other plastic pipe less than 2 inches in diameter: Except as otherwise specified, use select sand fill.
    2. Direct buried electrical and control conduits: Except as otherwise specified, use select sand fill.

END OF SECTION

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SECTION 02362

TERMITE CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Pre-construction application of termiticide for control of termite infestations in and around structures and construction.

1.02 REFERENCES

A. United States Environmental Protection Agency (EPA):
   1. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

1.03 SUBMITTALS

A. Product data:
   1. Include for each toxicant to be used, composition by percentage, dilution schedule, rate and volume calculations, and intended application rate.
   2. Current EPA-approved labels and Material Safety Data Sheets for each product used.

B. Manufacturer's instructions: Complete handling, mixing, application, cleanup, and safety instructions.

C. Project record documents: Accurately record quantity of product applied (concentrate), number of gallons of mixed emulsion applied, number of square feet treated, use of vapor barrier after treatment, type of fill material used, and rate of application depending on type of fill material**.**

1.04 QUALITY ASSURANCE

A. Applicator qualifications:
   1. Company specializing in application of termiticide.
   2. Licensed by state where Project is located.

B. Regulatory requirements:
   1. Products bear EPA registration numbers under Federal Insecticide, FIRFA.
   2. Conform to applicable codes in compliance with State, Local and Federal regulations.]

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store in cool, dry, well-ventilated place. Do not store below 40 degrees Fahrenheit.

B. Do not store products on Project site unless locked in storage space meeting regulatory requirements.

C. Remove unused and waste materials in accordance with appropriate regulations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Syngenta Crop Protection, LLC.
   2. FMC Professional Solutions.

2.02 MATERIALS

A. Dragnet(R) FT: Termiticide containing permethrin at rate of 3.2 pounds per gallon. EPA assigned "Signal Word" CAUTION or equal.

B. Demon Max: Termiticide containing cypermethrin at rate of 2.0 pounds per gallon. EPA assigned "Signal Word" CAUTION or equal.

2.03 MIX

A. Permethrin: 1.0 percent emulsion, add 2.5 gallons of Dragnet(R) FT to 97.5 gallons of water.

B. Cypermethrin: 0.6 percent emulsion, add 2.5 gallons of Prevail(R) FT to 97.5 gallons of water.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.

B. Insure that area is well ventilated.

C. Do not apply termiticide within 10 feet of storm drains.

D. Do not apply termiticide within 25 feet of aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; retention areas and commercial fish farm ponds).

3.02 PREPARATION

A. Remove non-essential wood and cellulose containing material from around foundation walls, crawl spaces, and porches.

B. Repair any faulty plumbing and appropriately grade around the structure to eliminate termite access to moisture.

C. Refer to manufacturer's instructions on package label.

D. Mix products with water to produce emulsions on job site.

3.03 APPLICATION

A. Apply in accordance with manufacturer's instructions.

B. Ensure that weather conditions comply with label recommendations prior to application. Do not make on-grade applications when sustained wind speeds are above 10 miles per hour (at application site) at nozzle end height.

C. Remove and handle termiticide containers per label instructions after application.

D. Re-treat if evidence of re-infestation is observed after initial treatment or treated area has been disturbed due to construction or improper drainage.

3.04 PROTECTION

A. Protect finished work as specified in Section 01500 - Temporary Facilities and Controls.

B. Cover treated soil with waterproof barrier when slab will not be poured same day as treatment.

C. Keep personnel off of treated area until completely dry.

D. No excavation, trenching, or movement of treated soil after application.

END OF SECTION

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SECTION 02581

PRECAST ELECTRICAL HANDHOLES AND ELECTRICAL MAS

PART 1 GENERAL

1.01 SUMMARY

A. Design, fabricate, and install precast electrical handholes and precast electrical maintenance access structures (MAS) of the size and type indicated on the Drawings and specified.
   1. Construction of cast-in-place concrete electrical structures, including handholes and MAS, are specified in other Sections.

B. Section includes:
   1. Precast portland cement concrete handholes and accessories.
   2. Precast portland cement concrete MAS and accessories.

1.02 REFERENCES

A. American Association of State Highway Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

B. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.

C. ASTM International (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings.
   2. C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   3. C858 - Standard Specification for Underground Precast Concrete Utility Structures.
   4. C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
   5. C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
   6. C1037 - Standard Practice for Inspection of Underground Precast Concrete Utility Structures.

D. National Fire Protection Association (NFPA):
   1. National Electrical Safety Code (NEC).

E. National Precast Concrete Association (NPCA).

F. Society of Cable Telecommunications Engineers (SCTE):
   1. 77 - Specification for Underground Enclosure Integrity.

G. Underwriters Laboratories (UL).

1.03 DEFINITIONS

A. Handhole: An enclosure for use in underground systems that has been sized and detailed to allow personnel to reach into, but not enter, the enclosure to install, operate, or maintain equipment or wiring or both. (Reference: NEC, Article 100):
   1. As used in this Section, "handhole" will refer to a precast electrical handhole.

B. Maintenance access structure (MAS): An enclosure for use in underground systems that has been sized and detailed to allow personnel to enter the enclosure to install, operate, or maintain equipment or wiring or both.
   1. As used in this Section, "MAS" will refer to a precast electrical maintenance access structure.

C. Portland cement concrete: A composite material consisting of a portland cement binder, water, admixtures, and a combination of fine and coarse mineral aggregates.
   1. Abbreviated "PCC" as in "PCC HANDHOLE" or "PCC MAS."

D. Precast concrete: A concrete fabrication designed by a qualified engineer and subsequently fabricated at a qualified fabrication site, which is usually located some distance from the site where the fabrication will be installed.

1.04 SYSTEM DESCRIPTION

A. General requirements for handholes and MAS:
   1. As specified in Section 16050 - Common Work Results for Electrical for general requirements for electrical work.
   2. Provide structures of the sizes and shapes indicated on the Drawings, with layouts, dimensions, and details as indicated on the Drawings and as specified.
   3. Conform to the requirements of:
      a. NEC.

B. Portland cement concrete handholes and MAS:
   1. Load resistance of boxes and covers.
   2. Design requirements: Loads on structures:
      a. In accordance with ASTM C857, except as modified in this Section.
      b. Loads at the ground surface:
         1) As indicated on the Drawings for minimum surface loading requirements at each structure. Sidewalk and Roadway loads are defined in ASTM C857.
         2) The vehicle and pedestrian loadings in the following paragraphs need not be additive; however, structures designated for "roadway" loading shall also support "sidewalk" loads.
         3) "Sidewalk": Load from regular pedestrian traffic with considerations for occasional non-deliberate vehicular traffic:
            a) Designation "A-0.3" in ASTM C857 Table 1 (300-psf uniform load).
         4) "Roadway": Load from heavy, frequently repeated vehicle traffic:
            a) Designation "A-16" in ASTM C857 Table 1 (AASHTO HS20-44).

c. Lateral earth pressure loads:
    1) Determine in accordance with the following requirements. Include effects of groundwater on lateral earth pressures.
        a) Equivalent lateral pressure: 55 pounds per square foot per foot of depth (triangular distribution) above the design groundwater elevation.
        b) Surface surcharge load:
            (1) Backfill-induced live load surcharge of 250 pounds per square foot (rectangular distribution).
            (2) In accordance with ASTM C857 Vehicle Load Designation "A-16" for "Roadway" or "A-0.3" for "Sidewalk" where such surcharge exceeds backfill loads described in the preceding paragraph.
        c) Groundwater effects:
            (1) Include effects from groundwater and soils saturated by flooding using design elevations specified in the Geotechnical Report.
            (2) Use equivalent lateral pressure of 90 pounds per square foot per foot of depth (triangular distribution) for soil below the design groundwater elevation.
d. Groundwater and flood loads - buoyancy effects:
    1) Buoyancy: For groundwater and flood conditions, provide factor of safety against flotation of at least 1.20.
        a) If the weight of soil overlying footing projections on the structure is considered to resist flotation, use a buoyant unit weight of soil equal to not more than 30 pounds per cubic foot.
        b) Concrete fill may be provided in the bottom section of precast portland cement concrete structures to add weight. Submit proposed details.
e. Soil-bearing pressure at base:
    1) Maximum 1,000 pounds per square foot total pressure on prepared subgrade soils.
f. Lifting and handling loads:
    1) Make provision in the design for the effects of loads or stresses that may be imposed on structures during fabrication, transportation, or erection.
g. Load combinations:
    1) Design structures to sustain the specified loads individually or in combination.

3. Design requirements: Structural analysis, design, and detailing:
    a. General:
        1) Analyze and design structures including the effects of 2-way action ("plate action") and of load transfer around current and future openings.
        2) Where structures include panels designed for future removal ("knockout panels"), design structures for loads and stresses with any combination of any or all such panels in place or removed.
    b. Precast portland cement concrete handholes and MAS:
        1) Design structures in accordance with the requirements of ACI 318 and this Section.
        2) Provide reinforcement at all areas subject to tensile stress when loaded with the specified loads and combinations thereof.

3) Provide temperature and shrinkage reinforcement to equal or exceed ACI 318 requirements in all concrete sections.
4) Provide minimum clear concrete cover over reinforcement at both interior and exterior faces of all members in accordance with the following:
   a) Handholes: 1.25 inch.
   b) MAS: 2 inches.
5) Reinforcement details:
   a) Walls: For structures with wall thickness of 8 inches or less, locate a single mat of reinforcement at the center of the wall.
   b) Slabs: For structures with slab thickness of 7 inches or less, locate a single mat of reinforcement at the center of the slab.
   c) Structures with wall or slab thicknesses exceeding these limits shall have a reinforcement at each face of the member.
6) Joints:
   a) Provide structures with watertight joints between sections, and detailed to minimize water infiltration at duct bank and conduit penetrations.
   b) Provide structures with non-skid, shiplap or tongue and groove joints between sections.

4. Design requirements: Materials:
   a. Polymer concrete handholes:
      1) Selectively-graded aggregates in combination with a polymer resin system. When combined through a process of mixing, molding and curing, a cross-linked bond shall be formed. Precast polymer concrete is to be reinforced with fiberglass for strength and durability.
   b. Portland cement concrete handholes and MAS:
      1) In accordance with ASTM C858 except as modified in this Section.

1.05 SUBMITTALS

A. Product data: Manufacturer's catalog data, details, and warranties for the following items.
   1. Portland cement concrete handholes and MAS:
      a. Materials of construction.
      b. Joint details and joint-sealing materials.
      c. Data for hatches or covers and rings.
      d. Preformed channels and accessories for cable racking.
      e. Drain and sump details, including removable covers.
      f. Pulling iron details.

B. Shop drawings:
   1. Portland cement concrete handholes and MAS:
      a. Shop drawings for each structure shall bear the seal and signature of a professional structural engineer licensed in the state where the structures will be installed.
      b. Dimensioned and "to-scale" plans, sections, and details for each structure including:
         1) Layout plan for that structure.
         2) Sizes, locations, and vertical positions of duct bank windows and knockout panels.

3) Locations and details for access openings, pulling irons, embedded cable supports and racks, and sumps.
4) Details of structural reinforcement showing bar size and spacing; true position of reinforcement in structural members with clear concrete cover at both inside and outside faces; location, bar size, and spacing of added reinforcement around openings; and other details relevant to design and fabrication of the structure.
5) Details of joints between adjacent precast sections, including provisions for overlap and for placement of sealants.

C. Design data:
1. Portland cement concrete handholes and MAS:
a. Structural calculations:
1) Submit complete structural calculations for each structure.
2) Provide calculations bearing the seal and signature of a professional engineer licensed in the state where the structures will be installed.
3) Calculations will be filed for record. Review comments will not be returned.
b. Manufacturer's statement of materials used for fabrication and construction, in accordance with ASTM C858, for record. Include the following:
1) Concrete mix design: For each concrete mix design to be used for the structures, include data describing:
a) Source and type of cement.
b) Sources, grading, and specific gravities of aggregates.
c) Aggregate reactivity data.
d) Concrete mix proportions and design strength.
e) Type, name, and dosage of all admixtures included in the concrete mix.
2) Reinforcing steel: Mill certificates.

D. Test reports:
1. Portland cement concrete handholes and MAS:
a. Fabricator's tests for compressive strength of concrete used in structures, made in accordance with recommendations of ASTM C858.

E. Certificates:
1. Polymer concrete handholes:
a. Manufacturer's certification that polymer concrete handholes are in accordance with the requirements of SCTE 77.
2. Portland cement concrete handholes and MAS:
a. Manufacturer's current plant certification under NPCA for the structures to be supplied.
1) Certification shall be current and in-effect at the time structures are manufactured.
b. Manufacturer's certification that handholes and MAS are in accordance with the requirements of ASTM C858.

F. Manufacturer's instructions:
1. Instructions for handling and setting structures in place.
2. Portland cement concrete handholes and MAS.

G. Manufacturer's field reports:
    1. Portland cement concrete handholes and MAS:
        a. Manufacturer's inspection reports in accordance with ASTM C1037.

H. Closeout documents:
    1. Project record documents:
        a. Portland cement concrete handholes and MAS:
            1) Final, revised plans and details of as-constructed precast handholes and MAS.
    2. Warranties:
        a. Manufacturer's standard warranty for:
            1) Polymer concrete handholes.
            2) Portland concrete handholes and MAS and accessories.

1.06 QUALITY ASSURANCE

A. Qualifications:
    1. Manufacturer:
        a. Portland cement concrete handholes and MAS:
            1) Holding current NPCA plant certification for the products produced.
            2) Demonstrating at least 5 years of experience in the design, production, and installation of products of the type required for this Work.
            3) Capable of providing structural designs prepared by a professional engineer licensed in the state where the structures will be installed.
            4) Providing inspection during fabrication and handling in accordance with the requirements of ASTM C1037.
    2. Installer:
        a. Capable of providing equipment of adequate capacity and mobility to handle and set units with proper bearing on the subgrade and without damage to the unit.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Packing, shipping, handling, and unloading:
    1. Package and brace structures to avoid damage during shipping and handling.
    2. Furnish crane or forklift for unloading and setting of portland cement concrete handholes and MAS.

B. Acceptance at site:
    1. Structures delivered to the site with cracks, damage, and damaged or missing accessories shall be removed from the site and replaced at no additional cost to the Owner.

C. Storage and protection:
    1. Store handholes and MAS and their appurtenances in areas protected from damage due to weather and site operations.

1.08 SEQUENCING

A. Coordinate installation of precast electrical handholes and MAS with duct banks specified in Section 16133 - Duct Banks.

1.09 WARRANTY

A. Provide manufacturer's standard warranty for precast handhole and MAS structures and accessories.

1.10 SYSTEM START-UP

A. As specified in Section 16050 - Common Work Results for Electrical.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cast-in-place concrete for fill at base sections of portland cement concrete MAS with deep sumps or ballast to resist buoyancy shall be "Class A" concrete as specified in Section 03300 - Cast-in-Place Concrete.

2.02 MANUFACTURED UNITS - PORTLAND CEMENT CONCRETE HANDHOLES AND MAS

A. General:
   1. Provide portland cement concrete handholes and MAS configured and designed as indicated on the Drawings and specified.
   2. In accordance with ASTM C858 unless otherwise noted.

B. Manufacturers: In accordance with PCU’s USSM.

C. Components:
   1. Floor:
      a. Construct floors as a monolith.
      b. Where sump or low-point drain is included, slope floor to that point.
   2. Roof, walls, and base:
      a. Designed and rated to support vehicle and pedestrian loads at the spans indicated.
      b. See the Drawings and ASTM C857 for required load rating by structure location.
   3. Access covers:
      a. Handholes: Aluminum plate hinged floor access door (hatch).
         1) Load rating:
            a) "Heavy Duty" for covers at locations designated for "Roadway" loads.
            b) "Medium Duty" or stronger for covers at locations designated for "Sidewalk" loads.
         2) Minimum access door size not less than 36 inches square, unless otherwise indicated on the Drawings.
         3) Provide bearing surface with pre-installed continuous elastomeric gasket to minimize water infiltration at lid.
         4) Provide skid-resistant lid with cast-in or machined-in grid pattern and the word "ELECTRICAL" in block letters at least 1.5 inches high.
      b. MAS: Aluminum frame and cover.
         1) The covers shall include a custom heavy duty aluminum frame with spring loaded mechanism to facilitate opening.

2) Also, the aluminum covers shall include an insulation layer of foam material on the interior, to minimize the radiation of exterior sun heat towards the interior of the box.
3) Security bolting
4) Covers shall include identification with word "ELECTRICAL" or "SIGNALS cast into the top exposed face, in accordance with the application for electrical or signal MAS.

D. Accessories:
1. Provide accessories as indicated on the Drawings and specified.
2. Materials at duct bank penetrations:
a. Joint filler as specified in Section 03150 - Concrete Accessories.
b. Backer rod and sealant as specified in Section 07900 - Joint Sealants.
3. Pulling irons:
a. Provide non-corroding cable pulling irons located for use with each current duct bank location and additional irons for use with duct banks that may be installed through future knockout panels.
b. Pulling irons may not be located on the floor.
c. Where pulling irons are installed on the wall, any pockets surrounding the irons shall have bottom surfaces sloped to drain.
d. Secure pulling eyes to structure reinforcement.
4. Cable racks and racking hardware:
a. Materials: Fiberglass as specified in Section 16070 - Hangers and Supports.
b. Embedded slots: Maximum depth of 1.5 inches.
5. Sumps and drains:
a. Fiberglass or HDPE fabrications including removable lids to prevent tripping hazards.
6. Exterior dampproofing:
a. Field applied to all wall and roof surfaces exposed to soil.

E. Fabrication:
1. Embeds:
a. Install embedded items with provisions for drainage to remove dripping or standing water, and to minimize corrosion.
1) Pulling irons may not be placed on the floor or in pockets that will collect water.
2) Detail bottom of cable rack channels to provide a downward sloping "sill" at the bottom of each vertical channel, so that the channel slot drains toward the floor.
b. Concrete cover:
1) Provide minimum 0.75-inch clear concrete cover between embeds and surrounding reinforcement.
2) Provide minimum 1.25-inch clear concrete cover between embed and exterior face of wall.

F. Tests and inspections:
1. Test and inspect structures in accordance with ASTM C858 and ASTM C1037.

PART 3 EXECUTION

3.01 GENERAL

A. Furnish and install precast electrical handholes and MAS as indicated on the Drawings and specified.

B. Install additional handholes and MAS required so installation procedures will conform to cable manufacturer's pulling tension requirements.
   1. Include proposed locations and details of such additional handholes and MAS with the submittals under Part 1.

3.02 PREPARATION

A. Design:
   1. Prepare detailed and scalable layouts for each MAS structure showing locations of conduit or duct bank penetrations, clearances, locations, and sizes of access openings and major accessories.

B. Protection:
   1. Where handhole and MAS structures are installed adjacent to existing site structures or utilities, provide excavation support or other protection as required to maintain those facilities in service and to prevent damage to both existing and new facilities.

C. Site preparation:
   1. Excavate and prepare exposed subgrade as indicated on the Drawings and as specified.
   2. Install and compact foundation layer as indicated on the Drawings and specified.
   3. Level foundation materials so that structures will be set plumb, and duct banks will be at proper grade and alignment.
      a. Install with uniform bearing on foundation materials.
      b. Wedging or blocking of base sections for leveling over the foundation materials will not be permitted.

3.03 INSTALLATION

A. General:
   1. Protect handholes and MAS from displacement, flooding, or flotation.

B. Polymer concrete handholes:
   1. Install structures in accordance with the manufacturer's recommendations.
   2. Clean joints between adjacent sections for tight fit.
   3. Set covers at elevations indicated on the Drawings.
      a. Securely attach cover to below-grade box.
   4. Backfill polymer concrete handholes as indicated on the Drawings and as specified.

C. Portland cement concrete handholes and MAS:
   1. Install structures in accordance with ASTM C891 and the provisions of this Section.
      a. In the event of conflicts, the more restrictive provisions shall apply.

2. Clean and prime joints between adjacent precast sections.
    a. Install sealing compound between sections and provide watertight joints.
3. Set covers and hatches at elevations indicated on the Drawings.
    a. Securely attach frames to top of precast structures and grade adjustment rings.
4. Penetrations:
    a. Holes for duct banks and other penetrations may not be cut into precast handholes and MAS unless they are located at designated locations shown on the shop drawings or at knockout panels cast into the structure during manufacturing.
    b. Carefully remove concrete from knockout panel areas with saws.
        1) Ensure that break-back does not extend beyond the designated limits of the knockout panel.
    c. Coat any reinforcement cut or exposed during removal of knockout panel sections with minimum 2 coats of high solids epoxy as specified in Section 09960 - High-Performance Coatings.
        1) Apply epoxy coating applied over and at least 1-inch past the perimeter of the reinforcement.
5. Install duct banks and conduit penetrations in accordance with the penetration details indicated on the Drawings.
    a. Place all joint fillers, caulks, and sealants before coating exterior concrete surface with bituminous dampproofing.
6. Fill holes that were provided for handling or other temporary purposes with non-shrink cement grout using procedures as specified in Section 03300 - Cast-in-Place Concrete unless otherwise detailed by the manufacturer.
7. After structures are set and before backfilling, coat exterior below-grade surfaces (around the sidewalls, over the top slab, and around any vertical risers to grade) with 2 heavy coats of bituminous dampproofing as specified in Section 09960 - High-Performance Coatings.
    a. Apply dampproofing in accordance with the coating manufacturer's instructions and at a rate of 40 to 60 square feet per gallon per coat.
    b. Mask over at least 1 inch back from joint caulks or sealants, and prevent dampproofing from coming in contact with those materials.
8. Backfill handholes and MAS as indicated on the Drawings and as specified in Section 02300 - Earthwork.

D. Site tolerances:
1. Set electrical handholes and MAS plumb and true at locations indicated on the Drawings.
2. Tolerances on placing:
    a. Horizontal location: Plus or minus 1 inch.
    b. Vertical elevation: Plus or minus 1/2 inch.
    c. Plumb: Plus or minus 1/8 inch over 10 feet.

3.04 REPAIR/RESTORATION

A. Repair cracks or blemishes in concrete as described in Section 03300 - Cast-in-Place Concrete.

3.05 ADJUSTING

A. After final grading is complete, adjust access covers to grade.

3.06 CLEANING

A. Before installation of cables in any duct banks and handholes or MAS, remove all concrete spoil, forms, debris, silt, dust, and other foreign material.

END OF SECTION

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SECTION 02831

ENTRANCE/EXIT CONTROL EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. This specification covers access control equipment to be installed at the entrance/exit to the Gibson Oaks property. This equipment shall control the movement of vehicles into and out from the property. The equipment shall include a slide gate operator. For entrance, a Cyberlock relay module shall open the gate. For exit, the gate shall open automatically when a vehicle approaches. Closure of the gate shall be controlled by a time delay that occurs after a gate has reached the fully open position. Safety features as outlined shall be provided.

B. The manufacturer and supplier of the equipment specified herein shall coordinate this work with the supplier of the slide gates to assure that the operators and gates function properly so as to provide proper operation and security.

C. Placement of the equipment shall be as indicated on the drawings.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions and the following:
   1. Submit material list including manufacturer, complete part numbers, and quantities.
   2. Submit shop drawings for the complete system.
   3. Submit a complete wiring diagram of the proposed system showing number of conductors in each run.

PART 2 PRODUCTS

2.01 GATE OPERATING REQUIREMENTS FOR ENTERING VEHICLES

A. The entrance gates shall open when either:
   1. An entering vehicle driver will use a Cyber Key on the entrance side of the gates within a module.
   2. The Owner shall have remote monitoring and control of the gate through the facility PLC. Personnel not having a Cyber Key may gain access by contacting the Owner personnel to provide access.

B. The gate shall be held open when a vehicle is within the driveway opening in such a position that if the gate were to begin closing it would strike the vehicle.

C. The gate shall open by a Knox Keyswitch is activated for emergency access.

D. The gate shall close when either:
   1. An adjustable time has passed (adjustable from 0 to 60 seconds) after the gate has reached the fully open position and there is no vehicle in the closing path. If the gate is fully open, and a vehicle is in the closing path, the time delay begins after the vehicle leaves the closing path.

E. When closing, the gate shall reverse and reopen when either:
   1. The gate's leading edge comes in contact with an object.

2.02 GATE OPERATING REQUIREMENTS FOR EXITING VEHICLES

A. The gate shall open when either:
   1. A vehicle drives onto an "Open" detector loop embedded in the roadway on the property side of the gate and in line with the gate.
   2. Owner personnel inserts a valid Cyber Key at the module.

B. The gate shall be held open when a vehicle is within the driveway opening in such a position that if the gate was to begin closing it would strike the vehicle.

C. The gate shall close when either:
   1. An adjustable time has passed (adjustable from 0 to 60 seconds and set to the same time for the gate) after the gate has reached the fully open position and there is no vehicle in the closing path. If the gate is fully open, and a vehicle is in the closing path, the time delay begins after the vehicle leaves the closing path.

D. When closing, the gate shall reverse and reopen when either:
   1. The gate leading edge comes in contact with an object.
   2. A vehicle enters the "Open" loop used to open the gate.

E. When closing, the gate shall reverse and reopen when a valid Cyber Key is inserted.

2.03 SLIDE GATE OPERATORS

A. The operators shall have the following:
   1. Durable construction.
   2. Reliable operating history.
   3. Delay on reversal feature.
   4. Maximum run timer feature.
   5. Delay to close feature.
   6. Each operator capable of reliably moving a properly hung, cantilever gate, of size(s) indicated in project documents.
   7. Continuous duty operating capability.
   8. Minimum 3/4 horsepower motor: 460-volt, 3-phase.
   9. Speed of gate travel to be nominally 1 foot per second.
   10. Painted aluminum metal cabinet.
      a. Model:"Osco" Model SDG4 or equal.

2.04 CONTROL DEVICES

A. 3 detector loops embedded in roadway.
   1. 2 safety loops to keep the gate from closing if a vehicle is in the closing path when time delay times out.
   2. 1 open loop for exiting traffic.

B. Vehicle detectors to operate with detector loops.

C. Safety edges to cause closing gates to reverse and reopen should safety edge mounted to leading edge of gate contact an object when closing.

D. Cyberlock relay module with the following:
   1. Weather resistant housing.
   2. Mounting pedestal (painted aluminum).
   3. Powerlinesurgesuppressorinstalledingate operator.
   4. Ability to operate in stand-alone mode.
   5. Ability to program out keypad codes singly or in a block.
   6. Non-volatile memory.
   7. Model:Cyberlock or equal.

E. Knox Keyswitch mounted adjacent to the Cyberlock module for emergency vehicle access.

2.05 WARRANTY

A. Warranty shall be for one year and cover at no charge parts, labor and travel for manufacturing and/or installation defects.

B. Service support shall be as follows:
   1. Supplier shall respond to a call for service the same working day if call is received before noon, or next working day if call is received after noon.
   2. Supplier shall be capable of providing weekend and holiday service.

C. Supplier must have annual maintenance contracts available. Provide cost of first year maintenance contract after expiration of warranty. Define contract coverage.

D. The installer for this equipment must be approved by the manufacturer of the equipment and must have been installing this type of equipment for at least 5 years.

PART 3 EXECUTION

A. Install as per manufacturer's recommendations.

B. Comply with Division 16 for electrical work and Division 17 for control system requirements.

C. Coordinate installation of detection loops with the County to minimize impacts to the plant operations and access.

D. Test installation for correct operation.

E. Clean exposed components.

END OF SECTION

SECTION 03071

EPOXIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Epoxy.
   2. Epoxy gel.
   3. Epoxy bonding agent.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C881 - Standard Specification for Epoxy-Resin-Base Systems for Concrete.
   2. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
   3. D638 - Standard Test Method for Tensile Properties of Plastics.
   4. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

B. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

1.03 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Provide epoxy materials that are new.
   2. Store and use products within limitations set forth by manufacturer.
   3. Perform and conduct work of this Section in neat orderly manner.

1.04 SUBMITTALS

A. General: Submit as specified in Section 01330 - Submittal Procedures.

B. Product Data: Submit manufacturer's data completely describing epoxy materials:
   1. Submit evidence of conformance to ASTM C881. Include manufacturer's designations of Type Grade, Class, and Color.
   2. Submit documentation that materials meet or exceed the specified strength and performance characteristics. Indicate test methods and test results.
   3. Submit documentation confirming listing under NSF-61.

C. Quality control submittals:
   1. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:
   1. Moisture tolerant, water-insensitive, two-component epoxy resin adhesive material containing 100 percent solids, and meeting or exceeding the performance properties specified when tested in accordance with the standards specified.
   2. Listed under NSF-61 for use in direct contact with potable water.

B. Epoxy: Low viscosity product in accordance with ASTM C881; Types I, II and IV; Grade 1; Class C.
   1. Manufacturers: One of the following or equal:
      a. BASF, MasterInject 1500.
      b. Dayton Superior, Sure Inject J56.
      c. Sika Corporation, Sikadur 35 Hi-Mod LV.
   2. Required properties:

Table 1 - Material Properties - Epoxy.

Property	Test Method	Required Results ("neat")
Tensile Strength (7-day)	ASTM D638	7,100 pounds per square inch, minimum.
Compressive Strength (7-day)	ASTM D695	11,000 pounds per square inch, minimum.
Bond Strength (2-day)	ASTM C882	1,500 pounds per square inch, minimum. Concrete failure before failure of epoxy.
Viscosity (mixed)		250-550 centipoise

Notes:
Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.

C. Epoxy gel: Non-sagging product in accordance with ASTM C881, Types I and IV, Grade 3, Class C.
   1. Manufacturers: One of the following or equal:
      a. BASF, MasterEmaco ADH 327.
      b. Dayton Superior, Sure Anchor J50.
      c. Sika Corp., Sikadur 31, Hi-Mod Gel.

2. Required properties:

Table 2 - Material Properties - Epoxy Gel.		
Property	**Test Method**	**Required Results ("neat")**
Tensile Strength (7-day)	ASTM D638	2,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,000 pounds per square inch, minimum.
Bond Strength (14-day)	ASTM C882	1,500 pounds per square inch, minimum.
Notes: Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.		

D. Epoxy bonding agent: Non-sagging product in accordance with ASTM C881, Type II, Grade 2, Class C.
   1. Manufacturers: One of the following or equal:
      a. BASF, MasterEmaco ADH 326.
      b. Dayton Superior, Sure Bond J58.
      c. Sika Chemical Corp., Sikadur 32 Hi-Mod LPL.
   2. Required properties:

Table 3 - Material Properties - Epoxy Bonding Agent		
Property	**Test Method**	**Required Results**
Tensile Strength (7-day)	ASTM D638	3,300 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,300 pounds per square inch, minimum.
Bond Strength (14-days)	ASTM C882	1,800 pounds per square inch, minimum. Concrete failure before failure of epoxy bonding agent.
Notes: Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.		

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.

B. Epoxy:
   1. Apply in accordance with manufacturer's installation instructions.

C. Epoxy gel:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Use for vertical or overhead work, or where high viscosity epoxy is required.
   3. Epoxy gel used for vertical or overhead work may be used for horizontal work.

D. Epoxy bonding agent:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

SECTION 03102

CONCRETE FORMWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Concrete formwork.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary.

B. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

C. Underwriters Laboratories (UL).

1.03 DEFINITIONS

A. Green concrete: Concrete with less than 100 percent of the minimum specified compressive strength (f'_c).

1.04 SYSTEM DESCRIPTION

A. Design requirements:
   1. Design of concrete forms, falsework, and shoring in accordance with local, state, and federal regulations.
   2. Design forms and ties to withstand concrete pressures without bulging, spreading, or lifting of forms.

B. Performance requirements:
   1. Construct forms so that finished concrete conforms to shapes, lines, grades, and dimensions indicated on the Drawings.
   2. It is intended that surface of concrete after stripping presents smooth, hard, and dense finish that requires minimum amount of finishing.
   3. Provide sufficient number of forms so that the work may be performed rapidly and present uniform appearance in form patterns and finish.
   4. Use forms that are clean and free from dirt, concrete, and other debris.
      a. Coat with form release agent if required, prior to use or reuse.

1.05 SUBMITTALS

A. Information on proposed forming system:
   1. Submit in such detail as the Engineer may require to assure himself that intent of the Specifications can be complied with by use of proposed system.
   2. Alternate combinations of plywood thickness and stud spacing may be submitted.

B. Form release agent. NSF 61 certification prepared by NSF, Underwriters Laboratories (UL) or other, similar, nationally recognized testing laboratory acceptable to the Engineer.

1.06 QUALITY ASSURANCE

A. Qualifications of formwork manufacturers: Use only forming systems by manufacturers having a minimum of 5 years' experience, except as otherwise specified, or accepted in writing by the Engineer.

B. Regulatory requirements: Install work of this Section in accordance with local, state, and federal regulations.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Forms: Built-up plywood:
   1. Built-up plywood forms may be substituted for prefabricated forming system subject to following minimum requirements:
      a. Size and material:
         1) Use full size 4-foot by 8-foot plywood sheets, except where smaller pieces are able to cover entire area.
         2) Sheet construction: 5-ply plywood sheets, 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.
      b. Wales: Minimum 2-inch by 4-inch lumber.
      c. Studding and wales: Contain no loose knots and be free of warps, cups, and bows.

B. Forms: Steel or steel framed:
   1. Steel forms:
      a. Rigidly constructed and capable of being braced for minimum deflection of finish surface.
      b. Capable of providing finish surfaces that are flat without bows, cups, or dents.
   2. Steel framed plywood forms:
      a. Provide forms that are rigidly constructed and capable of being braced.
      b. Plywood paneling: 5-ply, 5/8-inch nominal or 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.

C. Form release agent.
   1. Effective, non-staining, bond-breaking coating compatible with form surfaces and concrete mixes used.
   2. Certified for conformance to NSF 61 and leaving no taste or odor on the concrete surface.

D. Form ties:
   1. General:
      a. Provide form ties for forming system selected that are manufactured by recognized manufacturer of concrete forming equipment.
      b. Do not use wire ties or wood spreaders of any form.
      c. Provide ties of type that accurately tie, lock, and spread forms.
      d. Provide form ties of such design that when forms are removed, they locate no metal or other material within 1-1/2 inches of the surface of the concrete.
      e. Do not allow holes in forms for ties to allow leakage during placement of concrete.
   2. Cone-snap ties:
      a. Cone-snap ties shall form a cone shaped depression in the concrete with minimum diameter of 1 inch at the surface of the concrete and minimum depth of 1-1/2 inches.
      b. Provide neoprene waterseal washer that is located near the center of the concrete.
   3. Taper ties:
      a. Neoprene plugs for taper tie holes: Size so that after they are driven, plugs are located in center third of wall thickness.

E. Incidentals:
   1. External angles:
      a. Where not otherwise indicated on the Drawings, provide with 3/4-inch bevel, formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, slabs, walls, beams, columns, and openings.
      b. Provide 1/4-inch bevel formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, walls, and slabs at expansion, and construction joints.
   2. Keyways: Steel, plastic, or lumber treated with form release agent.

PART 3 EXECUTION

3.01 EXAMINATION

A. Site verification of conditions:
   1. Do not place concrete until forms have been checked for alignment, level, and strength, and mechanical and electrical inserts or other embedded items for correct location.

3.02 INSTALLATION

A. Forms: Built-up plywood:
   1. Studding:
      a. Spaced at 16 inches or 24 inches on center.
      b. Closer spacing may be required depending upon strength requirements of the forms, in order to prevent any bulging surfaces on faces of finished concrete work.
      c. Install studs perpendicular to grain of exterior plys of plywood sheets.
   2. Wales: Form wales of double lumber material with minimum size as specified in this Section.

3. Number of form reuses: Depends upon durability of surface coating or overlay used, and ability to maintain forms in condition such that they are capable of producing flat, smooth, hard, dense finish on concrete when stripped.

B. Forms: Steel or steel framed:
   1. Steel forms:
      a. Adequately brace forms for minimum deflection of finish surface.
   2. Steel framed plywood forms:
      a. Rigidly construct and brace with joints fitting closely and smoothly.
      b. Number of form reuses: Depends upon durability of surface coating or overlay used.
   3. Built-up plywood forms: As specified in this Section may be used in conjunction with steel forms or steel framed plywood forms for special forming conditions such as corbels and forming around items which will project through forms.

C. Form bracing and alignment:
   1. Line and grade: Limit deviations to tolerances which will permit proper installation of structural embedded items or mechanical and electrical equipment and piping.
   2. Formwork:
      a. Securely brace, support, tie down, or otherwise hold in place to prevent movement.
      b. Make adequate provisions for uplift pressure, lateral pressure on forms, and deflection of forms.
   3. When second lift is placed on hardened concrete: Take special precautions in form work at top of old lift and bottom of new lift to prevent:
      a. Spreading and vertical or horizontal displacement of forms.
      b. Grout "bleeding" on finish concrete surfaces.
   4. Pipe stubs, anchor bolts, and other embedded items: Set in forms where required.
   5. Cracks, openings, or offsets at joints in formwork: Close those that are 1/16-inch or larger by tightening forms or by filling with acceptable crack filler.

D. Forms: Incidentals:
   1. Keyways: Construct as indicated on the Drawings.
   2. Reentrant angles: May be left square.
   3. Level strips: Install at top of wall concrete placements to maintain true line at horizontal construction joints.
   4. Inserts:
      a. Encase pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Drawings or as required, in concrete.
   5. Pipe and conduit penetrations:
      a. Install pipe and conduit in structures as indicated on the Drawings, and seal with materials as specified in Section 07900 - Joint Sealants.

E. Form release agent:
   1. Apply in accordance with manufacturer's instructions.

F. Form ties:
   1. Cone-snap ties: Tie forms together at not more than 2-foot centers vertically and horizontally.

3.03 FORM REMOVAL

A. Keep forms in place for at least the periods indicated in the following paragraphs.
   1. Vertical forms:
      a. Keep vertical forms in place for a minimum of 24 hours after concrete is placed.
      b. If, after 24 hours, concrete has sufficient strength and hardness to resist surface or other damage, forms may be removed.
   2. Other forms and shoring: Keep in place:
      a. Sides of footings: 24 hours minimum.
      b. Vertical sides of beams, girders, and similar members: 48 hours minimum.
      c. Bottom of slabs, beams, and girders: Until concrete strength reaches specified strength f'_c or until shoring is installed.
      d. Shoring for slabs, beams, and girders: Shore until concrete strength reaches specified strength.
      e. Wall bracing: Brace walls until concrete strength of beams and slabs laterally supporting wall reaches specified strength.

B. Green concrete:
   1. No heavy loading on green concrete will be permitted.

3.04 SURFACE REPAIRS AND FINISHING

A. Immediately after forms are removed, carefully examine concrete surfaces, and repair any irregularities in surfaces and finishes as specified in Section 03300 - Cast-in-Place Concrete.

B. Form ties: Remove form ties from surfaces. Fill tie holes as follows:
   1. Remove form ties from surfaces.
   2. Roughen cone shaped tie holes by heavy sandblasting before repair.
   3. Dry pack cone shaped tie holes with dry-pack mortar as specified in Section 03600 - Grouting.
   4. Taper ties:
      a. After forms and taper ties are removed from wall, plug tie holes with neoprene plug as follows:
         1) Heavy sandblast and then clean tie holes.
         2) After cleaning, drive neoprene plug into each of taper tie holes with steel rod. Final location of neoprene plug shall be in center third of wall thickness. Bond neoprene plug to concrete with epoxy.
         3) Locate steel rod in cylindrical recess and against middle of plug during driving.
            a) At no time are plugs to be driven on flat area outside cylindrical recess.
      b. Dry-pack of taper tie holes:
         1) After installing plugs in tie holes, coat tie hole surface with epoxy bonding agent and fill with dry-pack mortar as specified in Section 03600 - Grouting.
            a) Place dry-pack mortar in holes in layers with thickness not exceeding tie hole diameter and heavily compact each layer.
            b) Dry-pack the outside of the hole no sooner than 7 days after the inside of the hole has been dry packed.

c) Wall surfaces in area of dry-packed tie holes: On the water side of water containing structures and the outside of below grade walls:
   (1) Cover with minimum of 10 mils of epoxy gel.
   (2) Provide epoxy gel coating on wall surfaces that extend minimum of 2 inches past dry-pack mortar filled tie holes.
   (3) Provide finish surfaces that are free from sand streaks or other voids.

3.05 TOLERANCES:

A. Finished concrete shall conform to shapes, lines, grades, and dimensions indicated on the Drawings.

B. Construct work within the tolerances in accordance with ACI 117, except as modified in the following paragraphs or as indicated on the Drawings.
   1. General:
      a. At certain locations in the Work, tolerances required for equipment placement and operation may be more restrictive than the general tolerance requirements of this Section.
      b. Confirm equipment manufacturers' required tolerances for location and operation of equipment that will be installed, and construct concrete to satisfy those requirements.
   2. Slabs:
      a. Slope: Uniformly sloped to drain when slope is indicated on the Drawings.
      b. Slabs indicated to be level: Have maximum vertical deviation of 1/8-inch in 10-foot horizontal length without any apparent changes in grade.
   3. Inserts and embedments:
      a. Set inserts and embedments to tolerances required for proper installation and operation of equipment or systems to which insert pertains.
      b. Maximum tolerances: As follows:

Item	Tolerance
Sleeves and inserts	Plus 1/8 Minus 1/8 inch.
Anchor bolts:	
Projected ends	Plus 1/4 Minus 0.0 inch.
Axial alignment	Not more than 2 degrees off the axis indicated on the Drawings.
Setting location	Plus 1/16 Minus 1/16 inch.

C. Remove and replace work that does not conform to required tolerances. Procedures and products employed in and resulting from such re-work shall be acceptable to the Engineer.

END OF SECTION

SECTION 03150

CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Waterstops.
   2. Joint fillers.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C203 - Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
   2. D570 - Standard Test Method for Water Absorption of Plastics.
   3. D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
   4. D638 - Standard Test Method for Tensile Properties of Plastics.
   5. D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
   6. D747 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
   7. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   8. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   9. D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
   10. D2240 - Standard Test Method for Rubber Property - Durometer Hardness.

B. American National Standards Institute (ANSI):
   1. A135.4 - Basic Hardboard.

C. U. S. Army Corps of Engineers (USACE):
   1. CRD-C-572, Specification for Polyvinyl Chloride Waterstop.

1.03 SUBMITTALS

A. Product data:
   1. Polyvinyl chloride waterstops: Complete physical characteristics.
   2. Preformed expansion joint material: Sufficient information on each type of material for review to determine conformance of material to requirements specified.

B. Samples:
   1. Polyvinyl chloride waterstop.

C. Laboratory test reports: Indicating that average properties of polyvinyl chloride waterstops material and finish conform to requirements specified in this Section.

D. Quality control submittals:
   1. Certificates of Compliance:
      a. Written certificates that polyvinyl chloride waterstops supplied on this Project meet or exceed physical property in accordance with USACE CRD-C-572 and the requirements of this Section.
   2. Manufacturer's instructions: For materials specified in this Section that are specified to be installed with such instructions.

1.04 QUALITY ASSURANCE

A. Mock-ups:
   1. Welding demonstration:
      a. Demonstrate ability to weld acceptable joints in polyvinyl chloride waterstops before installing waterstop in forms.

B. Field joints:
   1. Polyvinyl chloride waterstops field joints: Free of misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of material to water pressure at any point. Replace defective joints. Remove faulty material from site and disposed of by Contractor at its own expense.

C. Inspections:
   1. Quality of welded joints will be subject to acceptance of Engineer.
   2. Polyvinyl chloride waterstop: Following defects represent partial list that will be grounds for rejection:
      a. Offsets at joints greater than 1/16 inch or 15 percent of the material thickness, at any point, whichever is less.
      b. Exterior crack at joint due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
      c. Any combination of offset or crack that will result in net reduction in cross section of waterstop in excess of 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
      d. Misalignment of joint that will result in misalignment of waterstop in excess of 1/2 inch in 10 feet.
      e. Porosity in welded joint as evidenced by visual inspection.
      f. Bubbles or inadequate bonding.

PART 2 PRODUCTS

2.01 JOINT FILLERS

A. General:
   1. Use specific type in applications as indicated on the Drawings.
   2. Do not use scrap or recycled materials to manufacture joint fillers.

B. Expanded polystyrene joint filler:
   1. Commercially available polystyrene board.
   2. Minimum flexural strength: 35 pounds per square inch in accordance with ASTM C203.
   3. Compressive yield strength: Between 16 and 40 pounds per square inch at 5 percent compression.

C. Preformed expansion joint materials:
   1. Bituminous fiber expansion joint material:
      a. Properties:
         1) Thickness: To match joint width indicated on the Drawings.
         2) Asphalt-impregnated fiber in accordance with ASTM D1751.
      b. Manufacturers: One of the following or equal:
         1) Durajoint.
         2) W.R. Meadows, SealTight Fibre Expansion Joint.
   2. Synthetic sponge rubber expansion joint material:
      a. Properties:
         1) Thickness: As recommended for width indicated on the Drawings.
         2) Material in accordance with ASTM D1752, Type I.
      b. Manufacturers: One of the following or equal:
         1) Williams Products Inc., Everlastic 1300.
         2) W.R. Meadows, SealTight Sponge Rubber.

2.02 WATERSTOPS

A. Waterstops - polyvinyl chloride (PVC):
   1. Manufactured from prime virgin polyvinyl chloride plastic compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements as specified in this Section.
   2. Manufacturers: One of the following or equal:
      a. Vinylex Corp.
      b. Sika Corp., Greenstreak PVC Waterstop.
   3. Type: Ribbed waterstop:
      a. Construction joints: 6-inch wide ribbed type.
      b. Expansion joint for wall penetrations for concrete encased electrical duct banks: 6-inch ribbed type with hollow center bulb.
      c. Expansion joints: 9-inch wide ribbed type with hollow center bulb.
      d. Dumbbell-type waterstop will not be allowed unless otherwise specified or indicated on the Drawings.
      e. No scrap or reclaimed material shall be used.
   4. Properties as indicated in the following table:

2.03 JOINT DOWELS

A. Expansion joint dowels:
   1. Smooth, un-deformed steel bars conforming to ASTM A615, Grade 60.
   2. Provide dowels straight and clean, free of loose flaky rust and loose scale.
   3. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04 inch on the diameter of the dowel and extends no more than 0.04 from the end.
   4. Expansion end of the dowel:
      a. Coat bars with a bond breaker.

b. Provide expansion dowel caps.

B. Slip dowel plastic sleeves: Manufactured using polypropylene:
   1. Manufacturers: The following or equal:
      a. Sika Corp., speed dowel.

C. Slip dowel end caps:
   1. Manufacturers: One of the following or equal:
      a. Heckmann Building Products, Inc., No. 87 Dowel Caps.
      b. Dayton Superior Corp., Style K-11 Dowel Caps.

PART 3 EXECUTION

3.01 INSTALLATION

A. Waterstops:
   1. General:
      a. Store waterstops so as to permit free circulation of air around waterstop material and prevent direct exposure to sunlight.
      b. Install waterstops in concrete joints where indicated on the Drawings.
      c. Carry waterstops in walls into lower slabs and join to waterstops in slabs with appropriate types of fittings.
      d. In waterbearing structures: Provide all joints with waterstops, whether indicated on the Drawings or not.
      e. Provide waterstops that are continuous.
      f. Set waterstops accurately to position and line as indicated on the Drawings.
      g. Hold and securely fix edges in position at intervals of not more than 24 inches so that they do not move during placing of concrete.
      h. Position the waterstop so that symmetrical halves of waterstop are equally divided between concrete pours. Center axis of waterstop shall be coincident with centerline of the joint.
      i. Do not drive nails, screws, or other fasteners through waterstops in vicinity of construction joints.
      j. Use wires at not more than 24 inches on centers near outer edge of waterstop to tie waterstops into position.
      k. Special clips may be used in lieu of wires, at Contractor's option.
      l. Terminate waterstops 3 inches from top of finish surfaces of walls and slabs unless otherwise specified or indicated on the Drawings.
      m. When any waterstop is installed in concrete on one side of joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, take suitable precautions to shade and protect exposed waterstop from direct rays of sunlight during entire exposure and until exposed portion is embedded in concrete.
      n. When placing concrete at waterstops in slabs, lift edge of waterstop while placing concrete below the waterstop. Manually force waterstop against and into concrete, and then cover waterstop with fresh concrete.
   2. Polyvinyl chloride waterstop:
      a. Install waterstops so that joints are watertight.

b. Weld joints such as unions, crosses, ells, and tees, with thermostatically controlled equipment recommended by waterstop manufacturer:
    1) Do not damage material by heat sealing.
    2) Make joints by overlapping, then simultaneously cut ends of sections to be spliced so they will form smooth even joint. Heat cut ends with splicing tool until the plastic melts. Press 2 ends together until plastic cools.
    3) Maintain continuity of waterstop ribs and tubular center axis.
    4) The splices shall have tensile strength of not less than 60 percent of unspliced materials tensile strength.
c. Butt joints of ends of 2 identical waterstop sections may be made while material is in forms.
d. Manufacturer shall factory prefabricate joints for crosses and tees.
e. Split-type waterstops will not be permitted except where specifically indicated on the Drawings.

B. Joints:
1. Construct construction and expansion joints as indicated on the Drawings.
2. Preformed expansion joint material: Fasten expansion joint strips to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.

C. Expanded polystyrene joint filler:
1. When filler is indicated on the Drawings or specified, place filler in correct position before concrete is placed against filler.
2. Fill holes and joints in filler with caulking to prevent entry of mortar into joint or passage of mortar or concrete from one side of joint to other.

D. Slip dowels at expansion joints:
1. Where indicated on the Drawings, install smooth dowels at right angles to expansion joints.
    a. Align dowels with finished surface.
    b. Rigidly hold in place and support during concrete placement.
2. Slip dowel sleeves:
    a. Locate slip dowel sleeves on expansion joints as indicated on the Drawings.
3. Slip dowel end caps:
    a. Unless otherwise indicated on the Drawings, apply a bond breaker at one end of dowels through expansion joints.
    b. Provide slip dowel end caps on the lubricated end of expansion dowels.

END OF SECTION

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SECTION 03200

CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Reinforcing bars.
      a. Carbon steel.
      b. Hot-dip galvanized carbon steel.
   2. Thread bars.
   3. Bar supports.
   4. Tie wires.
   5. Welded wire fabric.
   6. Mechanical reinforcing bar couplers.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.
   2. SP-66 - ACI Detailing Manual.

B. American Iron and Steel Institute (AISI).

C. American Welding Society (AWS):
   1. D1.4 - Structural Welding Code - Reinforcing Steel.

D. ASTM International (ASTM):
   1. A123 - Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
   2. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. A493 - Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
   4. A615 - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
   5. A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   6. A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
   7. A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
   8. A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   9. A1064 - Standard Specification of Carbon-Steel wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

E. Concrete Reinforcing Steel Institute (CRSI):
   1. Manual of Standard Practice.

F. ICC Evaluation Service (ICC-ES):
   1. AC133 - Acceptance Criteria for Mechanical Connector Systems for Steel Reinforcing Bars.
   2. AC347 - Acceptance Criteria for Headed Deformed Bars.

1.03 DEFINITIONS

A. Architectural concrete: Concrete surfaces that will be exposed to view in the finished work. For purposes of this Section, architectural concrete includes the following:
   1. Concrete surfaces specified to receive paints or coatings.
   2. Exposed concrete in open basins, channels, and similar liquid containing structures, that is located above a line 2 feet below the normal operating water surface elevation in that structure.

B. Bars: Reinforcement or reinforcing bars as specified in this Section.

C. Evaluation Report: Report prepared by ICC-ES, or by other testing agency acceptable to the Engineer and to the Building Official.

D. Give away bars: Reinforcing bars that are not required by the Contract Documents, but are installed by the Contractor to provide support for the required reinforcing bars.

E. Wire supports: Metal reinforcing supports constructed of steel wire as specified. Includes individual high chairs, continuous high chairs, bolsters and other similar configurations and shapes.

1.04 SYSTEM DESCRIPTION

A. The drawings contain notes describing the size and spacing of reinforcement and its placement, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete, and other related information.

1.05 SUBMITTALS

A. General:
   1. Submit in accordance with 01330 - Submittal Procedures.
   2. Changes to reinforcement in Contract Documents:
      a. Indicate in a separate letter submitted with shop drawings any changes to reinforcement indicated on the Drawings or specified.
      b. Such changes will not be acceptable unless Engineer has accepted them in writing.

B. Product data:
   1. Bar supports:
      a. Wire bar supports:
         1) Schedule of support materials to be provided and locations of use.
   2. Mechanical reinforcing bar couplers. For each type and/or series to be provided:
      a. Evaluation Report documenting compliance with the requirements of ICC-ES AC133.

b. Details, properties, and dimensions of couplers. Include type or size identification, and bar size(s) and grade(s) for which the coupler is suitable.
c. Manufacturer's installation and testing instructions.
d. Manufacturer's statement that products installed in accordance with manufacturer's recommended procedures will develop strengths and limit slip as specified in this Section.

C. Shop drawings:
1. Reinforcement shop drawings:
a. Submit drawings showing bending and placement of reinforcement required by the Contract Documents.
b. Clearly indicate structures or portions of structures covered by each submittal.
c. Shop drawings shall conform to the recommendations of the CRSI Manual of Standard Practice and ACI SP-66.
d. Use the same bar identification marks on bending detail drawings, placement drawings, and shipping tags.
e. Submittals consisting solely of reinforcing bar schedules, without accompanying placement drawings, will not be accepted unless accepted under prior written agreement with Engineer.
2. Reinforcement placement drawings:
a. Clearly show placement of each bar listed in the bill of materials, including additional reinforcement at corners and openings, and other reinforcement required by details in the Contract Documents.
b. Clearly identify locations of reinforcement with coatings (e.g., galvanized or epoxy) and with yield strength other than ASTM A615, Grade 60.
c. Show splice locations.
d. Indicate locations of mechanical reinforcing couplers if used.
3. Reinforcement fabrication drawings:
a. If bend types or nomenclature differs from that recommended in the CRSI Manual of Standard Practice, provide details showing bend types and dimensional designations.
Clearly identify reinforcement with coatings and with yield strength other than ASTM A615, Grade 60.

D. Samples (when requested by Engineer):
1. Bar supports/wire reinforcement supports: Samples of each type of chair and bolster proposed for use. Submit with letter stating where each type will be used.
2. Precast concrete bar supports: Samples of each type of precast support proposed for use. Submit with letter stating where each will be used.

E. Test reports:
1. Certified copy of mill test for each steel used. Show physical properties and chemical analysis.
a. Mill test reports may be submitted as record documents at the time the reinforcement from that heat of steel is shipped to the site.

b. In such cases, submit certificates under the shop drawing submittal number with the letter "R" (for record date) appended to the end (e.g., if the reinforcement was submitted as 03200-002-1, deliver the associated mill certificate as submittal 03200-002-1R).

2. Mechanical reinforcing bar couplers:
   a. Current Evaluation Report confirming that couplers provide specified tension and compression strength and conform to specified limits on total slip within the coupler.
   b. Certified copy of mill tests for heat(s) of steel incorporated into the reinforcing bar couplers shipped.
   c. For threaded sleeve type couplers, heat treatment lot numbers for each shipment.

F. Manufacturer's instructions:
   1. Mechanical reinforcing bar couplers:
      a. Manufacturer's installation instructions.
      b. Manufacturer's instructions for confirmation testing of couplers after reinforcing bars have been inserted into the couplers.

G. Special procedures:
   1. Welding procedures conforming to AWS D1.4 for reinforcement to be field welded.
      a. Procedures qualification record.

H. Qualifications statements:
   1. Welder qualifications.

I. Closeout documents:
   1. Field quality control and inspection reports.
   2. Field quality assurance special inspection and testing reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
   1. Deliver bars bundled and tagged with identifying tags.

B. Acceptance at site:
   1. Reinforcing bars: Deliver reinforcing bars lacking grade identification marks with letter containing manufacturer's guarantee of grade.

1.07 SEQUENCING AND SCHEDULING

A. Bar supports:
   1. Do not place concrete until samples and product data for bar supports have been accepted by Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing bars:
   1. Provide reinforcement of the grades and quality specified, fabricated from new stock, free from excessive rust or scale, and free from unintended bends or other defects affecting its usefulness.
   2. Reinforcing bars:
      a. ASTM A615 Grade 60 deformed bars, including the following requirements.
         1) Actual yield strength based on mil tests of reinforcement provided shall not exceed the minimum yield strength specified in this Section by more than 18,000 pounds per square inch.
         2) Ratio of actual ultimate tensile strength to actual tensile yield strength shall not be less than 1.25.
   3. Reinforcing bars designated or required to be welded:
      a. Low-alloy, ASTM A706 Grade 60, deformed bars.

B. Bar supports:
   1. Wire supports:
      a. All stainless steel bar supports:
         1) Conforming to CRSI Manual of Standard Practice recommendations for types and details, but custom fabricated entirely from stainless steel wire conforming to ASTM A493, AISI Type 316.
      b. Stainless steel protected bar supports:
         1) Conforming to CRSI Manual of Standard Practice Class 2, Type B, and consisting of bright basic wire support fabricated from cold-drawn carbon steel wire with stainless steel ends attached at the bottom of each leg.
         2) Stainless steel wire ends shall conform to ASTM A493, AISI Type 316 and shall extend at least 3/4 inch inward from the formed surface of the concrete.
      c. Bright basic wire bar supports.
         1) Conforming to CRSI Manual if Standard Practice, Class 3.
   2. Plastic supports:
      a. Manufacturers: The following or equal:
         1) Aztec Concrete Accessories.
   3. Deformed steel reinforcing bar supports:
      a. Fabricated of materials and to CRSI details recommended for typical reinforcement embedded in concrete and bent to dimensions required to provide specified clearances and concrete cover.

C. Tie wires:
   1. General use: Black annealed steel wire, 16 gauge or heavier.

D. Welded wire fabric reinforcement:
   1. Material:
      a. Carbon steel conforming to ASTM A1064.
   2. Provide welded wire reinforcement in flat sheet form. Rolled wire fabric is not permitted.

3. Fabric may be used in place of reinforcing bars if accepted by Engineer:
    a. Provide welded wire fabric having cross-sectional area per linear foot not less than the cross-sectional area per linear foot of reinforcing bars.

E. Mechanical reinforcing bar couplers:
1. General:
    a. Only products conforming to the requirements of ACI 318 for mechanical splices, and holding a current Evaluation Report that documents the following performance characteristics, will be considered for use.
    b. Strength of coupler: Capable of developing tension and compression strength not lower than the lesser of the following:
        1) ACI 318 "Type 2" units: In static tension and compression:
            a) Minimum 125 percent of the ASTM-specified minimum yield strength of the reinforcement being spliced.
            b) Minimum 100 percent of the ASTM-specified minimum ultimate strength of the reinforcement being spliced.
    c. Slip of reinforcing bars within coupler: Total slip of the reinforcing bars within the splice sleeve limited as follows:
        1) For bar sizes #14 and smaller, elongation between gauge points measured clear of the splice sleeve not exceeding 0.010 inch after coupler has been loaded to a tension of 30,000 pounds per square inch and load relaxed to a tension of 3,000 pounds per square inch.
    d. Fabrication:
        1) Threaded joints:
            a) Provide threaded ends designed so that cross-threading of bars will not occur during assembly.
            b) Fabricate male ends for female couplers using coupler manufacturer's bar threading equipment to ensure proper taper and thread engagement.
        2) Mark each sleeve with heat treatment lot number.
2. Couplers: Threaded - Reinforcing bar splice at construction joints.
    a. Steel sleeve butt splice with tapered internal threads in forged or swaged head, and nailing flange for attaching to forms. Provide with matching, tapered male-threaded dowels for insertion and tightening into threaded sleeve after form removal.
        1) Provide sleeve with factory-installed plugs to prevent concrete mortar from entering internally threaded coupler.
        2) Provide optional clipped nailing flanges as required to maintain minimum specified concrete cover over all surfaces of coupler.
    b. Holding current Evaluation Report demonstrating acceptance under ICC ES AC133.
    c. Manufacturers: One of the following or equal:
        1) Dayton Superior, DBDI Splice System.
        2) ERICO-Pentair, Lenton Form Saver.
3. Couplers: Threaded - reinforcing bar splice:
    a. Steel sleeve butt splice with tapered internal threads at each end for joining to matching tapered male threads on reinforcing bars.
    b. Holding current Evaluation Report demonstrating acceptance under ICC ES AC133.
    c. Manufacturers: One of the following, or equal:
        1) Dayton Superior: Taper-Lock System.
        2) ERICO-Pentair: Lenton Taper Threaded Splicing System.

2.02 FABRICATION

A. Shop fabrication and assembly:
   1. Cut and bend bars in accordance with provisions of ACI 318 and the CRSI Manual of Standard Practice.
   2. Bend bars cold. Use bending collars to develop the recommended bend radius.
   3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.
   4. Circumferential and radiused reinforcement: Roll to the radius required for its location in the structure before installation.
   5. Bars to be fitted with mechanical couplers:
      a. Fabricate threaded ends for connections in shop using manufacturer's recommended tools. Field fabrication is not allowed.
      b. Cut ends square.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Reinforcing bars and welded wire reinforcement:
      a. Verify that reinforcement is new stock, free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings that will adversely affect bonding capacity when placed in the Work.
   2. Welded wire fabric:
      a. Verify that sheets are not curled or kinked before or after installation.

3.02 PREPARATION

A. Surface preparation:
   1. Reinforcing bars - uncoated:
      a. Clean reinforcement of concrete, dirt, oil and other coatings that will adversely affect bond before embedding bars in subsequent concrete placements.
      b. Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean bars having rust scale, loose mill scale, or thick rust coat.
      c. Partially embedded reinforcement: Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placements.
   2. Reinforcing bars - coated:
      a. Repair damaged zinc coatings by cleaning and wire brushing damaged areas. Apply repair materials in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Reinforcing bars: General:
   1. Field-cutting of reinforcing bars is not permitted.
   2. Field-bending of reinforcing bars, including straightening and rebending, is not permitted.

B. Placing reinforcing bars:
   1. Accurately place bars to meet position and cover requirements indicated on the Drawings and specified. Secure bars in position.
   2. Tolerances for placement and minimum concrete cover: As listed in Table 1.

Table 1 - Reinforcement Placing Tolerances

Member	Tolerance on Reinforcement Location (1)	Tolerance on Minimum Concrete Cover (1,2)
Slabs, beams, walls and columns except as noted below		
10 inches thick and less	± 3/8 inch	- 3/8 inch
More than 10 inches thick	± 1/2 inch	- 1/2 inch
Formed soffits	As noted above	- 1/4 inch
Longitudinal location of bends and ends of reinforcement		
Conditions not listed below	± 2 inches	- 1/2 inch
At discontinuous ends of brackets and corbels	± 1/2 inch	- 1/4 inch
At discontinuous ends of other members	± 1 inch	- 1/2 inch

Notes:
(1) ± indicates "plus or minus;" - indicates "minus;" + indicates "plus."
(2) Tolerance on cover is limited as noted, but decrease in cover shall not exceed one third of the minimum cover indicated on the Drawings.

   3. Spacing between bars:
      a. Minimum clear spacing between bars in a layer:
         1) As indicated on the Drawings, but not less than the larger of 1.5 times the bar diameter or 1-1/2 inches.
      b. Minimum clear spacing between bars in 2 or more parallel layers:
         1) Place bars in upper layers directly above bars in lower layers.
         2) Minimum spacing between layers: As indicated on the Drawings, but not less than the larger of 1.5 times the bar diameter or 1-1/2 inches.
      c. Limits on minimum clear spacing between bars also applies to the clear spacing between a lap splice and the adjacent bars and/or lap splices.
   4. Lap splices for bars:
      a. Lap splice locations and lap splice lengths: as indicated on the Drawings. Where lap lengths are not indicated, provide in accordance with ACI 318.
      b. Unless otherwise specifically indicated on the Drawings (and noted as "non-contact lap splice"), install bars at lap splices in contact with each other and fasten together with tie wire.
      c. Where bars are to be lap spliced at concrete joints, ensure that bars project from the first concrete placement a length equal to or greater than minimum lap splice length indicated on the Drawings.
      d. Stagger lap splices where indicated on the Drawings.
      e. Where lap splice lengths are not indicated on the Drawings, provide lap splice lengths in accordance with ACI 318.

C. Reinforcing supports:
   1. Provide supports of sufficient numbers, sizes, and locations to maintain concrete cover, to prevent sagging and shifting, and to support loads during construction without displacement and without gouging or indentation into forming surfaces.
      a. Quantities and locations of supports shall not be less than those indicated in ACI SP-66 and the CRSI Manual of Standard Practice.
   2. Do not use brick, concrete masonry units, concrete spalls, rocks, wood, or similar materials for supporting reinforcement.
   3. Do not use "give away bars" that have less cover than that required by the Contract Documents. Do not adjust the location of reinforcement required by the Contract Documents to provide cover for give away bars.
   4. Provide bar supports of height required to maintain the clear concrete cover indicated on the Drawings.
   5. Provide bar supports at formed vertical faces to maintain the clear concrete cover indicated on the Drawings.
   6. Schedule of reinforcement support materials: Provide bar supports as indicated in Table 2.

Table 2 - Reinforcement Support Materials

Case	Location	Material
a.	Concrete placed over earth and concrete seal slabs ("mud mats")	Stainless steel wire supports on stainless steel plates.
b.	Concrete placed against forms and exposed to water or wastewater process liquids (whether or not such concrete received additional linings or coatings)	All stainless steel bar supports.
c.	Concrete placed against forms and exposed to earth, weather, frequent washdown, or groundwater in the finished work	All stainless steel bar supports.
d.	Concrete placed against forms and exposed to interior equipment/piping areas in the finished work	All stainless steel bar supports.
e.	Between mats of reinforcement, and fully embedded within a concrete member	Deformed steel reinforcing bars.

D. Tying of reinforcing:
   1. Fasten reinforcement securely in place with wire ties.
   2. Tie reinforcement at spacings sufficient to prevent shifting.
      a. Provide at least 3 ties in each bar length. (Does not apply to dowel lap splices or to bars shorter than 4 feet, unless necessary for rigidity).
   3. Tie slab bars at every intersection around perimeter of slab.

4. Tie wall bars and slab bar intersections other than around perimeter at not less than every fourth intersection, but at not more than the spacing indicated in Table 3:

Table 3 - Maximum Spacing of Tie Wires for Reinforcement		
Bar Size	**Slab Bar Spacing (Inches)**	**Wall Bar Spacing (Inches)**
Bars Number 5 and Smaller	60	48
Bars Number 6 through Number 9	96	60
Bars Number 10 and Number 11	120	96

5. After tying:
   a. Bend ends of wires inward towards the center of the concrete section. Minimum concrete cover for tie wires shall be the same as cover requirements for reinforcement.
   b. Remove tie wire clippings from inside forms before placing concrete.

E. Welded wire fabric reinforcement:
1. Install only where indicated on the Drawings or accepted in advance by Engineer.
2. Install necessary tie wires, spacing chairs, and supports to keep welded wire fabric at its designated position in the concrete section while concrete is being placed.
3. Straighten welded wire fabric to make sheets flat in the Work.
4. Do not allow wire fabric to drape between supports unless such a configuration is specifically indicated on the Drawings.
   a. If fabric is displaced during placement of concrete, make provisions to restore it to the designated location using methods acceptable to Engineer.
5. Bend welded wire fabric as indicated on the Drawings or required to fit Work.
6. Lap splice welded wire fabric as indicated on the Drawings.
   a. If lap splice length is not indicated, splice in accordance with ACI 318, but not less than 1-1/2 courses of fabric or 8 inches minimum. Tie laps at ends and at not more than 12 inches on center.

F. Welding reinforcing bars:
1. Weld reinforcing bars only where indicated on the Drawings or where acceptance is received from Engineer prior to welding.
2. Perform welding in accordance with AWS D1.4 and welding procedures accepted by Engineer.
   a. Conform to requirements for minimum preheat and interpass temperatures.
3. Submit:
   a. Welding procedures specification.
   b. Procedures qualification record.
   c. Welder qualification test record.
4. Do not tack weld reinforcing bars except where specifically indicated on the Drawings.

G. Reinforcing bar mechanical couplers:
   1. Install only at locations indicated on the Drawings or where prior approval has been obtained from Engineer.
   2. Install in accordance with manufacturer's instructions and requirements of Evaluation Report.
      a. Make splices using manufacturer's standard equipment, jigs, clamps, and other required accessories.
      b. After assembly of the splice, tighten using torque load not less than that recommended by the manufacturer.
   3. Unless greater cover is indicated on the Drawings, provide clear cover from surface of concrete to outside face of couplers that is not less than the minimum concrete cover specified for typical reinforcement.
      a. If cover is less than required, contact Engineer for evaluation of conditions before modifying locations of bars or placing concrete.
      b. Modifications to maintain or provide required concrete cover, such as addition of concrete ; re-positioning of stirrups, ties, etc., may be completed only after approval by Engineer.

3.04 FIELD QUALITY CONTROL

A. Provide quality control for the Work of this Section as specified in Section 01450 - Quality Control.

B. Field inspections and testing:
   1. Submit records of inspections and testing to Engineer in electronic format within 24 hours after completion.

3.05 FIELD QUALITY ASSURANCE

A. Provide quality assurance as specified in Section 01450 - Quality Control.

B. Special inspections and tests:
   1. Provide as specified in Section 01455 - Special Tests and Inspections.
   2. Frequency of inspections:
      a. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the Building Code specified in Section 01410 - Regulatory Requirements.
   3. Preparation:
      a. Review Drawings and Specification for the Work to be observed.
      b. Review approved submittal sand shop drawings.
   4. Inspections: Special inspection shall include, but is not limited to, the following items.
      a. Reinforcement: General:
         1) Type (material) and location of reinforcement supports.
         2) Bar material/steel grade and bar size.
         3) Location, placement, and spacing of bars.
         4) Clear concrete cover over reinforcement.
         5) Lap splice: Location and lap length. Bars within tolerances for contact (unless non-contact splice is indicated on the Drawings.)
         6) Bar hooks and development lengths embedded within concrete sections as indicated on the Drawings.

7) Reinforcement tired in position and tie wire legs turned inward toward the center of the concrete section.

b. Reinforcement: Welding:
   1) Inspector qualification and inspections shall be in accordance with the requirements of AWS D1.4.
   2) Provide periodic inspection for:
      a) Weldability of reinforcement other than ASTM A706.
      b) Single pass fillet welds with thickness less than or equal to 5/16 inch.
   3) Provide continuous inspection for:
      a) Other welds.
      b) Welds at mechanical reinforcing bar couplers and end anchors.
   4) In addition to visual inspection, Owner may inspect reinforcing bar welds by other methods, including radiographic inspection.

5. Mechanical reinforcing bar couplers:
   a. Special inspection shall include, but is not limited to, the following items:
      1) Coupler model and identification.
      2) Couplers are installed in accordance with the requirements of the Engineering Report for each product.
      3) Confirmation of the following:
         a) Grade and size of reinforcing bars.
         b) Positon of couplers.
         c) Insertion length of reinforcement.
         d) Tightening of bars in the couplers.
6. Records of inspections:
   a. Provide a written record of each inspection using forms acceptable to the Engineer and to the Building Official.
   b. Submit electronic copies of inspection reports to Engineer within 24 hours after completion of inspections.

3.06 NON-CONFORMING WORK

A. Before placing concrete, adjust or remove and re-install reinforcement to conform to the requirements of the Contract Documents.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Cast-in-place concrete.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 305 - Hot Weather Concreting Standard.
   2. 306 - Cold Weather Concreting Standard.
   3. 318 - Building Code Requirements for Structural Concrete and Commentary.
   4. 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
   5. Manual of Concrete Practice.

B. ASTM International (ASTM):
   1. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   2. C33 - Standard Specification for Concrete Aggregates.
   3. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   4. C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
   5. C42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   6. C88 - Standard Test Method of Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
   7. C94 - Standard Specification for Ready-Mixed Concrete.
   8. C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement.
   9. C117 - Standard Test Method for Materials Finer that 75-m (No. 200) Sieve in Mineral Aggregates by Washing.
   10. C123 - Standard Test Method for Lightweight Particles in Aggregate.
   11. C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   12. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   13. C142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregate.
   14. C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
   15. C150 - Standard Specification for Portland Cement.
   16. C156 - Standard Test Method for Water Loss from a Mortar Specimen Through Liquid Membrane-Forming Curing Compounds for Concrete.
   17. C157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
   18. C171 - Standard Specifications for Sheet Materials for Curing Concrete.
   19. C172 - Standard Practice for Sampling Freshly Mixed Concrete.

20. C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
21. C227 - Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
22. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
23. C295 - Standard Guide to Petrographic Examination of Aggregates for Concrete.
24. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
26. C469 - Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression.
27. C494 - Standard Specification for Chemical Admixtures for Concrete.
28. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
29. C856 - Standard Practice for Petrographic Examination of Hardened Concrete.
30. C1260 - Standard Test Method of Potential Alkali Reactivity of Aggregates (Mortar Bar Method).
31. C1293 - Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
32. D75 - Standard Practice for Sampling Aggregates.
33. D2103 - Standard Specification for Polyethylene Film and Sheeting.

C. NSF International (NSF):
1. 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

A. Alkali: Sum of sodium oxide and potassium oxide calculated as sodium oxide.

B. Cementitious materials: Portland cement and fly ash.

C. Cold weather: A period when for more than 3 consecutive days, the average daily outdoor temperature drops below 40 degrees Fahrenheit. The average daily temperature is the average of the highest and lowest temperatures during the period from midnight to midnight. When temperatures above 50 degrees Fahrenheit occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.

D. Cold weather concreting: Operations for placing, finishing, curing, and protection of concrete during cold weather.

E. Green concrete: Concrete with less than 100 percent of the specified strength.

F. Hairline crack: Crack with a crack width of less than 4 thousandths of an inch.

G. Hot weather: A period when project conditions such as low humidity, high temperature, solar radiation, and high winds, promote rapid drying of freshly placed concrete.

H. Hot weather concreting: Operations for placing, finishing, curing, and protection of concrete during hot weather.

1.04 SYSTEM DESCRIPTION

A. Performance requirements:
   1. General:
      a. Except as otherwise specified, provide concrete composed of portland cement, fly ash, fine aggregate, coarse aggregate, admixtures and water so proportioned and mixed as to produce plastic, workable mixture in accordance with requirements as specified in this Section and suitable to specific conditions of placement.
      b. Proportion materials in a manner that will secure lowest water-cementitious materials ratio that is consistent with good workability, plastic and cohesive mixture, and a mixture that is within specified slump range.
      c. Proportion fine and coarse aggregates in manner such as not to produce harshness in placing or honeycombing.
   2. It is the intent of this Section to secure for every part of the Work concrete with homogeneous mixture, which when hardened will have required strength, watertightness, and durability:
      a. It is recognized that some surface hairline cracks and crazing will develop in the concrete surfaces.
      b. Construction and expansion joints have been specified and positioned in structures as indicated on the Drawings, and curing methods specified, for purpose of reducing number and size of cracks, due to normal expansion and contraction expected from specified concrete mixes.
      c. Repair cracks which develop in walls or slabs and repair cracks which show any signs of leakage until all leakage is stopped.
      d. Pressure inject visible cracks, other than hairline cracks and crazing, in following areas with epoxy as specified in Section 03931 - Epoxy Injection System:
         1) Floors and walls of water bearing structures.
         2) Walls and overhead slabs of passageways or occupied spaces, outsides of which are exposed to weather or may be washed down and are not specified to receive separate waterproof membrane.
         3) Other items not specified to receive separate waterproof membrane: Slabs over water channels, wet wells, reservoirs, and other similar surfaces.
      e. Walls or slabs, as specified above, that leak or sweat because of porosity or cracks too small for successful pressure injection with epoxy: Seal on water or weather side by coatings of surface sealant system, as specified in this Section.
      f. Pressure injection and sealing: Continue as specified above until structure is watertight and remains watertight for not less than 1 year after final acceptance or date of final repair, whichever occurs later in time.
   3. Workmanship and methods: Provide concrete work, including detailing of reinforcing, conforming with best standard practices and as set forth in ACI 318, ACI 350, Manual of Concrete Practices, and recommended practices.

1.05 SUBMITTALS

A. Cement mill tests:
   1. Include alkali content representative of each shipment of cement for verification of compliance with specified requirements.

2. Provide mill test reports dated not more than 90 days before the date of submittal.

B. Cold weather concreting:
   1. Procedures for the production, transportation, placement, protection, curing, and temperature monitoring for concrete during cold weather.
   2. Procedures to be implemented upon abrupt changes in weather conditions or equipment failures.

C. Concrete mixes: Full details, including mix design calculations for concrete mixes proposed for use for each class of concrete:
   1. Include information on correction of batching for varying moisture contents of fine aggregate.
   2. Source quality test records with mix design submittal:
      a. Include calculations for required compressive strength (f'_{cr}) based on source quality test records.

D. Concrete aggregate tests: Certified copies in triplicate of commercial laboratory tests not more than 90 days old of all samples of concrete aggregates:
   1. Coarse aggregate:
      a. Abrasion loss.
      b. Clay lumps and friable particles.
      c. Coal and lignite.
      d. Materials finer than 200 sieve.
      e. Reactivity.
      f. Shale and chert.
      g. Soundness.
   2. Fine aggregate:
      a. Clay lumps.
      b. Color.
      c. Decantation.
      d. Reactivity.
      e. Shale and chert.
      f. Soundness.

E. Drying shrinkage test data.

F. Fine or coarse aggregate batched from more than 1 bin: Analyses for each bin, and composite analysis made up from these, using proportions of materials to be used in mix.

G. Fly ash Certificate of Compliance: Identify source of fly ash and certify compliance in accordance with ASTM C618.

H. For conditions that promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind: Corrective measures for use prior to placing concrete.

I. Hot weather concreting: Procedures for production, placement, finishing, curing, protection, and temperature monitoring for concrete during hot weather and appropriate corrective measures.

J. Heating equipment for cold weather concreting: Information on type of equipment used for heating materials and new concrete in process of curing during excessively cold weather.

K. Information on mixing equipment.

L. Product data: Submit data completely describing products.

M. Sequence of concrete placing: Submit proposed sequence of placing concrete showing proposed beginning and ending of individual placements.

N. Sieve analysis: Submit sieve analyses of fine and coarse aggregates being used in triplicate at least every 3 weeks and at any time there is significant change in grading of materials.

O. Trial batch test data:
   1. Submit data for each test cylinder.
   2. Submit data that identifies mix and slump for each test cylinder.

P. Weather monitoring: Records of:
   1. Relative humidity.
   2. Site ambient temperature.
   3. Wind speed.

Q. Temperature of freshly placed concrete.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
   1. Deliver, store, and handle concrete materials in manner that prevents damage and inclusion of foreign substances.
   2. Deliver and store packaged materials in original containers until ready for use.
   3. Deliver aggregate to mixing site and handle in such manner that variations in moisture content will not interfere with steady production of concrete of specified degree of uniformity and slump.

B. Acceptance at site: Reject material containers or materials showing evidence of water or other damage.

1.07 PROJECT CONDITIONS

A. Environmental requirements:
   1. Monitoring weather conditions:
      a. Install an outdoor weather station capable of measuring and recording ambient temperature, wind speed, and humidity. Furnish instruments accurate to within 2 degrees Fahrenheit, 5 percent relative humidity, and 1 mile per hour wind speed.
      b. Measure and record temperature of fresh concrete. Furnish and use sufficient number of maximum and minimum self-recording thermometers to adequately measure temperature of concrete.

c. Monitor and keep records of the weather forecast starting at least 48 hours prior to placing concrete in order to allow enough time for taking appropriate measures pertaining to Hot or Cold weather concreting.

2. Hot weather concreting:
   a. Initiate evaporation control measures when concrete and air temperatures, relative humidity of the air, and the wind velocity have the capacity to evaporate water from a free surface at a rate that is equal to or greater than 0.2 pound per square feet per hour. Determine evaporation rate using the Menzel Formula and monograph in ACI 305 3.1.3.
   b. When ambient air temperature is above 85 degrees Fahrenheit: Prior to placing concrete, cool forms and reinforcing steel by water cooling to below 90 degrees Fahrenheit.
   c. Monitor weather conditions at the site including air temperature, humidity, and wind speed, to assess the need for evaporation control measures begin monitoring site conditions no later than 1 hour before the start of concrete placement. Continue to monitor site conditions at intervals of 30 minutes until concrete curing has begun.
   d. Temperature of concrete mix at time of placement: Keep temperature below 90 degrees Fahrenheit by methods which do not impair quality of concrete.
   e. For conditions that promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind: Take corrective measures to minimize rapid water loss from concrete:
   f. Furnish and use sufficient number of maximum and minimum self-recording thermometers to adequately measure temperature around concrete.
3. Cold weather concreting:
   a. Concrete placed below ambient air temperature of 45 degrees Fahrenheit and falling or below 40 degrees Fahrenheit:
      1) Make provision for heating water.
   b. Follow recommendations of ACI 306 for preparation, placement, and protection of concrete during cold weather.
   c. If materials have been exposed to freezing temperatures to degree that any material is below 35 degrees Fahrenheit: Heat such materials.
   d. Heating water, cement, or aggregate materials:
      1) Do not heat in excess of 160 degrees Fahrenheit.
   e. Protection of concrete in forms:
      1) Do not remove forms from concrete when outside ambient air temperature is below 50 degrees Fahrenheit until concrete has attained its minimum specified compressive strength. Evidence of strength shall be based on by testing of cylinders stored in the field under equivalent conditions to those at the concrete structure.
      2) Protect by means of covering with tarpaulins, or other acceptable covering acceptable to Engineer.
      3) Provide means for circulating warm moist air around forms in manner to maintain temperature of 50 degrees Fahrenheit for at least 5 days.

1.08 SEQUENCING AND SCHEDULING

A. Schedule placing of concrete in such manner as to complete any single placing operation to construction, or expansion joint.

PART 2 PRODUCTS

2.01 MATERIALS

A. Admixtures:
   1. General:
      a. Do not use admixtures of any type, except as specified, unless written acceptance has been obtained from the Engineer.
      b. Admixtures shall be compatible with concrete and other admixtures. Admixtures other than pozzolans shall be the products of a single manufacture to ensure compatibility.
      c. Do not use admixtures containing chlorides calculated as chloride ion in excess of 0.5 percent by weight of cement.
      d. Use in accordance with manufacturer's recommendations. Add each admixture to concrete mix separately.
   2. Air entraining admixture:
      a. Provide concrete with 5 percent, within 1 percent, entrained air of evenly dispersed air bubbles at time of placement.
      b. In accordance with ASTM C260.
   3. Water reducing admixture:
      a. May be used at the Contractor's option.
      b. In accordance with ASTM C494, Type A or Type D.
      c. Not contain air-entraining agents.
      d. Liquid form before adding to the concrete mix.
      e. No decrease in cement is permitted as result of use of water reducing admixture.
   4. Super-plasticizers: Are not to be used without acceptance by Engineer.

B. Aggregate:
   1. General:
      a. Provide concrete aggregates that are sound, uniformly graded, and free of deleterious material in excess of allowable amounts specified.
      b. Grade aggregate in accordance with ASTM C136 and D75.
      c. Provide unit weight of fine and coarse aggregate that produces in place concrete with weight of not less than 140 pounds per cubic foot.
      d. Do not use aggregate made from recycled materials such as crushed and screened hydraulic-cement concrete, brick, and other construction materials.
   2. Fine aggregate:
      a. Provide fine aggregate for concrete or mortar consisting of clean, natural sand or of sand prepared from crushed stone or crushed gravel.

b. Do not provide aggregate having deleterious substances in excess of following percentages by weight of contaminating substances.
   1) In no case shall total exceed percent listed.

Item	Test Method	Percent
Removed by decantation (dirt, silt, etc.)	ASTM C117	3
Shale or Chert	ASTM C123 ASTM C295*	1 1
Clay Lumps	ASTM C142	1

* Test Method C123 is used to identify particles in the sample lighter than 2.40 Specific Gravity. Test Method C295 is used to identify which of the lightweight particles are shale or chert. If the results of Test Method C123 are less than 1 percent, Test Method C295 is not required.

c. Except as otherwise specified, grade fine aggregate from coarse to fine in accordance with ASTM C33.
d. In accordance with NSF 61.

3. Coarse aggregate:
   a. Provide coarse aggregate consisting of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances.
   b. Not exceeding 15 percent by weight, of thin or elongated pieces having length greater than 5 times average thickness.
   c. In accordance with NSF 61.
   d. Deleterious substances: Not in excess of following percentages by weight, and in no case having total of all deleterious substances exceeding 2 percent.

Item	Test Method	Percent
Shale or chert	ASTM C123 ASTM C295*	1.25 1
Coal and lignite	ASTM C123	1/4
Clay lumps and friable particles	ASTM C142	1/4
Materials finer than Number 200 sieve	ASTM C117	1/2**

* Test Method C123 is used to identify particles in the sample lighter than 2.40 Specific Gravity. Test Method C295 is used to identify which of the lightweight particles are shale, chert, coal, or lignite. If the results of Test Method C123 are less than 1.25 percent (the minimum combined percentage of shale, chert, coal and lignite), Test Method C295 is not required.

** Except when material finer than Number 200 sieve consists of crusher dust, maximum amount shall be 1 percent.

e. Grading:
   1) Aggregate for Class A, B, C, and D concrete: In accordance with ASTM C33, Size Number 57, except as otherwise specified or authorized in writing by the Engineer.

2) Aggregate for Class CE concrete for encasement of electrical conduits:
a) Graded in accordance with ASTM C33, Size Number 8.

C. Concrete sealer:
1. Manufacturers: One of the following or equal:
a. Euclid Chemical Co., Diamond Hard.
b. L&M Construction Chemicals, SealHard.

D. Conduit encasement coloring agent:
1. Color: Red color concrete used for encasement of electrical ducts, conduits, and similar type items.
2. Manufacturers: One of the following or equal:
a. Davis Co., #160 Brick Red.
b. Euclid Chemical Co., Increte Division, "Colorcrete Brick Red."
3. Conduit encasement concrete: Mix into each cubic yard of concrete 10 pounds of coloring agent.

E. Evaporation retardant:
1. Manufacturers: One of the following or equal:
a. BASF, MasterKure ER 50.
b. Euclid Chemical Co., Eucobar.

F. Fly ash:
1. Fly ash in accordance with ASTM C618, Class F, may be used in concrete made with Type II portland cement.
2. Maximum of 15 percent by weight of fly ash to total weight of cementitious materials.
a. The total weight of cementitious materials shall not be less than minimum cementitious materials listed in Table A.
3. Do not use in concrete made with portland-pozzolan cement.
4. Loss on ignition: Not exceed 4 percent.
5. In accordance with NSF 61.

G. Keyway material: Steel, plastic, or lumber.

H. Nonslip abrasive:
1. Aluminum oxide abrasive size 8/16, having structure of hard aggregate that is, homogenous, nonglazing, rustproof, and unaffected by freezing, moisture, or cleaning compounds.
2. Manufacturers: One of the following or equal:
a. Abrasive Materials, Inc.
b. Euclid Chemical Co., Flexolith Summer Grade.

I. Portland cement:
1. Conform to specifications and tests in accordance with ASTM C150, Types II or III, low alkali, except as specified otherwise.
2. Have total alkali containing not more than 0.60 percent.
3. Exposed concrete in any individual structure: Use only one brand of portland cement.
4. Cement for finishes or repairs: Provide cement from same source and of same type as concrete to be finished or repaired.
5. In accordance with NSF 61.

J. Sheet membrane for curing:
   1. Polyethylene film:
      a. In accordance with ASTM C171.
      b. Color: White.
      c. Thickness: Nominal thickness of polyethylene film shall not be less than 0.0040 inch when measured in accordance with ASTM D2103. Thickness of polyethylene film at any point shall not be less than 0.0030 inch.
      d. Loss of moisture: Not exceed 0.055 gram per square centimeter of surface when tested in accordance with ASTM C156.

K. Sprayed membrane curing compound: Clear type with fugitive dye in accordance with ASTM C309, Type 1D.

L. Surface sealant system:
   1. In accordance with NSF-61.
   2. Manufacturers: One of the following or equal:
      a. Euclid Chemical Co., Vandex Super.
      b. Kryton International, Inc., Krystol T1.
      c. Xypex Chemical Corp., Xypex Concentrate.

M. Water:
   1. Water for concrete, washing aggregate, and curing concrete: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.
   2. Chlorides and sulfate ions:
      a. Water for conventional reinforced concrete: Use water containing not more than 1,000 milligrams per liter of chlorides calculated as chloride ion, nor more than 1,000 milligrams per liter of sulfates calculated as sulfate ion.
      b. Water for prestressed or post-tensioned concrete: Use water containing not more than 650 milligrams per liter of chlorides calculated as chloride ion, or more than 800 milligrams per liter of sulfates calculated as sulfate ion.

2.02 EQUIPMENT

A. Mixing concrete:
   1. Mixers may be of stationary plant, paver, or truck mixer type.
   2. Provide adequate equipment and facilities for accurate measurement and control of materials and for readily changing proportions of material.
   3. Mixing equipment:
      a. Capable of combining aggregates, cementitious materials, and water within specified time into thoroughly mixed and uniform mass and discharging mixture without segregation.
      b. Maintain concrete mixing plant and equipment in good working order and operated at loads, speeds, and timing recommended by manufacturer or as specified.
      c. Proportion cementitious materials and aggregate by weight.

B. Machine mixing:
   1. Batch plant shall be capable of controlling delivery of all material to mixer within 1 percent by weight of individual material.

2. If bulk cementitious materials are used, weigh them on separate visible scale which will accurately register scale load at any stage of weighing operation from zero to full capacity.
3. Prevent cementitious materials from coming into contact with aggregate or with water until materials are in mixer ready for complete mixing with all mixing water.
4. Procedure of mixing cementitious materials with sand or with sand and coarse aggregate for delivery to project site, for final mixing and addition of mixing water will not be permitted.
5. Retempering of concrete will not be permitted.
6. Discharge entire batch before recharging.
7. Volume of mixed material per batch: Not exceed manufacturer's rated capacity of mixer.
8. Mixers:
    a. Perform mixing in batch mixers of acceptable type.
    b. Equip each mixer with device for accurately measuring and indicating quantity of water entering concrete, and operating mechanism such that leakage will not occur when valves are closed.
    c. Equip each mixer with device for automatically measuring, indicating, and controlling time required for mixing:
        1) Interlock device to prevent discharge of concrete from mixer before expiration of mixing period.

C. Transit-mixed concrete:
1. Mix and deliver in accordance with ASTM C94.
2. Total elapsed time between addition of water at batch plant and discharging completed mix:
    a. Not to exceed 90 minutes.
    b. Elapsed time at project site shall not exceed 30 minutes.
3. Under conditions contributing to quick setting, total elapsed time permitted may be reduced by the Engineer.
4. Equip each truck mixer with device interlocked to prevent discharge of concrete from drum before required number of turns and furnish device that is capable of counting number of revolutions of drum.
5. Continuously revolve drum after it is once started until it has completely discharged its batch:
    a. Do not add water until drum has started revolving.
    b. Right is reserved to increase required minimum number of revolutions or to decrease designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing. The Contractor will not be entitled to additional compensation because of such increase or decrease.

D. Other types of mixers: In case of other types of mixers, mixing shall be as follows:
1. Mix concrete until there is uniform distribution of materials, and discharge mixer completely before recharging.
2. Neither speed nor volume loading of mixer shall exceed manufacturer's recommendations.
3. Continue mixing for minimum of 1-1/2 minutes after all materials are in drum, and for batches larger than 1 cubic yard increase minimum mixing time 15 seconds for each additional cubic yard or fraction thereof.

2.03 MIXES

A. Measurements of materials:
   1. Measure materials by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the Engineer.
   2. Furnish apparatus for weighing aggregates and cementitious materials that is suitably designed and constructed for this purpose.
   3. Accuracy of weighing devices: Furnish devices that have capability of providing successive quantities of individual material that can be measured to within 1 percent of desired amount of that material.
   4. Measuring or weighing devices: Subject to review by the Engineer. Shall bear valid seal of the Sealer of Weights and Measures having jurisdiction.
   5. Weighing cementitious materials:
      a. Weigh cementitious materials separately.
      b. Cement in unbroken standard packages (sacks): Need not be weighed.
      c. Weigh bulk cementitious materials and fractional packages.
   6. Measure mixing water by volume or by weight.

B. Concrete proportions and consistency:
   1. Provide concrete that can be worked readily into corners and angles of forms and around reinforcement without excessive vibration and without permitting materials to segregate or free water to collect on surface.
   2. Prevent unnecessary or haphazard changes in consistency of concrete.
   3. Ratio of coarse aggregate to fine aggregate: Not less than 1.0 or more than 2.0 for all concrete Classes, with exception of Class CE.
   4. Aggregate:
      a. Obtain aggregate from source that is capable of providing uniform quality, moisture content, and grading during any single day's operation.
   5. Maximum concrete mix water to cementitious materials ratio, minimum cementitious materials content, and slump range: Conform to values specified in Table A in this Section.
   6. Concrete batch weights: Control and adjust to secure maximum yield. At all times, maintain proportions of concrete mix within specified limits.
   7. Mix modification: If required, by the Engineer, modify mixture within limits set forth in this Section.

C. Concrete mixes:
   1. Proportioning of concrete mix: Proportion mixes based on required compressive strength f'_{cr}.
   2. Mixes:
      a. Adjusting of water: After acceptance, do not change mixes without acceptance by Engineer, except that at all times adjust batching of water to compensate for free moisture content of fine aggregate.
      b. Total water content of each concrete class: Not exceed those specified in Table A in this Section.
      c. Checking moisture content of fine aggregate: Furnish satisfactory means at batching plant for checking moisture content of fine aggregate.
   3. Change in mixes: Submit new mix design and perform new trial batch and test program as specified in this Section.

D. Hand mixed concrete:
   1. Hand mix concrete only when acceptable to the Engineer.
   2. Prepare hand mixed concrete on watertight, level platform in batches not to exceed 1/3 cubic yard each.
   3. Aggregate:
      a. First, spread required amount of coarse aggregate on platform in an even and uniform layer:
         1) Then over coarse aggregate, spread proper proportion of fine aggregate.
      b. Depth of combined coarse and fine aggregate layers: Not be greater than 1 foot.
   4. Cementitious materials:
      a. First, evenly spread required quantity of cementitious materials over fine aggregate.
      b. Then turn entire batch with shovels at least 2 times before adding water.
   5. Water:
      a. Then uniformly sprinkle or spray proper amount of water over batched materials.
      b. Then turn with shovels not less than 3 times before concrete is removed from platform.

E. Classes of concrete:
   1. Provide concrete consisting of 5 classes: Classes A, B, C, D, and CE. Use where specified or indicated on the Drawings.
   2. Weight of concrete classes: Provide classes of concrete having minimum weight of 140 pounds per cubic foot.
   3. Class B concrete: Class B concrete may be substituted for Class A concrete, when high-early strength concrete is needed in areas specifically accepted by the Engineer and that do not require sulfate resistant concrete.
   4. Class C concrete: Class C concrete may be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and where indicated on the Drawings.
   5. Class D concrete: Use Class D for precast concrete items.
   6. Class CE concrete: Use Class CE for electrical conduit encasements.
   7. All other concrete, unless specified or otherwise indicated on the Drawings: Use Class A concrete.

TABLE A1: CONCRETE

Class	Minimum Specified Compressive Strength f'_c at 28 Days (Pounds per Square Inch)	Water-to-Cementitious Materials Ratio	Cementitious Materials per Cubic Yard of Concrete by Weight (Pounds)	Slump Range (Inches)
A	4,000	0.40 to 0.45	564 to 658	2 to 4
B (Type III cement)	4,000	0.40 to 0.45	564 to 658	2 to 4
C	2,500	Maximum 0.62	Minimum 423	3 to 6
CE	2,500	Maximum 0.62	Minimum 423	3 to 6
D	5,000	0.40 to 0.45	564 to 658	2 to 4

8. Pumped concrete: Provide pumped concrete that complies with all requirements of this Section.
9. Do not place concrete with slump outside limits indicated in Table A.
10. Classes:
    a. Classes A, C, D, and CE concrete: Make with Type II low alkali portland cement.
    b. Class B concrete: Make with Type III low alkali portland cement.
    c. Admixtures: Provide admixtures as specified in this Section.

F. Air entraining admixture:
1. Add agent to batch in portion of mixing water.
2. Batch solution by means of mechanical batcher capable of accurate measurement.

2.04 SOURCE QUALITY CONTROL

A. Tests:
1. Trial batches:
    a. After concrete mix designs have been accepted by Engineer, have trial batches of the accepted Class A, Class B, and Class D concrete mix designs prepared by testing laboratory acceptable to the Engineer.
    b. Prepare trial batches using cementitious materials and aggregates proposed to be used for the Work.
    c. Prepare trial batches with sufficient quantity to determine slump, workability, consistency, setting time, and finishing characteristics, and to provide sufficient test cylinders.
    d. Test cylinders: Provide cylinders having 6-inch diameter by 12-inch length and that are prepared in accordance with ASTM C31 for tests specified in this Section.
    e. Determine slump in accordance with ASTM C143.
    f. Test cylinders from trial batch:
        1) Test 8 cylinders for compressive strength in accordance with ASTM C39:
            a) Test 4 cylinders at 7 days and 4 at 28 days.
            b) Establish ratio between 7 day and 28-day strength for mix. 7-day strength may be taken as satisfactory indication of 28-day strength provided effects on concrete of temperature and humidity between 7 day and 28 day are taken into account.
        2) Average compressive strength of 4 test cylinders tested at 28 days: Equal to or greater than required average compressive strength (f'_{cr}) on which concrete mix design is based.
    g. Perform test batches and tests required to establish trial batches and acceptability of materials without change in Contract Price.
    h. Do not place concrete until the concrete mix design and trial batch have been accepted by Engineer.
2. Required average compressive strength:
    a. Determine required average compressive strength (f'_{cr}) for selection of concrete proportions for mix design, for each class of concrete, using calculated standard deviation for its corresponding specified compressive strength ($f'_{c,}$) in accordance with ACI 318 and ACI 350.

b. When test records of at least 30 consecutive tests that span period of not less than 45 calendar days are available, establish standard deviation as in accordance with ACI 318 and ACI 350 and as modified in this Section.
c. Provide test records from which to calculate standard deviation that represent materials, quality control procedures, and conditions similar to materials, quality control procedures, and conditions expected to apply in preparation of concrete for the Work.
d. Provide test records with materials and proportions that are more restricted than those for the Work.
e. Specified compressive strength (f'_c) of concrete used in test records: Within 1,000 pounds per square inch of that specified for the Work.
f. When lacking adequate test records for calculation of standard deviation meeting requirements, determine required average compressive strength f'_{cr} from following Table B.

TABLE B
REQUIRED AVERAGE COMPRESSION STRENGTH

Specified Compressive Strength f'_c (pounds per square inch)	**Required Average Compressive Strength f'_{cr} (pounds per square inch)**
Less than 3,000	$f'_c + 1,000$
3,000 to 5,000	$f'_c + 1,200$
Over 5,000	$1.10f'_c + 700$

3. Aggregate:
   a. Testing of concrete aggregate is at Contractor's expense.
   b. Provide test reports representing samples of materials taken and tested at the following times:
      1) Not more than 60 days prior to the date on the proposed materials for concrete mixes.
      2) Not more than 60 days prior to any change in the source of aggregates, including suppliers and/or quarries.
      3) Whenever there is a significant change in aggregate quality or gradation from a previously submitted and accepted source.
   c. Sample aggregate in accordance with ASTM D75.
   d. Fine and coarse aggregates:
      1) Gradation: Test in accordance with ASTM C136. Use sieves with square openings for testing grading of aggregates.
      2) Alkali-silica reactivity:
         a) Provide fine and coarse aggregate with expansion not greater than 0.10 percent at 14 days when tested in accordance with ASTM C1260, unless the aggregate has been determined to be not deleteriously reactive based on testing in accordance with one of the following:
            (1) ASTM C227: Expansion not greater than 0.05 percent and 3 months, and not greater than 0.10 percent at 6 months.
            (2) ASTM C1293: Expansion not greater than 0.04 percent at 1 year.
   e. Fine aggregate:
      1) Provide fine aggregate that does not contain strong alkali nor organic matter which gives color darker than standard color when tested in accordance with ASTM C40.

2) Provide aggregate having soundness in accordance with ASTM C33 when tested in accordance with ASTM C88.

f. Coarse aggregate:
   1) Soundness when tested in accordance with ASTM C88: Have loss not greater than 10 percent when tested with sodium sulfate.
   2) Abrasion Loss: Not exceed 45 percent after 500 revolutions when tested in accordance with ASTM C131.

g. Fly ash:
   1) Sampling and testing: Sample and test fly ash in accordance with ASTM C311.

h. Portland cement:
   1) Determination of alkali content: In accordance with ASTM C114.

PART 3 EXECUTION

3.01 INSTALLATION

A. Liquid evaporation retardant:
   1. Under conditions that result in rapid evaporation of moisture from the surface of the concrete, immediately after the concrete has been screeded, coat the surface of the concrete with a liquid evaporation retardant.
   2. Apply the evaporation retardant again after each work operation as necessary to prevent drying shrinkage cracks.
   3. Conditions which result in rapid evaporation of moisture may include one or more of the following:
      a. Low humidity.
      b. Windy conditions.
      c. High temperature.

B. Surface sealant system:
   1. Apply as recommended by manufacturer published instructions.
   2. Where concrete continues to sweat or leak, apply additional coats of surface sealant until the sweating or leaks stop.

C. Joints and bonding:
   1. As far as practicable construct concrete work as monolith.
   2. Locations of construction, expansion, and other joints are indicated on the Drawings or as specified in this Section.
   3. Time between placement of adjacent concrete separated by joints:
      a. Provide not less than 3 days (72 hours) between placement of adjacent sections for the following:
         1) Slabs.
         2) Walls.
      b. Provide not less than 7 days (168 hours) between placement of upper and lower pours for the following:
         1) Walls over slabs.
         2) Slabs over walls.
         3) Slabs keyed into the sides of walls.

4. Construction joints:
    a. Where construction joints are not indicated on the Drawings, provide construction joints in slabs and walls at intervals not greater than 35 feet.
    b. In order to preserve strength and watertightness of structures, make no other joints, except as authorized the Engineer.
    c. At construction joints, thoroughly clean concrete of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter by means of heavy sandblasting.
    d. Cleaning of construction joints:
        1) Wash construction joints free of sawdust, chips, and other debris after forms are built and immediately before concrete or grout placement.
        2) Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, use vacuum cleaner for their removal, after which flush cleaned surfaces with water.
        3) Provide cleanout hole at base of each wall and column for inspection and cleaning.
    e. At horizontal joints: As initial placement over cold joints, thoroughly spread bed of cement grout as specified in Section 03600 - Grouting with a thickness of not less than 1/2 inch nor more than 1 inch.
5. Keyways in joints:
    a. Provide keyways in joints unless specifically noted otherwise on the Drawings.
    b. Treat lumber keyway material with form release coating, applied in accordance with manufacturer's instructions.
6. Take special care to ensure that concrete is well consolidated around and against waterstops and waterstops are secured in proper position.
7. Construction and expansion Joints:
    a. Constructed where and as indicated on the Drawings.
    b. Waterstops, expansion joint material, synthetic rubber sealing compound, and other similar materials: As specified in Sections 03150 - Concrete Accessories and 07900 - Joint Sealants.
8. Repair of concrete: Where it is necessary to repair concrete by bonding mortar or new concrete to concrete which has reached its initial set, first coat surface of set concrete with epoxy bonding agent as specified in Section 03071 - Epoxies.

D. Conveying and placing concrete:
1. Convey concrete from mixer to place of final deposit by methods that prevent separation or loss of materials.
2. Use equipment for chuting, pumping, and conveying concrete of such size and design as to ensure practically continuous flow of concrete at delivery end without segregation of materials.
3. Design and use chutes and devices for conveying and depositing concrete that direct concrete vertically downward when discharged from chute or conveying device.
4. Keep equipment for conveying concrete thoroughly clean by washing and scraping upon completion of day's placement.

E. Placing concrete:
1. Place no concrete without prior authorization of the Engineer.

2. Do not place concrete until:
    a. Reinforcement is secure and properly fastened in its correct position and loose form ties at construction joints have been retightened.
    b. Dowels, bucks, sleeves, hangers, pipes, conduits, anchor bolts, and any other fixtures required to be embedded in concrete have been placed and adequately anchored.
    c. Forms have been cleaned and oiled as specified.
3. Do not place concrete in which initial set has occurred, or that has been retempered.
4. Do not place concrete during rainstorms or high velocity winds.
5. Protect concrete placed immediately before rain to prevent water from coming in contact with such concrete or winds causing excessive drying.
6. Keep sufficient protective covering on hand at all times for protection of concrete.
7. After acceptance, adhere to proposed sequence of placing concrete, except when specific changes are requested and accepted by the Engineer.
8. Notify the Engineer in writing of readiness, not just intention, to place concrete in any portion of the work:
    a. Provide this notification in such time in advance of operations, as the Engineer deems necessary to make final inspection of preparations at location of proposed concrete placing.
    b. Place forms, reinforcement, screeds, anchors, ties, and inserts in place before notification of readiness is given to the Engineer.
    c. Depositing concrete:
        1) Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing.
        2) Do not deposit concrete in large quantities in one place and work along forms with vibrator or by other methods.
        3) Do not drop concrete freely into place from height greater than 5 feet.
        4) Use tremies for placing concrete where drop is over 5 feet.
        5) Commence placement of concrete on slopes, starting at bottom of slope.
9. Place concrete in approximately horizontal layers not to exceed 24 inches in depth and bring up evenly in all parts of forms.
10. Continue concrete placement without avoidable interruption, in continuous operation, until end of placement is reached.
11. After concrete placement begins, continue concrete placement without significant interruption. Plan and implement precautions to prevent any delay, between layers being placed, from exceeding 20 minutes.
12. If concrete is to be placed over previously placed concrete and more than 20 minutes has elapsed, spread layer of cement grout not less than 1/2 inch in thickness nor more than 1 inch in thickness over surface before placing additional concrete.
13. Placement of concrete for slabs, beams, or walkways:
    a. If cast monolithically with walls or columns, do not commence until concrete in walls or columns has been allowed to set and shrink.
    b. Allow set time of not less than 1 hour for shrinkage.

F. Consolidating concrete:
   1. Place concrete with aid of acceptable mechanical vibrators.
   2. Thoroughly consolidate concrete around reinforcement, pipes, or other shapes built into the work.
   3. Provide sufficiently intense vibration to cause concrete to flow and settle readily into place and to visibly affect concrete over radius of at least 18 inches.
   4. Vibrators:
      a. Keep sufficient vibrators on hand at all times to vibrate concrete as placed.
      b. In addition to vibrators in actual use while concrete is being placed, have on hand minimum 1 spare vibrator in serviceable condition.
      c. Do not place concrete until it has been ascertained that all vibrating equipment, including spares, are in serviceable condition.
   5. Take special care to place concrete solidly against forms to leave no voids.
   6. Take every precaution to make concrete solid, compact, and smooth. If for any reason surfaces or interiors have voids or are in any way defective, repair such concrete in manner acceptable to the Engineer.

G. Footings and slabs on grade:
   1. Do not place concrete on ground or compacted fill until subgrade is in moist condition acceptable to the Engineer.
   2. If necessary, sprinkle subgrade with water not less than 6 or more than 20 hours in advance of placing concrete.
   3. If subgrade becomes dry prior to concrete placement, sprinkle again, without forming pools of water.
   4. Do not place concrete if subgrade is muddy or soft.

H. Loading concrete:
   1. Green concrete:
      a. No heavy loading of green concrete will be permitted.
   2. No backfill shall be placed against concrete walls, connecting slabs, or beams until the concrete has reached the specified strength.
   3. Use construction methods, sequencing, and allow time for concrete to reach adequate strength to prevent overstress of the concrete structure during construction.

I. Curing concrete:
   1. General:
      a. Cure concrete by methods specified in this Section.
      b. Keep concrete continuously moist and at a temperature of at least 50 degrees Fahrenheit for minimum of 7 days after placement.
      c. Cure concrete to be painted with water or sheet membrane.
      d. Do not use sprayed membrane curing or sealing compounds on concrete surfaces that are to receive paint or upon which any material is to be bonded.
      e. Water cure or sheet membrane cure concrete slabs that are specified to be sealed by concrete sealer.
      f. Cure other concrete by water curing or sprayed membrane curing compound at the Contractor's option.
      g. Floor slabs may be cured using sheet membrane curing.

2. Water curing:
    a. Keep surfaces of concrete being water cured constantly and visibly moist day and night for period of not less than 7 days.
    b. Each day forms remain in place count as 1 day of water curing.
    c. No further curing credit will be allowed for forms in place after contact has once been broken between concrete surface and forms.
    d. Do not loosen form ties during period when concrete is being cured by leaving forms in place.
    e. Flood top of walls with water at least 3 times per day and keep concrete surfaces moist at all times during 7 day curing period.
3. Sprayed membrane curing compound:
    a. Apply curing compound to concrete surface after repairing and patching, and within 1 hour after forms are removed.
    b. If more than 1-hour elapses after removal of forms, do not use curing compound, but use water curing for full curing period.
    c. If surface requires repairing or painting, water cure such concrete surfaces.
    d. Do not remove curing compound from concrete in less than 7 days.
    e. Curing compound may be removed only upon written request by Contractor and acceptance by Engineer, stating what measures are to be performed to adequately cure concrete.
    f. Take care to apply curing compound to construction joints. Apply to all surfaces along full profile of joints.
    g. After curing period is complete, remove curing compound placed within construction joint profile by heavy sandblasting prior to placing any new concrete.
    h. Contractor's Option: Instead of using curing compound for curing of construction joints, such joints may be water cured.
    i. Apply curing compound by mechanical, power operated sprayer and mechanical agitator that will uniformly mix all pigment and compound.
    j. Apply curing compound in at least 2 coats.
    k. Apply each coat in direction 90 degrees to preceding coat.
    l. Apply curing compound in sufficient quantity so that concrete has uniform appearance and that natural color is effectively and completely concealed at time of spraying.
    m. Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
    n. Thickness and coverage of curing compound: Provide curing compound having film thickness that can be scraped from surfaces at any and all points after drying for at least 24 hours.
    o. The Contractor is cautioned that method of applying curing compound specified in this Section may require more curing compound than normally suggested by manufacturer of curing compound and also more than is customary in the trade.
    p. Apply amounts specified in this Section, regardless of manufacturer's recommendations or customary practice.
    q. If the Contractor desires to use curing compound other than specified curing compound, coat sample areas of concrete wall with proposed curing compound and also similar adjacent area with specified compound in specified manner for comparison:
        1) If proposed sample is not equal or better, in opinion of the Engineer, in all features, proposed substitution will not be allowed.

r. Prior to final acceptance of the work, remove, by sandblasting or other acceptable method, any curing compound on surfaces exposed to view, so that only natural color of finished concrete is visible uniformly over entire surface.

4. Sheet membrane curing:
   a. Install sheet membrane as soon as concrete is finished and can be walked on without damage.
   b. Seal joints and edges with small sand berm.
   c. Keep concrete moist under sheet membrane.

3.02 CONCRETE FINISHING

A. Provide concrete finishes as specified in Section 03366 - Tooled Concrete Finishing.

B. Edges of joints:
   1. Provide joints having edges as indicated on the Drawings.
   2. Protect wall and slab surfaces at edges against concrete spatter and thoroughly clean upon completion of each placement.

C. Concrete sealer:
   1. Floors and slabs to receive concrete sealer: As specified in the Contract Documents on finish schedule:
   2. Apply concrete sealer:
      a. Apply concrete sealer at coverage rate not to exceed 300 square feet per gallon.
      b. Apply as soon as slab or floor will bear weight.
      c. Sealer:
         1) Before applying concrete sealer, sweep entire surface clean with very soft bristled brush that will not mark concrete finish and remove any standing water.
         2) Apply concrete sealer with sprayer.
         3) Use of paint rollers or mop is not acceptable.
         4) Workmen shall wear flat soled shoes which will not mark or scar concrete surface.
         5) Do not allow traffic on floors and slabs until concrete sealer has dried and hardened.

3.03 FIELD QUALITY CONTROL

A. Testing of concrete:
   1. During progress of construction, the Owner will have tests made to determine whether the concrete, as being produced, complies with requirements specified.
   2. Tests will be performed in accordance with ASTM C31, ASTM C39, and ASTM C172.
   3. Contractor shall hire a Certified Independent Laboratory that will make and deliver test cylinders to the laboratory and testing expense will be borne by the Owner.
   4. Furnish test equipment.
   5. Make provisions for and furnish concrete for test specimens and provide manual assistance to the Engineer in preparing said specimens.

6. Assume responsibility for care of and providing of curing conditions for test specimens in accordance with ASTM C31.
7. Sampling frequency:
    a. 1 set of test cylinders for each 150 cubic yards of each class of concrete.
    b. Minimum of 1 set of test cylinders for each class of concrete placed.
    c. Not less than 1 set of test cylinders for each half-day's placement.
    d. At least 2 sets of test cylinders for each structure.

B. Compressive strength tests:
1. Set of 3-cylinder specimens, 6-inch diameter by 12 inch long.
2. Information: Test 1 cylinder at 7 days.
3. Acceptance: Test 2 cylinders at 28 days.

C. Slump tests:
1. Test slump of concrete using slump cone in accordance with ASTM C143.
2. Do not use concrete that does not meet specification requirements in regard to slump:
    a. Remove such concrete from project site.
    b. Test slump at the beginning of each placement, as often as necessary to keep slump within the specified range, and when requested to do so by the Engineer.

D. Air entrainment tests:
1. Test percent of entrained air in concrete at beginning of each placement, as often as necessary to keep entrained air within specified range, and when requested to do so by the Engineer.
2. Do not use concrete that does not meet Specification requirements for air entrainment:
    a. Remove such concrete from project site.
3. Test air entrainment in concrete in accordance with ASTM C173.
4. The Engineer may at any time test percent of entrained air in concrete received on project site.

E. Enforcement of strength requirement:
1. Concrete is expected to reach a compressive strength (f'_c) equal to or greater than that the minimum specified in Table A.
2. Strength level of concrete will be considered acceptable if following conditions are satisfied:
    a. Averages of all sets of 3 consecutive strength test results is greater or equal to specified compressive strength(f'_c).
    b. No individual strength test (average of 2 cylinders) falls below specified compressive strength (f'_c) by more than 500 pounds per square inch.
3. Non-compliant strength tests:
    a. Mark non-compliant strength test reports to highlight that they contain non-complying results and immediately forward copies of test reports to all parties on the test report distribution list.
    b. Provide treatment of non-compliant concrete at no additional cost to Owner and with no additional time added to project schedule:
    c. Initial treatment may consist of additional curing and testing of the affected concrete.
        1) Provide additional curing of concrete using means and duration acceptable to the Engineer.

2) Upon completion of the additional curing, provide additional testing designated by the Engineer.
    a) Obtain and test core samples for compression strength in accordance with ASTM C42, ACI 318, and ACI 350.
    b) Provide not less than 3 cores for each affected area. Obtain Engineer's acceptance of proposed coring locations before proceeding with that work.
    c) Submit report of compression strength testing for Engineer's review.
    d) If required by the Engineer, provide additional cores and obtain petrographic examination in accordance with ASTM C856. Submit report of petrographic analysis for Engineer's review.
3) If additional curing does not bring average of 3 cores taken in affected area to at least the minimum specified compressive strength (f'_c), designate such concrete in affected area as defective.

3.04 ADJUSTING

A. Provide repair of defective concrete at no additional cost to Owner and with no additional time added to the project schedule:

B. Make repairs using approach and means acceptable to the Engineer:
1. Provide repairs having strength equal to or greater than specified concrete for areas involved.
2. Do not patch, repair, or cover defective work without inspection by the Engineer.
3. Acceptable means may include, but are not limited to strengthening, repair, or removal and replacement.

C. Strengthening of defective concrete:
1. By addition of concrete.
2. By addition of reinforcing.
3. By addition of both concrete and reinforcing.

D. Repairs:
1. Methods of repair:
    a. Dry pack method:
        1) Use for holes having depth nearly equal to or greater than least surface dimension of hole, for cone-bolt holes, and for narrow slots cut for repair.
        2) Smooth holes: Clean and roughen by heavy sandblasting before repair.
    b. Mortar replacement method:
        1) Use for holes too wide to dry pack and too shallow for concrete replacement.
        2) Comparatively shallow depressions, large or small, which extend no deeper than nearest surface reinforcement.
    c. Concrete replacement method:
        1) Use when holes extend entirely through concrete section or when holes are more than 1 square foot in area and extend halfway or more through the section.

2. Preparation of concrete for repair:
    a. Chip out and key imperfections in the work and make them ready for repair.
    b. Obtain Engineer's acceptance of surface preparation methods and of prepared surfaces prior to repair.
    c. Surfaces of set concrete to be repaired: First coat with epoxy bonding agent as specified in Section 03071 - Epoxies.

E. Remove and replace defective concrete.

END OF SECTION

SECTION 03366

TOOLED CONCRETE FINISHING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Tooled concrete finishes.

1.02 QUALITY ASSURANCE

A. Mock-ups:
   1. Test panels for concrete finishes:
      a. Prepare test panels for F4 and F5 finishes and tie-hole repairs for review by Engineer.
      b. Accepted test panels serve as standard of quality and workmanship for project.
   2. Prepare test panel showing horizontal and vertical joints proposed for project for review by the Engineer. Refer to finishes specified in this Section.
   3. Test panels indicating methods for making concrete repairs: Prepare test panels for proposed repairs at beginning of project for review by Engineer:
      a. Accepted test panels serve as standard for repairs during the project.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
   1. Deliver and store packaged materials in original containers until ready for use.

PART 2 PRODUCTS

2.01 MIXES

A. Mortar mix for F4 finish: Consist of 1-part cement and 1-1/2 parts of fine sand passing Number 100 screen. Mix with enough water and emulsified bonding agent to have consistency of thick cream.

B. Mortar mix for F5 finish: Consist of 1-part cement to 1-1/2 parts of sand which passes Number 16 screen.

PART 3 EXECUTION

3.01 CONCRETE FINISHES

A. Cement for finishes:
   1. Addition of white cement may be required to produce finish which matches color of concrete to be finished.

B. Finish vertical concrete surfaces with one of the following finishes as indicated in the Finish Schedule:
   1. F1 finish: No special treatment other than repair defective work and fill depressions 1 inch or deeper and tie holes with mortar after removal of curing compound.
   2. F2 finish: No special treatment other than repair defective work, remove fins, fill depressions 1/2 inch or deeper and tie holes with mortar after removal of curing compound.
   3. F3 finish: Repair defective work, remove fins, offsets, and grind projections smooth. Fill depressions 1/4 inch or larger in depth or width and tie holes with mortar after removal of curing compound.
   4. F4 finish: Receive same finish as specified for F3 finish, and, in addition fill depressions and holes 1/16 inch or larger in width with mortar.
      a. "Brush-Off" sandblast surfaces prior to filling holes to expose all holes near surface of the concrete.
      b. Thoroughly wet surfaces and commence filling of pits, holes, and depressions while surfaces are still damp.
      c. Perform filling by rubbing mortar over entire area with clean burlap, sponge rubber floats, or trowels.
      d. Do not let any material remain on surfaces, except that within pits and depressions.
      e. Wipe surfaces clean and moist cure.
   5. F5 finish: Receive same finish as specified for F3 finish, and, in addition, receive special stoned finish, in accordance with following requirements:
      a. Remove forms and perform required repairs, patching, and pointing as specified in this Section.
      b. Wet surfaces thoroughly with brush and rub with hard wood float dipped in water containing 2 pounds of portland cement per gallon.
      c. Rub surfaces until form marks and projections have been removed.
      d. Spread grindings from rubbing operations uniformly over surface with brush in such manner as to fill pits and small voids.
      e. Moist cure brushed surfaces and allow to harden for 3 days:
         1) After curing, obtain final finish by rubbing with carborundum stone of approximately Number 50 grit until entire surfaces have smooth texture and are uniform in color.
         2) Continue curing for remainder of specified time.
      f. If any concrete surface is allowed to become too hard to finish in above specified manner, sandblast and wash related surfaces exposed to view, whether finished or not.
         1) While still damp, rub over surface, plastic mortar, as specified for brushed surfaces and handstoned with Number 60 grit carborundum stone, using additional mortar for brushed surfaces until surface is evenly filled without an excess of mortar.
         2) Continue stoning until surface is hard.
         3) After moist curing for 3 days, make surface smooth in texture and uniform in color by use of Number 50 or Number 60 grit carborundum stone.
         4) After stoning, continue curing until 7 day curing period is completed.

C. Finish horizontal concrete surfaces with one of the following finishes as indicated in the Finish Schedule after proper and adequate vibration and tamping:
   1. S1 finish: Screeded to grade and leave without special finish.
   2. S2 finish: Smooth steel trowel finish.
   3. S3 finish: Steel trowel finish free from trowel marks. Provide smooth finish free of all irregularities.
   4. S4 finish: Steel trowel finish, without local depressions or high points, followed by light hairbroom finish. Do not use stiff bristle brooms or brushes. Perform brooming parallel to slab-drainage. Provide resulting finish that is rough enough to provide nonskid finish. Finish is subject to review and acceptance by the Engineer.
   5. S5 finish: Nonslip abrasive: After concrete has been screeded level and hardened enough to support man standing on a board, sprinkle abrasive from shake screen into surface at uniform rate of 25 pounds for each 100 square feet of surface area, wood float into finish, then trowel abrasive into surface with steel trowel properly exposing abrasive in surface as required to provide nonslip surface.
   6. S6 finish: Roughened finish: After concrete has been screeded to grade, apply a roughened finish by use of a jitterbug roller or similar device.

D. Finish concrete floor surfaces to which surfacing material is applied: Finish smooth with tolerance within 1/8 inch in 10 feet in any direction from lines indicated on the Drawings.

3.02 CONCRETE FINISH SCHEDULE

A. Finish concrete surfaces as follows:
   1. F4 finish for following vertical surfaces:
      a. Concrete surfaces specified or indicated to be painted.
      b. Concrete surfaces, interior or exterior, exposed to view.
   2. Surfaces in open channels, basins, and similar structures:
      a. F3 finish for vertical surfaces which are normally below water surface.
      b. F4 finish for vertical surfaces located above normal water surface and exposed to view.
      c. Remove fins and fill tie holes from concrete surfaces located in closed boxes or channels where there is normally no access or passageway.
   3. S1 finish for following surfaces:
      a. Projecting footings which are to be covered with dirt.
      b. Slab surfaces which are to be covered with concrete fill.
   4. S2 finish for following surfaces:
      a. Tops of corbels.
      b. Tops of walls and beams not covered above in this Section.
      c. Tops of slabs not covered above in this Section.
      d. All other surfaces not specified to be finished otherwise.
   5. S3 finish for following surfaces:
      a. Building and machine room floors which are not covered with surfacing material: Provide floors that are free from trowel marks.

6. S4 finish for following surfaces:
    a. Exterior walkways.
    b. Tops of exterior walls or beams which are to serve as walkways.
    c. Tops of exterior walls or beams which are to support gratings.
    d. Top surface of slabs for basins, channels, digesters, and similar structures.
7. S6 finish for following surfaces:
    a. Basin bottoms, or other similar slab surfaces, over which layer of basin bottom grout will be applied.

END OF SECTION

SECTION 03600

GROUTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cement grout.
   2. Cement mortar.
   3. Dry-pack mortar.
   4. Epoxy grout.
   5. Grout.
   6. Non-shrink epoxy grout.
   7. Non-shrink grout.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch or cube specimens).
   2. C230 - Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
   3. C531 - Standard Test Method for Liner Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   4. C579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.
   5. C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   6. C942 - Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
   7. C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
   8. C1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

B. International Concrete Repair Institute (ICRI):
   1. 310.2R - Selecting and specifying Concrete Surface Preparations for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.03 SUBMITTALS

A. Cement grout:
   1. Mix design.
   2. Material submittals.

B. Cement mortar:
   1. Mix design.
   2. Material submittals.

C. Non-shrink epoxy grout:
   1. Manufacturer's literature.

D. Non-shrink grout:
   1. Manufacturer's literature.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to jobsite in their original, unopened packages or containers, clearly labeled with manufacturer's product identification and printed instructions.

B. Store materials in cool dry place and in accordance with manufacturer's recommendations.

C. Handle materials in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Non-shrink epoxy grout:
   1. Manufacturers: One of the following or equal:
      a. Five Star Products, Inc., Five Star Epoxy Grout.
      b. BASF Construction Chemicals, Masterflow 648 CP Plus.
      c. L&M Construction Chemicals, Inc., EPOGROUT.
   2. Non-shrink epoxy grout shall be 100 percent solid, premeasured, prepackaged system containing 2-component thermosetting epoxy resin and inert aggregate.
   3. Maintain flowable consistency for at least 45 minutes at 70 degrees Fahrenheit.
   4. Shrinkage or expansion: Less than 0.0006 inch per inch when tested in accordance with ASTM C531.
   5. Minimum compressive strength: 10,000 pounds per square inch at 24 hours and 14,000 pounds per square inch at 7 days when tested in accordance with ASTM C579, Method B.
   6. Compressive creep: Not exceed 0.0027 inch/per inch when tested under 400 pounds per square inch constant load at 140 degrees Fahrenheit in accordance with ASTM C1181.
   7. Coefficient of thermal expansion: Not exceed 0.000018 inch per inch per degree Fahrenheit when tested in accordance with ASTM C531, Method B.

B. Non-shrink grout:
   1. Manufacturers: One of the following or equal:
      a. Five Star Products, Inc., Five Star Grout.
      b. BASF Construction Chemicals, Masterflow 928.
      c. L&M Construction Chemicals, Inc., CRYSTEX.
   2. In accordance with ASTM C1107.
   3. Preportioned and prepackaged cement-based mixture.
   4. Contain no metallic particles such as aluminum powder and no metallic aggregate such as iron filings.
   5. Require only addition of potable water.
   6. Water for pre-soaking, mixing, and curing: Potable water.

7. Free from emergence of mixing water from within or presence of water on its surface.
8. Remain at minimum flowable consistency for at least 45 minutes after mixing at 45 degrees Fahrenheit to 90 degrees Fahrenheit when tested in accordance with ASTM C230.
    a. If at fluid consistency, verify consistency in accordance with ASTM C939.
9. Dimensional stability (height change):
    a. In accordance with ASTM C1107, volume-adjusting Grade B or C at 45 degrees Fahrenheit to 90 degrees Fahrenheit.
    b. Have 90 percent or greater bearing area under bases.
10. Have minimum compressive strengths at 45 degrees Fahrenheit to 90 degrees Fahrenheit in accordance with ASTM C1107 for various periods from time of placement, including 5,000 pounds per square inch at 28 days when tested in accordance with ASTM C109 as modified by ASTM C1107.

2.02 MIXES

A. Cement grout:
    1. Use same sand-to-cementitious materials ratio for cement grout mix that is used for concrete mix.
    2. Use same materials for cement grout that are used for concrete.
    3. Use water-to-cementitious materials ratio that is no more than that specified for concrete.
    4. For spreading over surfaces of construction or cold joints.

B. Cement mortar:
    1. Use same sand-to-cementitious materials ratio for cement mortar mix that is used for concrete mix.
    2. Use same materials for cement mortar that are used for concrete.
    3. Use water-to-cementitious materials ratio that is no more than that specified for concrete being repaired.
    4. At exposed concrete surfaces not to be painted or submerged in water: Use sufficient white cement to make color of finished patch match that of surrounding concrete.

C. Dry-pack mortar:
    1. Proportions by weight: 1-part portland cement to 2 parts concrete sand.
        a. Portland cement: As specified in Section 03300 - Cast-in-Place Concrete.
        b. Concrete sand: As specified in Section 03300 - Cast-in-Place Concrete.

D. Epoxy grout:
    1. Consist of mixture of epoxy or epoxy gel and sand.
        a. Epoxy: As specified in Section 03071 - Epoxies.
        b. Epoxy gel: As specified in Section 03071 - Epoxies.
        c. Sand: Clean, bagged, graded, and kiln-dried silica sand.
    2. Proportioning:
        a. For horizontal work: Consist of mixture of 1-part epoxy with not more than 2 parts sand.
        b. For vertical or overhead work: Consist of 1-part epoxy gel with not more than 2 parts sand.

E. Grout:
   1. Mix in proportions by weight: 1-part portland cement to 4 parts concrete sand.
      a. Portland cement: As specified in Section 03300 - Cast-in-Place Concrete.
      b. Concrete sand: As specified in Section 03300 - Cast-in-Place Concrete.

F. Non-shrink epoxy grout:
   1. Mix in accordance with manufacturer's installation instructions.

G. Non-shrink grout:
   1. Mix in accordance with manufacturer's installation instructions such that resulting mix has flowable consistency and is suitable for placing by pouring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect concrete surfaces to receive grout or mortar and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations, and loose material or foreign matter likely to reduce bond or performance of grout or mortar.

3.02 PREPARATION

A. Surface preparation for grouting other baseplates:
   1. Remove grease, oil, dirt, dust, curing compounds, laitance, and other deleterious materials that may affect bond to concrete and bottoms of baseplates.
   2. Roughen concrete surfaces in contact with grout to ICRI CSP-6 surface profile or rougher.
      a. Remove loose or broken concrete.
   3. Metal surfaces in contact with grout: Grit blast to white metal surface.

3.03 INSTALLATION

A. Mixing:
   1. Cement grout:
      a. Use mortar mixer with moving paddles.
      b. Pre-wet mixer and empty out excess water before beginning mixing.
   2. Cement mortar:
      a. Use mortar mixer with moving paddles.
      b. Pre-wet mixer and empty out excess water before beginning mixing.
   3. Dry-patch mortar:
      a. Use only enough water so that resulting mortar will crumble to touch after being formed into ball by hand.
   4. Non-shrink epoxy grout:
      a. Keep temperature of non-shrink epoxy grout from exceeding manufacturer's recommendations.
   5. Non-shrink grout:
      a. May be drypacked, flowed, or pumped into place. Do not overwork grout.
      b. Do not retemper by adding more water after grout stiffens.

B. Placement:
   1. Cement grout:
      a. Exercise care in placing cement grout because it is required to furnish structural strength, impermeable water seal, or both.
      b. Do not use cement grout that has not been placed within 30 minutes after mixing.
   2. Cement mortar:
      a. Use mortar mixer with moving paddles.
      b. Pre-wet mixer and empty out excess water before beginning mixing.
   3. Epoxy grouts:
      a. Wet surfaces with epoxy for horizontal work or epoxy gel for vertical or overhead work prior to placing epoxy grout.
   4. Non-shrink epoxy grout:
      a. Mix in complete units. Do not vary ratio of components or add solvent to change consistency of mix.
      b. Pour hardener into resin and mix for at least 1 minute and until mixture is uniform in color. Pour epoxy into mortar mixer wheelbarrow and add aggregate. Mix until aggregate is uniformly wetted. Over mixing will cause air entrapment in mix.
   5. Non-shrink grout:
      a. Add non-shrink cement grout to premeasured amount of water that does not exceed the manufacturer's maximum recommended water content.
      b. Mix in accordance with manufacturer's instructions to uniform consistency.

C. Curing:
   1. Cement based grouts and mortars:
      a. Keep continuously wet for minimum of 7 days. Use wet burlap, soaker hose, sun shading, ponding, and in extreme conditions, combination of methods.
      b. Maintain above 40 degrees Fahrenheit until it has attained compressive strength of 3,000 pounds per square inch, or above 70 degrees Fahrenheit for minimum of 24 hours to avoid damage from subsequent freezing.
   2. Epoxy based grouts:
      a. Cure grouts in accordance with manufacturers' recommendations.
         1) Do not water cure epoxy grouts.
      b. Do not allow any surface in contact with epoxy grout to fall below 50 degrees Fahrenheit for minimum of 48 hours after placement.

D. Grouting equipment bases, baseplates, soleplates, and skids: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

E. Grouting other baseplates:
   1. General:
      a. Use non-shrink grout as specified in this Section.
      b. Baseplate grouting shall take place from one side of baseplate to other in continuous flow of grout to avoid trapping air in grout.
      c. Maintain hydrostatic head pressure by keeping level of grout in headbox above bottom of baseplate. Fill headbox to maximum level and work grout down.
      d. Vibrate, rod, or chain non-shrink grout to facilitate grout flow, consolidate grout, and remove trapped air.

2. Forms and headboxes:
    a. Build forms using material with adequate strength to withstand placement of grouts.
    b. Use forms that are rigid and liquidtight. Caulk cracks and joints with elastomeric sealant.
    c. Line forms with polyethylene for easy grout release. Coating forms with 2 coats of heavy-duty paste wax is also acceptable.
    d. Headbox shall be 4 to 6 inches higher than baseplate and shall be located on one side of baseplate.
    e. After grout sets, remove forms and trim back grout at 45-degree angle from bottom edges of baseplate.

3.04 FIELD QUALITY CONTROL

A. Non-shrink epoxy grout:
    1. Test for 24-hour compressive strength in accordance with ASTM C579, Method B.

B. Non-shrink grout:
    1. Test for 24-hour compressive strength in accordance with ASTM C942.

END OF SECTION

SECTION 03931

EPOXY INJECTION SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Epoxy injection system.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C881 - Standard Test Method for Epoxy-Resin-Base Bonding Systems for Concrete.
   2. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear.
   3. D638 - Standard Test Method for Tensile Properties of Plastics.
   4. D648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
   5. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
   6. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

B. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

A. General: Submit as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Manufacturer's data completely describing epoxy injection system materials and including test methods and results for strength in tension, flexure, compression and bond; flexural modulus of elasticity; coefficient of thermal expansion; and elongation.
   2. Data demonstrating that products are listed under NSF-61 for use in direct contact with potable water.

C. Quality control submittals:
   1. Certificates of Compliance.
   2. Manufacturer's Instructions.

D. Special procedure submittals:
   1. Protection plan for surrounding areas and non-cementitious surfaces.

1.04 QUALITY ASSURANCE

A. Products:
   1. Provide materials that are new and use them within shelf life limitations set forth by manufacturer.

B. Qualifications:
   1. Installer:
      a. Minimum 5 years' experience in concrete repair, with focus on application of similar systems and products to projects of similar size and scope.

C. Pre-installation meeting:
   1. At least 1 week prior to commencing work of this Section, convene a meeting at the project site to review and discuss the following:
      a. Surface preparation.
      b. Substrate conditioning and pre-treatment.
      c. Installation procedures.
      d. Environmental conditions (including weather forecast) and curing requirements.
      e. Testing and inspection procedures.
      f. Protection of surrounding surfaces and equipment.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Labels shall include product identification, batch numbers, and shelf life information.

B. Store materials off the ground and away from moisture and direct sunlight, and at temperatures within manufacturer's recommended range.

C. Pre-condition materials to manufacturer's recommended temperatures before mixing and using.

1.06 PROJECT CONDITIONS

A. Take precautions to protect surfaces and equipment in the work area from damage and staining.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:
   1. Repair materials shall be free of chlorides or alkalis (except for those attributed to water).
   2. To ensure compatibility of materials and methods, a single manufacturer shall produce and provide all products used together in a single area of concrete repair.
   3. Listed under NSF-61 for use in direct contact with potable water.

B. Manufacturers: One of the following or equal:
   1. BASF Building Systems, MasterInject 1500 (formerly Concresive Standard LVI).
   2. Sika Chemical Corp., Sikadur 35 Hi-Mod LV.

C. Epoxy:
   1. In accordance with ASTM C881, Types I, II, and IV, Grade 1, Class C.
   2. Water-insensitive 2-component low viscosity, epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified:

Table 1 - Epoxy, Physical Properties

Characteristic	Test Method	Required Results, minimum(1,2)
Viscosity (mixed)	--	250 - 375 centipoise
Tensile Strength	ASTM D638	7,500 pounds per square inch
Tensile Elongation at Break	ASTM D638	1 percent
Compressive Strength	ASTM D695	11,000 pounds per square inch
Compressive Modulus	ASTM D695	2.5×10^5 pounds per square inch.
Bond Strength, slant shear, hardened concrete to hardened concrete	ASTM C882	1500 pounds per square inch at 2 days at minimum 73 degrees Fahrenheit. Concrete shall fail before failure of epoxy.
Heat Deflection Temperature	ASTM D648	124 degrees Fahrenheit

Notes:
(1) Properties for mixes with neat epoxy.
(2) Results after 7-day cure at temperature between 72 and 78 degrees Fahrenheit, unless otherwise noted.

2.02 EQUIPMENT

A. Injection pump:
   1. Use positive displacement injection pump with interlock to provide in-line mixing and metering system for 2-component epoxy.
   2. Use pressure hoses and injection nozzle designed to properly mix of 2 components of epoxy.
   3. Standby injection unit may be required.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface preparation:
   1. Confirm that surface temperature and moisture conditions are within manufacturer's recommended limits. Condition surfaces to within those limits before commencing epoxy injection.
   2. Sweep or clean area in vicinity of cracks that will be injected with epoxy. Leave area in generally clean condition after epoxy injection is complete.
   3. Clean cracks so they are free from dirt, laitance, and other loose matter.

3.02 INSTALLATION

A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.

B. Mixing:
   1. Mix epoxy in accordance with manufacturer's installation instructions.
   2. Do not use solvents to thin epoxy system materials introduced into cracks or joints.

C. Injection:
   1. Apply adequate surface seal to crack to prevent leakage of epoxy.
   2. Establish injection points at distance along crack not less than thickness of cracked member.
   3. Crack injection sequence:
      a. Inject epoxy into crack or joint at first port with sufficient pressure to advance epoxy to adjacent port. Start at lowest port along the injection line and work upwards.
      b. Seal original port and shift injection to next adjacent port where epoxy appears.
      c. Continue port-to-port injection until crack has been injected for its entire length.
      d. For small amounts of epoxy, or where excessive pressure developed by injection pump might further damage structure, premixed epoxy and use hand caulking gun to inject epoxy if acceptable to the Engineer.
      e. Seal ports, including adjacent locations where epoxy seepage occurs, as necessary to prevent drips or run out.
      f. After epoxy injection is complete, remove surface seal material, and refinish concrete in area where epoxy was injected to match existing concrete. Leave finished work and work area in a neat, clean condition.

3.03 FIELD QUALITY ASSURANCE

A. Provide Contractor quality control as specified in Section 01450 - Quality Control.

B. Field inspections and testing:
   1. Submit records of inspections and tests to Engineer within 24 hours after completion.

C. Manufacturer's services.
   1. Pre-installation meeting: Provide manufacturer's technical representative to attend pre-installation meeting specified in this Section.

3.04 FIELD QUALITY CONTROL

A. Provide Owner's quality assurance for the Work of this Section as specified in Section 01450 - Quality Control.

B. Special inspections special tests, and structural observation:
   1. Not required.

C. Field inspections:
   1. Preparation.
      a. Review manufacturer's product data and installation instructions.
   2. Required inspections.
      a. Observe surfaces to be injected for temperature and moisture conditions and for surface preparation.
      b. Observe conditioning and mixing of epoxy resin components.

c. Observe injection procedures for filling cracks.

3. Records of inspections:
   a. Provide record of each inspection.
   b. Submit to Engineer upon request.

3.05 NON-CONFORMING WORK

A. Rework surface finishes that do not match surrounding concrete to the satisfaction of Engineer at no additional cost to Owner.

END OF SECTION

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SECTION 04090

MASONRY ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Adjustable veneer anchors.
   2. Adjustable wall ties.
   3. Control joint filler.
   4. Loose fill insulation.
   5. Reinforcing bars.
   6. Sheet metal ties.
   7. Wall tie screws.
   8. Water repellent.
   9. Wire joint reinforcement, single Wythe type.
   10. Flashing sealant.
   11. Weep holes.

1.02 REFERENCES

A. American Welding Society (AWS):
   1. D1.4 - Structural Welding Code - Reinforcing Steel.

B. ASTM International (ASTM):
   1. A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   2. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   4. A641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   5. A951 - Standard Specification for Masonry Joint Reinforcement.
   6. C549 - Standard Specification for Perlite Loose Fill Insulation.
   7. D2000 - Standard Classification System for Rubber Products in Automotive Applications.
   8. D2287 - Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

1.03 SYSTEM DESCRIPTION

A. The Drawings contain general notes concerning amount of reinforcement and placing, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in masonry.

1.04 SUBMITTALS

A. Reinforcing bars:
   1. Changes to reinforcing steel contract drawing requirements:
      a. Indicate in separate letter submitted with shop drawings any changes of requirements indicated on the Drawings for reinforcing steel.
      b. Such changes will not be acceptable unless the Engineer has accepted such changes in writing.
      c. Reinforcement detail drawings:
         1) Review of reinforcement shop drawings by the Engineer will be limited to general compliance with the Contract Documents.
      d. Welding procedures.

B. Product data.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
   1. Deliver bars bundled and tagged with identifying tags.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Adjustable veneer anchors: 2-piece zinc coated fabrications, minimum 12-gauge, 3/4-inch wide by minimum 6-inch long, hat channel shaped base, capable of being mechanically fastened or welded to stud framing and receiving minimum 3/16-inch diameter triangular steel wire tie.
   1. Manufacturers: One of the following or equal:
      a. Hohmann & Barnard, 359-FH Weld-On Ties and VBT, Vee Byna Tie.
      b. Heckmann Building Products, #315-B: Weld-On Anchor Straps and #316: Triangle Ties.
      c. Wire-Bond, Type II, 1001 and 1100.

B. Adjustable wall ties: 2-piece zinc coated fabrications, minimum 3/16-inch diameter steel wire formed into hook or pin and eye pieces, capable of restraining compression and tension forces from veneer.
   1. Manufacturers: One of the following or equal:
      a. Hohmann & Barnard, Adjustable Wall Ties.
      b. Heckmann Building Products, No. 262 and 263.
      c. Wire-Bond, 1800 Hook and 1801 Eye.

C. Anchor bolts:
   1. Cast-in/built-in steel anchors: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
      a. Includes: anchor bolts, anchor rods, deformed bar anchors, and welded studs).
   2. Post-installed steel anchors: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
      a. Includes concrete anchors for concrete masonry, and screw anchors for concrete masonry.

D. Control joint filler: The key shall be of the width and shape as indicated on the Drawings. In accordance with ASTM D2000 or ASTM D2287.
   1. Manufacturers: One of the following or equal:
      a. Hohmann & Barnard, VS Standard.
      b. Wire-Bond, No. 2901.
      c. Southern Metals and Plastics, No. CJ1.

E. Loose fill insulation:
   1. Perlite: In accordance with ASTM C549, Type IV, surface-treated for water repellency and to limit dust generation during installation.

F. Reinforcing bars:
   1. Deformed bars in accordance with ASTM A615, Grade 60.
   2. Provide reinforcing steel that is of quality specified, free from excessive rust or scale or any defects affecting its usefulness.

G. Sheet metal ties: Minimum 22-gauge corrosion resistant corrugated sheet metal, minimum 7/8-inch-wide by 7 inches long, pre-punched for wire ties to wire joint reinforcement.

H. Wall tie screws.

I. Water repellent: Water based, methacrylate polymer with aqueous polysiloxane.

J. Wire joint reinforcement, single Wythe type: In accordance with ASTM A951 with ASTM A82, 9-gauge 3/16-inch wire side rails and 9-gauge cross ties, sized to suit application, and galvanized in accordance with ASTM A641, Class 1 (minimum 0.1 ounce of zinc per square foot).
   1. Manufacturers: One of the following or equal:
      a. Heckmann Building Products, No. 1100 Ladder Type Wall Reinforcement (9-gauge standard, other diameters special order).
      b. Hohmann & Barnard, 220 Ladder Mesh Reinforcement.
      c. Wire-Bond, Ladder Type, Series 200.

K. Flashing sealant: Non-staining, butyl-rubber compound, suitable for in-service temperature of -40 degrees Fahrenheit to 180 degrees Fahrenheit and compatible with the specified materials.

L. Weep holes: 3/8-inch cellular drainage structure to fit in head joint of veneer units to promote drainage of the air space cavity.
   1. Manufacturers: One of the following or equal:
      a. Hohmann & Barnard, Quadro-Vent.
      b. Wire-Bond, #3601 Cell-Vent.
   2. Weep holes shall be manufactured of ultraviolet-light resistant polypropylene cellular 3/8 inch thick.
   3. Color shall be selected from manufacturer's standard colors to most closely match the selected mortar color.
   4. Size shall match the depth and height of the veneer units selected.

2.02 FABRICATION

A. Reinforcing bars:
   1. Cut and bend bars in accordance with building code.

2. Bend bars cold.
3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Reinforcing bars:
      a. Verify that bars are new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings which adversely affect bonding capacity when placed in the work.

3.02 PREPARATION

A. Reinforcing bars:
   1. Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean any bars that have rust scale, loose mill scale, or thick rust coat.
   2. Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent masonry placement.

3.03 INSTALLATION

A. Reinforcing bars:
   1. No field bending of bars will be allowed.
   2. Welding:
      a. Weld reinforcing bars where indicated on the Drawings or acceptable to the Engineer.
      b. Perform welding in accordance with AWS D1.4.
      c. Submit welding procedures.
      d. Do not tack weld reinforcing bars.

B. Placing reinforcing bars:
   1. Accurately place bars and adequately secure them in position.
   2. Overlap bars at splices as indicated on the Drawings or specified.
   3. If not indicated on the Drawings, lap splice bars in masonry in accordance with the building code.

END OF SECTION

SECTION 04100

MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Mortar and grout for masonry construction.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C144 - Standard Specification for Aggregate for Masonry Mortar.
   2. C150 - Standard Specification for Portland Cement.
   3. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
   4. C270 - Standard Specification for Mortar for Unit Masonry.
   5. C404 - Standard Specification for Aggregates for Masonry Grout.
   6. C476 - Standard Specification for Grout for Masonry.
   7. C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
   8. C1019 - Standard Test Method for Sampling and Testing Grout.

1.03 DEFINITIONS

A. Alkali: Sum of sodium oxide and potassium oxide calculated as sodium oxide.

1.04 PERFORMANCE REQUIREMENTS

A. Compressive strength:
   1. Mortar: Minimum 1,800 pounds per square inch at 28 days.
   2. Grout: Minimum 2,000 pounds per square inch at 28 days.

1.05 SUBMITTALS

A. Product data.

B. Shop drawings.

C. Mortar color samples.

D. Design Mixes for mortar and grout.

E. Test reports:
   1. Mortar Strength Test Results.
   2. Grout Strength Test Results.

1.06 QUALITY ASSURANCE

A. Materials for mortar and grout: Do not change source of materials which will affect the appearance of finished work after the work has started unless acceptable to Engineer.

1.07 PROJECT CONDITIONS

A. Environmental requirements:
   1. Cold weather requirements:
      a. Cold Weather Construction: In accordance with the building code .
      b. Provide adequate equipment for heating mortar and grout materials when air temperature is below 40 degrees Fahrenheit.
         1) Temperatures of separate materials, including water, shall not exceed 140 degrees Fahrenheit when placed in mixer.
         2) Maintain mortar temperature on boards above freezing.
   2. Hot weather requirements:
      a. Wet mortar board before loading and cover mortar to retard drying when not being used.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland cement:
   1. Type II, low alkali, containing maximum 0.6 percent total alkali in accordance with ASTM C150.

B. Hydrated lime:
   1. Type S in accordance with ASTM C207.

C. Aggregate for mortar:
   1. Fine aggregate: Sand in accordance with ASTM C144.

D. Aggregate for grout:
   1. Fine aggregate: Size Number 2 in accordance with ASTM C404.
   2. Coarse aggregate: Size Number 8 in accordance with ASTM C404.

E. Admixtures:
   1. Mortar color admixture:
      a. Containing maximum 15 percent lime proof, inorganic compounds, unless recommended otherwise by manufacturer.
      b. Maximum 3 percent carbon black by weight of cement.
      c. Factory blend for full color saturation of mortar joint.
      d. Packaging for unitized jobsite mixing at ratio of 1 unit of color per sack of portland cement.
   2. Grout admixture:
      a. Manufacturers: The following or equal:
         1) Sika Corp., Sika Grout Aid, Type II.

3. Mortar water repellent admixture:
    a. Manufacturers: One of the following or equal:
        1) Sika Corp., Sikaproof A.
        2) W.R. Grace, Dry Block Mortar.
        3) BASF, Rheopel Plus Mortar Admixture.
4. Other admixtures:
    a. Prohibited, unless accepted by the Engineer.

F. Water: Clean, clear, potable, free of oil, soluble salts, chemicals, and other deleterious substances.

G. Other materials:
1. Prohibited, unless acceptable to Engineer.

2.02 MIXES

A. Mortar mix:
1. Portland cement-lime mortar.
2. Mortar mix proportions by volume: As required to meet strength requirements.
3. Mortar mixing:
    a. Mix on jobsite in accordance with ASTM C270.
    b. Mix in mechanical mixer and only in quantities needed for immediate use.
    c. Mix for minimum 3 minutes, and maximum of 5 minutes after materials have been added to mixer.
4. Measurement by volume: Measurement of constituents shall be accomplished by the use of a container of known capacity.
5. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units.
    a. Use no mortar which has been standing for more than 1 hour after being mixed.
6. Whenever 90 minutes has elapsed since last batch was mixed, completely empty mixer drum of materials and wash down before placing next batch of materials.

B. Grout mix:
1. Grout mix proportions by volume: As required to meet strength requirements.
2. Grout mixing:
    a. Mix on jobsite or in a transit mix in accordance with ASTM C476.
    b. Slump: 8 to 11 inches, unless otherwise accepted by the Engineer.
    c. Use within 90 minutes after addition of mixing water.
    d. Mix for minimum of 5 minutes after ingredients are added and until uniform mix is attained. Grout shall have sufficient water added to produce pouring consistency without segregation.
3. Use coarse grout for hollow cell masonry units with minimum 4-inch cell dimensions in both horizontal directions.
    a. Calculate cell dimension for this criterion by subtracting diameter(s) of any horizontal reinforcement crossing the cell from clear cell dimensions of the masonry unit.

2.03 SOURCE QUALITY CONTROL

A. Tests:
   1. Trial batches:
      a. Have trial batches of mortar and grout prepared by testing laboratory acceptable to Consultant.
      b. Prepare trial batches with sufficient quantity to determine slump, workability, and consistency and to provide sufficient material for tests.
   2. Mortar trial batch strength testing:
      a. Compressive strength tests on trial batches of mortar: In accordance with ASTM C780, Annex A7 by an independent testing laboratory acceptable to the Consultant.
      b. Cost of tests and trial batches shall be paid by the Contractor.
   3. Grout trial batch strength testing:
      a. Compressive strength tests of trial batches of grout: In accordance with ASTM C1019 by an independent testing laboratory acceptable to the Consultant.
      b. Cost of tests and trial batches shall be paid by the Contractor.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Testing of grout and mortar:
   1. During progress of construction, the Owner will have tests made to determine whether the grout and mortar, as being produced, complies with Specifications.
   2. Compressive strength test for grout: In accordance with ASTM C1019.
   3. The Engineer will make and deliver test specimens to the laboratory and testing expense will be borne by the Owner.
   4. Required number of tests:
      a. At least 2 test specimens of grout and mortar will be made per week.
   5. Do not use grout and mortar that does not meet specification.
      a. Remove such mortar and grout from Project site.
   6. Make provisions for and furnish grout and mortar for test specimens, and provide manual assistance to the Engineer in preparing test specimens.
   7. Assume responsibility for care of and providing proper curing conditions for test specimens.

3.02 ADJUSTING

A. Repair of defective masonry:
   1. Remove and replace or repair defective work.
   2. Do not patch, repair, or cover defective work without inspection by the Engineer.
   3. Provide repairs having strength equal to or greater than specified strength for areas involved.

END OF SECTION

SECTION 04220

CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Concrete masonry units and accessories.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. ACI 530.1 - Specification for Masonry Structures.

B. ASTM International (ASTM):
   1. C90 - Standard Specification for Loadbearing Concrete Masonry Units.
   2. C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
   3. C426 - Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

1.03 DEFINITIONS

A. Standard Level of Quality: High quality, but conventional, nearly free of chips, cracks, or other imperfections detracting from appearance when discernible and identified from distance of 20 feet under diffused lighting. When level of quality is not specified, Standard Level of Quality shall be assumed.

B. Mortar Smears: Mortar paste smeared across the permanent masonry construction during construction and absorbed into the masonry pores.

C. Mortar Splash: Mortar dropped splashed onto the permanent masonry construction at the base of the wall or off the scaffolding.

D. Mortar Tag: Excess mortar between masonry units worked out of the joints during tooling or striking.

E. Mortar Stains: Mortar paste left after mortar tags are removed.

1.04 SUBMITTALS

A. Product data:
   1. Submit manufacturer's product data for split face block.
   2. Submit manufacturer's product data for proposed cleaning agent.

B. Shop drawings: Include elevations of each wall indicating type and layout of units, including type of mortar joints, bond pattern, reinforcing steel, connecting dowels, joint reinforcement, grouted cells, and control joints.

C. Samples: Include samples of stretcher units in sufficient quantity to illustrate color range.

D. Test reports:
   1. Compressive strength.
   2. Linear shrinkage.
   3. Moisture content as a percentage of total absorption.
   4. Total absorption.
   5. Unit weight.

E. Manufacturer's instructions:
   1. Submit printed or written recommendations from the masonry unit manufacturer of the cleaning procedures and cleaning agents appropriate for each type of masonry unit included in the work.

F. Quality assurance submittals:
   1. If requested by the Engineer, submit a record of the Installer's evidence of qualifications.
   2. If requested by the Engineer, submit a record of the Masonry Cleaner's evidence of qualifications.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Installer qualifications:
      a. The mason shall hold an appropriate contractor's license in the State where the work will be constructed.
      b. The mason shall have not less than 5 years' experience and completed a minimum of 20 projects and at least 5 of which included the type of masonry units specified for this Work.
   2. Masonry cleaner qualifications:
      a. The masonry cleaner shall have not less than 5 years' experience and completed a minimum of 20 projects and at least 5 of which included the type of masonry units specified for this Work.

B. Pre-installation conference: Conduct as specified in Section 01312 - Project Meetings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Transport and handle concrete masonry units as required to prevent discoloration, chipping, and breakage.

B. Store masonry units off the ground in a dry location, covered and protected from absorbing moisture.
   1. Locate storage piles, stacks, and bins to protect materials from heavy traffic.
   2. If masonry units are delivered in shrink-wrapped packaging and condensation develops, remove shrink-wrap packaging.

C. Remove chipped, cracked, and otherwise defective units from jobsite upon discovery.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Cold weather requirements:
   1. In accordance with building code, provide adequate equipment for heating masonry materials when air temperature is below 40 degrees Fahrenheit.

B. Hot weather requirements:
   1. In accordance with building code, when ambient air temperature exceeds 100 degrees Fahrenheit, or when ambient air temperature exceeds 90 degrees Fahrenheit and wind velocity is greater than 8 miles per hour, implement hot weather protection procedures.
   2. Wet mortarboard before loading and cover mortar to retard drying when not being used.
   3. Do not spread mortar beds more than 48 inches ahead of placing masonry units.
   4. Place masonry units within one minute of spreading mortar.

1.08 SEQUENCING AND SCHEDULING

A. Order concrete masonry units well before start of installation to ensure adequate time for manufacturing and minimum 28 days for curing and drying before start of installation. Protect from weather after curing period to avoid moisture increase.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Hollow load bearing concrete masonry units:
   1. Class: Class 3 in accordance with ASTM C90, Standard Level of Quality with minimum compressive strength of 1,900 pounds per square inch.
   2. Surface texture: Standard and split face.
   3. Color: Integral, selected by Owner.
   4. Typical size: 8 inches wide by 8 inches high by 16 inches long, unless otherwise indicated on the Drawings, or other sizes as needed to minimize cutting.
   5. Special sizes and shapes: As required for window and door openings, bond beams, piers, lintels, control joints, and other special applications to minimize cutting.

B. Anchor bolts: As specified in Section 05120 - Structural Steel.

C. Steel reinforcement: As specified in Section 04090 - Masonry Accessories.

D. Wall ties: As specified in Section 04090 - Masonry Accessories.

E. Wire joint reinforcement: As specified in Section 04090 - Masonry Accessories.

F. Loose fill insulation: As specified in Section 04090 - Masonry Accessories.

PART 3 EXECUTION

3.01 PREPARATION

A. Protection:
   1. Protect adjacent construction with appropriate means from mortar droppings and other effects of laying of concrete masonry units.

B. Surface preparation:
   1. Thoroughly clean foundations of laitance, grease, oil, mud, dirt, mortar droppings, and other matter that will reduce bond.

3.02 INSTALLATION

A. Forms and shores:
   1. Where required, construct forms to the shapes indicated on the Drawings:
      a. Construct forms sufficiently rigid to prevent deflection which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout.
      b. Do not remove supporting forms or shores until the supported masonry has acquired sufficient strength to support safely its weight and any construction loads to which it may be subjected.
         1) Wait at least 24 hours after grouting masonry columns or walls before applying uniform loads.
   2. Wait at least 72 hours before applying concentrated loads.

B. Concrete masonry units:
   1. Provide Standard Level of Quality. Comply with the requirements of ACI 530.1 unless more restrictive requirements are contained in this Section.
   2. Lay concrete masonry units dry.
   3. Lay units in uniform and true courses, level, plumb, and without projections or offset of adjacent units.
   4. Lay units to preserve unobstructed vertical continuity of cells to be filled with grout or insulation.
   5. Align vertical cells to be filled with grout to maintain clear, unobstructed continuous vertical cell measuring not less than 2 by 3 inches.
   6. Place mortar with full coverage of joints at webs of all cells and face shells.
   7. Butter vertical head joints for thickness equal to face shell thickness of units, and shove joints tightly together so that mortar bonds to both masonry units.
   8. Solidly fill joints from face of units to inside face of cells.
   9. Lay units to desired height with joints of uniform thickness.
   10. Bond shall be plumb throughout.
   11. Lay units to avoid formation of cracks when units are placed. Keep cells of units as free of mortar as possible as masonry wall height increases.
   12. When positions of units shift after mortar has stiffened, bond is broken, or cracks are formed, relay units in new mortar.
   13. Remove mortar, mortar droppings, debris, and other obstructions and materials from inside of cell walls to receive grout or insulation.
   14. Remove mortar tags and smears daily with a non-metallic tool.
      a. Mortar tags and smears shall be removed after they initially set but shall not be permitted to remain more than 24 hours.

15. Where practical, protect completed work from mortar splash by placing thin plastic sheeting around the base of walls.
    a. Place sand, straw, sawdust or other similar material on the floor around the base of walls to protect floors and walls.
16. Turn scaffold planks over at the end of the workday to avoid mortar splashes from wet weather.
    a. Cover tops of walls at the end of the workday and other work stoppages to prevent entry of water into the partially completed masonry.
17. Seal cleanouts after inspection and before grouting or placing insulation.

C. Bond pattern:
    1. Lay concrete masonry units in running bond pattern, unless otherwise indicated on the Drawings.

D. Loose fill insulation:
    1. Fill concrete masonry unit cells of building exterior walls indicated on the Drawings with reinforcing and grout, and loose fill insulation.
    2. Place in lifts of 4 feet maximum when filling concrete masonry unit cells.
    3. Do not lay units more than 4 feet vertically ahead of units filled with loose fill insulation.
    4. Ensure that no insulation gets into cells which are to be filled with grout.

E. Mortar joints:
    1. Make joints straight, clean, smooth, and uniform in thickness.
    2. Tool exposed joints, slightly concave. Strike concealed joints flush.
    3. Make vertical and horizontal joints 3/8-inch thick.
    4. Where fresh masonry joins totally or partially set masonry, clean and roughen set masonry before laying new units.
    5. Remove mortar that protrudes more than 1/2 inch into the cells of units that are to be grouted.

F. Wire joint reinforcement:
    1. Lap splice longitudinal wire joint reinforcement minimum 75 wire diameters.
    2. Place longitudinal wires in approximate centers of mortar beds with minimum 5/8-inch mortar cover on exposed faces.
    3. Provide intersecting masonry walls with prefabricated wire joint reinforcement tees.
    4. Rake intersecting joints 1/2 inch and caulk joints.

G. Grouting and reinforcement:
    1. Where horizontal and vertical bars are spliced and adjacent lap splices are separated by more than 3 inches, the lap splice length shall be 72 bar diameters. Where adjacent lap splices are separated by 3 inches or less, the lap splice length shall be increased by 1.3 times or the lap splices shall be staggered at least 24 bar diameters with no increase in length.
    2. Hold vertical reinforcing bars in position at top and bottom and at intervals not exceeding 200 bar diameters. Use steel wire bar positioners to position bars. Tie reinforcing bars to dowels with wire ties.
    3. Obtain acceptance of reinforcement placement before grouting.

4. Fill spaces and cells containing reinforcing bars solidly with grout.
    a. Low-lift grouting:
        1) Hollow unit masonry to be grouted by the low lift method shall be constructed and grouted in lifts not exceeding 4 feet.
        2) Slushing with mortar will not be permitted.
    b. High-lift grouting:
        1) Hollow unit masonry shall be allowed to cure at least 24 hours before grouting.
        2) Grout shall be placed in lifts not to exceed 6 feet in depth.
        3) Each lift shall be allowed to set for 10 minutes after initial consolidation of grout before successive lift is placed.
        4) The full height of each section of wall shall be grouted in 1 day.
5. Grout in cells shall have full contact with surface of concrete footings.
6. When grouting stops for 1 hour or longer, form horizontal construction joints by stopping grout placement 1-1/2 inches below top of uppermost unit containing grout.
7. After placement, consolidate grout using mechanical immersion vibrators designed for consolidating grout.
8. Placement:
    a. Use a hand bucket, concrete hopper, or grout pump.
    b. Place grout in final position within 1-1/2 hours after mixing. Place grout so as to completely fill the grout spaces without segregation of the aggregates.
    c. Do not insert vibrators into lower grout placements that are in a semi-solidified state.
    d. Remove grout spills immediately by hand washing with a bucket and brush.

H. Bond beams:
1. Starting courses at bottom of walls shall be bond beams.
2. Place horizontal reinforcement and solidly grout bond beam units in place.
3. Provide wire mesh at openings in bottom of bond beams to support grout where walls are not grouted solid.

I. Cutting concrete masonry units:
1. When possible, use full units of the proper size in lieu of cut units. Cut units as required to form chases, openings, for anchorage, and for other appurtenances.
2. Cut and fit units with power-driven carborundum or diamond disc blade saw.

J. Control joints:
1. Provide in masonry walls at locations indicated on the Drawings.
2. Make full height and continuous in appearance.
3. Run bond beams and bond beam reinforcing bars continuously through control joints.
4. Insert control joint filler in joints as wall is constructed.
5. Apply sealant as specified in Section 07900 - Joint Sealants.

K. Openings and lintels:
1. Place horizontal reinforcement in fully grouted bond beam units.
2. Use lintel block units where underside of lintel will be exposed.
3. Provide minimum of 8-inch bearing at each end of lintel.

4. Embed reinforcing bars minimum 24 inches or 48 bar diameters, whichever is longer, into wall past edges of openings or as indicated on the Drawings:
    a. At corners, provide 90-degree bend with equivalent total embedment.

L. Steel door frames:
1. Anchor and fully grout jambs and head of steel doorframes connected to concrete unit masonry.
2. Fill frames with grout as each 2 feet of concrete unit masonry is laid.

M. Bearing plates:
1. Provide minimum of 12 inches of grouted concrete unit masonry below steel bearing plates and beams bearing on masonry walls.

N. Anchor bolts:
1. Hold anchor bolts in place with template during grouting to ensure precise alignment.
2. Do not cut or ream members being anchored or use other means to accommodate misaligned anchor bolts in roof deck support angles.
3. Provide minimum 6-inch wide grouted concrete unit masonry entirely around anchor bolts and other attachment devices.

O. Enclosures:
1. Where concrete masonry units enclose conduit, pipes, stacks, ducts, and similar items, construct chases, cavities, and similar spaces as required, whether or not such spaces are indicated on the Drawings.
2. Point openings around flush mounted electrical outlet boxes with mortar, including flush joints above boxes.
3. Do not cover enclosures until inspected and when appropriate, tested.

P. Other embedded items:
1. Build in wall plugs, accessories, flashings, pipe sleeves, and other items required to be built-in as the masonry work progresses.

Q. Patching:
1. Patch exposed concrete masonry units at completion of the Work and in such manner that patching will be indistinguishable from similar surroundings and adjoining construction.

R. Water curing:
1. Protect concrete masonry units from drying too rapidly by frequently fogging or sprinkling so walls will always be visibly damp for minimum 3 days.

S. Miscellaneous:
1. Build in required items, such as anchors, flashings, sleeves, frames, structural steel, lintels, anchor bolts, and metal fabrications, as required for complete installation.

T. Water repellent:
1. Apply water repellent as specified in Section 09960 – High Performance Coatings.

U. Grouting equipment:
    1. Grout pumps:
        a. Do not pump grout through aluminum tubes.
        b. Operate pumps to produce a continuous stream of grout without air pockets.
        c. Upon completion of each days pumping, eject grout from pipeline without contamination or segregation of the grout:
            1) Remove waste materials and debris from the equipment.
            2) Dispose of waste materials, debris, and all flushing water outside the masonry.
    2. Vibrators:
        a. Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout.
        b. Maintain at least 1 spare vibrator, at the site at all times.
        c. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine.
        d. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

3.03 CONSTRUCTION

A. Site tolerances: Lay masonry plumb, true to line, and with courses level. Keep bond pattern plumb throughout. Lay masonry within the following tolerances:
    1. Maximum variation from the plumb in the lines and surfaces of columns, walls, and in the flutes and surfaces of fluted or split faced blocks:
        a. In adjacent masonry units: 1/8 inch.
        b. In 10 feet: 1/4 inch.
        c. In any story or 20 feet maximum: 3/8 inch.
        d. In 40 feet or more: 1/2 inch.
    2. Maximum variations from the plumb for external corners, expansion joints, and other conspicuous lines:
        a. In any story or 20 feet maximum: 1/4 inch.
        b. In 40 feet or more: 1/2 inch.
    3. Maximum variations from the level or grades indicated on the Drawings for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
        a. In any bay or 20 feet maximum: 1/4 inch.
        b. In 40 feet or more: 1/2 inch.
    4. Maximum variations of the linear building lines from established position in plan and related portion of columns, walls, and partitions:
        a. In any bay or 20 feet maximum: 1/2 inch.
        b. In 40 feet or more: 3/4 inch.
    5. Maximum variation in cross sectional dimensions of columns and in thickness of walls:
        a. Minus: 1/4 inch.
        b. Plus: 1/2 inch.

3.04 FIELD QUALITY CONTROL

A. Site tests:
   1. Owner will have tests performed by an independent laboratory.
   2. Have minimum 3 concrete masonry units of each type proposed for Project tested in accordance with ASTM C90, C140, and C426 to verify conformance to Specifications.
   3. Tests shall include compressive strength, linear shrinkage, moisture content as percent of total absorption, total absorption, and unit weight.

3.05 FINAL CLEANING

A. General:
   1. Final cleaning shall be performed within 7 to 14 days after construction of masonry work.
   2. Protect adjacent materials and equipment that may be damaged by cleaning.
   3. Pre-wet masonry before applying cleaning agent, but do not saturate masonry.
   4. Remove mortar stains, smears, and splash, efflorescence, and grout stains on exposed surfaces with the submitted cleaning agent as directed by the masonry unit manufacturer's recommendations.
   5. Do not use muriatic acid as cleaning agent.
   6. Cleaning agents shall be applied when the masonry surface and air temperatures are at least 50 degrees Fahrenheit.
      a. Dilute cleaning agents in accordance with manufacturer's recommendations.
      b. Do not allow cleaning agents to dry on the masonry.
   7. Clean wall from the top to the bottom, without overlapping areas being cleaned for consistency.
   8. If pressure cleaning equipment is used, the following limitations shall be observed:
      a. Apply cleaning agent to pre-wetted wall with low pressure (less than 50 pounds per square inch).
      b. Use a 25° to 50° flared-tip nozzle (not a pointed tip).
      c. Maintain a consistent distance from the spray nozzle to the masonry surface no closer than 12 inches.
         1) Masonry cleaner shall use a combination of pressure, nozzle, and distance from tip to masonry that does not damage the masonry surface.
   9. Rinse cleaning agents off the wall with potable water.
   10. Dispose of debris, refuse, and surplus material offsite legally.

3.06 PROTECTION

A. Provide temporary protection for exposed masonry corners subject to damage.

B. Bracing:
   1. Unless wall is adequately supported by permanent supporting elements so wall will not overturn or collapse, adequately brace masonry walls over 8 feet in height to prevent overturning and to prevent collapse.
   2. Keep bracing in place until permanent supporting elements of structure are in place.

C. Limited access zone:
   1. Establish limited access zone prior to start of masonry wall construction.
   2. Zone shall be immediately adjacent to wall and equal to height of wall to be constructed plus 4 feet by entire length of wall on unscaffolded side of wall.
   3. Limit access to zone to workers actively engaged in constructing wall. Do not permit other persons to enter zone.
   4. Keep zone in place until wall is adequately supported or braced by permanent supporting elements to prevent overturning and collapse.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Structural steel shapes and plate.
   2. Fasteners and structural hardware:
      a. All thread rods.
      b. All thread rods, high strength.
      c. High-strength bolts.
   3. Welding.
   4. Bolting.

1.02 REFERENCES

A. American Institute of Steel Construction (AISC):
   1. 303 - Code of Standard Practice for Steel Buildings and Bridges.
   2. 360 - Specification for Structural Steel Buildings.

B. American Iron and Steel Institute (AISI):
   1. Steel and stainless steel alloys ("types") as indicated.

C. American Welding Society (AWS):
   1. A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   2. A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
   3. A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
   4. D1.1 - Structural Welding Code - Steel.
   5. D1.6 - Structural Welding Code - Stainless Steel

D. ASTM International (ASTM):
   1. A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
   2. A36 - Standard Specification for Carbon Structural Steel.
   3. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
   4. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   5. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   6. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   7. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   8. A276 - Standard Specification for Stainless Steel Bars and Shapes.

9. A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
10. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
11. A489 - Standard Specification for Carbon Steel Lifting Eyes.
12. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
13. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
14. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
15. A992 - Standard Specification for Structural Steel Shapes.
16. F436 - Standard Specification for Hardened Steel Washers.
17. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
18. F594 - Standard Specification for Stainless Steel Nuts.
19. F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
20. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.
21. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

E. Research Council on Structural Connections (RCSC):
1. Specification for Structural Joints Using High-Strength Bolts (RCSC Specification).

1.03 DEFINITIONS

A. Snug-tight: At bolted joints, the tightness attained with a few impacts of an impact wrench, or by the full effort of an ironworker using a spud wrench to bring the connected plies into firm contact.

B. Stainless steel related terms:
1. Descaling: Removal of heavy, tightly adherent oxide films resulting from hot-forming, heat-treatment, welding, and other high-temperature operations.
2. Pickling: Chemical descaling of stainless steel using aqueous solutions of nitric and hydrofluoric acid, or various proprietary formulations as specified.
3. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.

1.04 SUBMITTALS

A. Product data:
1. Compressible-washer-type direct tension indicators: Manufacturer's detailed installation instructions including:
a. Requirements for type and frequency of pre-installation verification.
b. Requirements for coordination with regular washers.
c. Instructions for assembling and tightening the joint so that work progresses from the most rigid part until the connected plies are in firm contact.

2. Stainless steel: Fabricator name and qualifications, member dimensions and structural section properties, and specifications and procedures used for pickling and passivating members.

B. Shop drawings:
   1. Fabrication and erection drawings.

C. Quality control submittals:
   1. Welder qualifications: For each welding process and position:
      a. Welder's qualification certificates.
      b. Contractor's statement that certificate will be "in effect" at the time(s) welding will be performed based on the "Period of Effectiveness" provisions of AWS D1.1 and D1.6.

D. Test reports:
   1. Certified copies of mill tests and analyses made in accordance with applicable ASTM standards, or reports from a recognized commercial laboratory, including chemical and tensile properties of each shipment of structural steel or part thereof having common properties.

1.05 QUALITY ASSURANCE

A. Welding:
   1. Perform welding of structural metals in accordance with AWS D1.1 and D1.6 using welders who have current AWS qualification certificate for the process, position, and joint configuration to be welded.
   2. Make Welding Procedure Specifications available at the locations where welding is performed.
   3. Notify Engineer at least 24 hours before starting shop or field welding.
   4. Engineer may check materials, equipment, and qualifications of welders.
   5. Remove welders performing unsatisfactory Work or require requalification.
   6. Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
   7. Contractor shall bear costs of retests on defective welds.
   8. Contractor shall also bear costs in connection with qualifying welders.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver structural steel free from mill scale, rust, and pitting.

B. Storage and protection: Until erection and painting, protect from weather items not galvanized or protected by a shop coat of paint.

PART 2 PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified or indicated on the Drawings, materials shall conform to the following.

2.02 FASTENERS AND STRUCTURAL HARDWARE

A. General:
   1. Materials: Of domestic manufacture.
   2. Where fasteners and hardware are specified to be galvanized, galvanize in accordance with ASTM A153 or ASTM F2329.

B. All thread rods:
   1. Carbon steel:
      a. In accordance with ASTM A36 unless otherwise indicated on the Drawings.
      b. High strength all thread rods: In accordance with ASTM F1554, Grade 55.
      c. Nuts: ASTM A194.
      d. Washers: ASTM F436.
   2. Galvanized carbon steel:
      a. In accordance with ASTM A36 unless otherwise indicated on the Drawings, and hot dip galvanized in accordance with ASTM A153.
      b. High strength galvanized all thread rods: In accordance with ASTM F1554, Grade 55, and galvanized in accordance with ASTM F2329.
      c. Nuts: ASTM A194, hot-dip galvanized in accordance with ASTM A153.
      d. Washers: ASTM F436, hot-dip galvanized in accordance with ASTM A153.
   3. Stainless steel:
      a. Units descaled, pickled, and passivated as specified in "Fabrication" in this Section.
      b. Threaded rods and nuts to be the products of a single manufacturer/fabricator to ensure proper fit without galling. Ship all thread rods with properly fitting nuts attached.
      c. Alloy Type 304 or Type 316 as indicated on the Drawings.
      d. Type 304:
         1) Rod: ASTM F593, Group 1, Condition CW, coarse threads.
         2) Nuts: ASTM F594. Match alloy of rod (group and UNS designation).
         3) Washers: Type 304 stainless steel.
      e. Type 316:
         1) Rod: ASTM F593, Group 2, Condition CW, coarse threads.
         2) Nuts: ASTM F594. Match alloy of rod (group and UNS designation).
         3) Washers: Type 316 stainless steel.

C. Anchor bolts, anchor rods, and post-installed steel anchors: As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

D. High-strength bolts:
   1. Provide high-strength bolt assembly, with nuts, hardened flat washers, and compressible-washer-type direct tension indicators. Provide uncoated components unless galvanized coating is indicated on the Drawings.
   2. Carbon steel - Uncoated:
      a. Bolts: Plain heavy hex structural bolts in accordance with ASTM A325 Type 1.
      b. Nuts: Heavy hex nuts in accordance with ASTM A563, Grade C.

c. Washers: Flat:
1) Adjacent to normal, oversized, and short-slotted holes: Circular and square or rectangular beveled washers in accordance with ASTM F436.
2) Adjacent to long slotted holes: 5/16-inch thick plate washer fabricated from steel in accordance with ASTM A36.
d. Washers: Tension indicating: In accordance with ASTM F959.

3. Carbon steel - Galvanized:
a. Bolt and nut assemblies fabricated, galvanized, tested for rotational capacity, and shipped accordance with the provisions ASTM A325 and the RCSC Specification.
b. Bolts, nuts, and washers: Hot-dip galvanized and in accordance with ASTM A153, Class C or ASTM F2329.
c. Bolts: Plain heavy hex structural bolts in accordance with ASTM A325 Type 1 and galvanized as specified.
d. Nuts: Heavy hex nuts in accordance with ASTM A563, Grade DH, galvanized as specified, and lubricated in accordance with ASTM A563, Supplementary Requirement S1 to minimize galling.
e. Washers:
1) Adjacent to normal, oversized, and short-slotted holes: Circular and square or rectangular beveled washers in accordance with ASTM F436 and galvanized as specified.
2) Adjacent to long slotted holes: 5/16-inch thick plate washer fabricated from steel in accordance with ASTM A36, and galvanized in accordance with ASTM A123.

4. Direct-tension indicators.
a. For each high-strength bolt at slip-critical connections, provide compressible washer type direct tension indicator in accordance with ASTM F959.

E. Stainless steel bolts (for use in stainless steel structures):
1. General:
a. Bolts and nuts shall be the products of a single manufacturer/fabricator to ensure proper fit without galling. Ship bolts with properly fitting nuts attached.
b. Units descaled, pickled and passivated as specified in "Fabrication."

2. Alloy: Type 304 or Type 316 to match alloy of structural members being connected.
3. Type 304:
a. Bolts: ASTM F593, Group 1, Condition CW, coarse threads.
b. Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
c. Washers: Type 304 stainless steel.

4. Type 316:
a. Bolts: ASTM F593, Group 2, Condition CW, coarse threads.
b. Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
c. Washers: Type 316 stainless steel.

5. Welded studs: As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.03 ISOLATING SLEEVES AND WASHERS

A. As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.04 GALVANIZED SURFACE REPAIR

A. Manufacturers: The following or equal:
   1. Jelt, Galvinox.

2.05 THREAD COATING

A. Manufacturers: One of the following or equal:
   1. Bostik, Never-Seez.
   2. Oil Research, Inc., WLR No. 111.

2.06 SUPPLEMENTARY PARTS

A. Furnish as required for complete structural steel erection, whether or not such parts and Work are specified or indicated on the Drawings.

2.07 FABRICATION

A. Shop assembly:
   1. Fabricate structural steel in accordance with AISC 360 and AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
   2. Where anchors, connections, or other details of structural steel are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.
   3. Round off sharp and hazardous projections and grind smooth.
   4. Take measurements necessary to properly fit work in the field. Take responsibility for and be governed by the measurements and proper working out of all the details.
   5. Take responsibility for correct fitting of metalwork.
   6. Welded connections:
      a. Comply with AWS requirements for the metals to be welded.
      b. Weld only in accordance with approved Welding Procedure Specifications.
      c. Keep Welding Procedure Specifications readily available for welders and inspectors during fabrication processes.

B. Stainless steel shapes and assemblies:
   1. For structural members such as W shapes, S shapes, channels, angles, and similar rolled shapes not available in quantity, size, and type of stainless steel specified or indicated on the Drawings:
      a. Fabricate shapes using laser-fused, full penetration welds between pieces of plate to attain same or higher section modulus and moment of inertia as that of members indicated on the Drawings.
      b. Fabricate shapes from dual grade stainless steel.
      c. Fabricate beams and channels to ASTM A6 tolerances.
      d. Manufacturers: The following or equal:
         1) Stainless Structurals, LLC.

2. Cleaning and passivation:
    a. Following shop fabrication of stainless steel members and bolts, clean and passivate fabrications at point of manufacture.
    b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a bright passive finished surface with no etching, pitting, frosting, or discoloration.
    c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated.
        1) Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.
    d. Pre-clean, chemically de-scale ("pickle"), passivate, and final-clean fabrications in accordance with the requirements of ASTM A380.
        1) If degreasing is required before cleaning (pickling) to remove scale or iron oxide, cleaning with citric acid treatments is permissible; however, such treatments shall be followed inorganic cleaners.
        2) Pickle and passivate stainless steel using a nitric acid solution in accordance with ASTM A380, Annex A2, Table A2.1, Part II.
        3) Pickling by citric acid treatment or sulfuric acid treatment is not considered to satisfy the requirements of this Section.
    e. Inspect after cleaning using methods specified for "gross inspection" in ASTM A380.
    f. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the site.

C. Galvanized carbon steel:
    1. Where galvanizing is required, hot-dip structural steel after fabrication in accordance with ASTM A123.
    2. Do not electro-galvanize or mechanically-galvanize unless specified or accepted by Engineer.
    3. Re-straighten galvanized items that bend or twist during galvanizing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 ERECTION

A. General:
    1. Fabricate structural and foundry items to true dimensions without warp or twist.
    2. Form welded closures neatly and grind off smooth where weld material interferes with fit or is unsightly.
    3. Install structural items accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
    4. Do not shift out of alignment, re-drill, re-shape, or force fit fabricated items.

5. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and level.
6. Rigidly support and brace structural items needing special alignment to preserve straight, level, even, and smooth lines. Keep structural items braced until concrete, grout, or dry pack mortar has hardened for 48 hours minimum.
7. Erect structural steel in accordance with AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
8. Where anchors, connections, and other details of structural steel erection are not specifically indicated on the Drawings or specified, form, locate, and attach with equivalent in quality and workmanship to items specified.
9. Round off sharp or hazardous projections and grind smooth.
10. Paint or coat steel items as specified in Sections 09900 - Painting and 09960 - High-Performance Coatings.

B. Stainless steel. Take all necessary precautions to avoid iron contamination of stainless steel during delivery, storage, and handling.
   1. Segregate stainless steel from iron.
   2. Tools and handling devices.
      a. Do not use iron tools clamps, chokes, working surfaces, or brushes when fabricating, handling, and erecting stainless steel.
      b. Do not use tools that have been contaminated by contact with iron.
      c. Use stainless steel, polymer coated, or wood tools and handling equipment. Do not use tools that have been contaminated by contact with iron or steel.

C. Welding: General:
   1. Make welds full penetration type, unless otherwise indicated on the Drawings.
   2. Remove backing bars and weld tabs after completion of weld. Repair defective welds observed after removal of backing bars and weld tabs.

D. Welding: Carbon steel:
   1. General: In accordance with AWS D1.1:
      a. Weld ASTM A36 and A992 structural steel, ASTM A500 and A501 structural tubing, and ASTM A53 pipe with electrodes in accordance with AWS A5.1, using E70XX electrodes; AWS A5.17, using F7X-EXXX electrodes; or AWS A5.20, using E7XT-X electrodes:
      b. Field repair cut or otherwise damaged galvanized surfaces to equivalent original condition using a galvanized surface repair.

E. Welding - stainless steel:
   1. General: In accordance with AWS D1.6.
   2. Field welding of stainless steel will not be permitted.
   3. Passivation of field-welded surfaces:
      a. Provide cleaning, pickling and passivating as specified under "Fabrications" of this Section. Clean using Derustit Stainless Steel Cleaner, or equal.

F. Interface with other products:
   1. Where steel members and fasteners come in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals with isolating sleeves and washers as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

G. Fasteners: General:
   1. Install bolts to project 2 threads minimum, but 1/2 inch maximum beyond nut.
   2. Anchor bolts and anchor rods: Install as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
      a. Unless otherwise specified, tighten nuts on anchor bolts and anchor rods specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry to the "snug-tight" condition.

H. Fasteners: High-strength carbon steel bolts:
   1. Connections with high-strength bolts shall in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
   2. Provide snug-tight joints at bolted connections, except where slip-critical or pre-tensioned connections are indicated on the Drawings.
   3. Joints: Slip-critical.
      a. Confirm that faying surfaces at connections are free of dirt and other foreign material, have been blast cleaned, and are free of coatings and inadvertent overspray in accordance with RCSC Specification.
      b. Furnish hardened flat washers in accordance with ASTM F436:
         1) On outer plies with slotted holes.
         2) When 1 or more plies of the connected material has a yield strength less than 40 ksi.
         3) Under element, nut, or bolt head, turned in tightening.
      c. Install tension indicator washers, placed in accordance with ASTM F959 Figure X1, to confirm adequate tightening of bolts.
      d. Tighten bolts to full pretension.
   4. Joints: Pre-tensioned.
      a. Joint preparation, assembly, and tightening shall be as specified for slip-critical connections, except that the requirements for un-coated faying surfaces shall not apply.
   5. Joints: Snug-tight:
      a. Install bolts with washers where required in accordance with RCSC Specification.
      b. Tighten bolts to bring the connected plies into firm contact. Tightening shall progress systematically beginning with the most rigid part of the joint. More than 1 cycle through the bolt pattern may be required to achieve this condition.
      c. Verify adequate tightening of bolts by visual observation to confirm that washers have been installed at locations required in accordance with RCSC Specification, and that the plies of the connected parts have been brought into firm contact.

I. Fasteners: Stainless steel bolts:
   1. Connections shall be snug-tight joints unless otherwise indicated on the Drawings.
   2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.
   3. Rotate nuts using a slow, smooth action without interruptions. Avoid over-tightening.

3.03 FIELD QUALITY CONTROL

A. Provide quality control as specified in Section 01450 - Quality Control.

3.04 FIELD QUALITY ASSURANCE

A. Provide quality assurance as specified in Section 01450 - Quality Control.

END OF SECTION

SECTION 05190

MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cast-in anchors and fasteners:
      a. Anchor bolts.
      b. Anchor rods.
      c. Welded studs.
   2. Post-installed steel anchors and fasteners:
      a. Concrete anchors.
   3. Appurtenances for anchoring and fastening:
      a. Anchor bolt sleeves.
      b. Isolating sleeves and washers.
      c. Thread coating for threaded stainless steel fasteners.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary.

B. American National Standards Institute (ANSI):
   1. B212.15 - Cutting Tools - Carbide-tipped Masonry Drills and Blanks for Carbide-tipped Masonry Drills.

C. American Welding Society (AWS):
   1. D1.1 - Structural Welding Code - Steel.
   2. D1.6 - Structural Welding Code - Stainless Steel.

D. ASTM International (ASTM):
   1. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   2. A108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold Finished.
   3. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   4. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. A240 - Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   6. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   7. A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
   8. A563 - Standard Specification for Carbon and Alloy Steel Nuts.

9. B633 - Standard Specification for *Electrodeposited* Coatings of Zinc on Iron and Steel.
10. B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
11. E488 - Standard Test Methods for Strength of Anchors in Concrete Elements.
12. F436 - Standard Specification for Hardened Steel Washers.
13. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
14. F594 - Standard Specification for Stainless Steel Nuts.
15. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
16. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

E. International Code Council Evaluation Service, Inc. (ICC-ES):
1. AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.
2. AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

1.03 DEFINITIONS

A. Built-in anchor: Headed bolt or assembly installed in position before filling surrounding masonry units with grout.

B. Cast-in anchor: Headed bolt or assembly installed in position before placing plastic concrete around.

C. Overhead installations: Fasteners installed on overhead surfaces where the longitudinal axis of the fastener is more than 60 degrees above a horizontal line so that the fastener resists sustained tension loads.

D. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.

E. Post-installed anchor: Fastener or assembly installed in hardened concrete or finished masonry construction, typically by drilling into the structure and inserting a steel anchor assembly.

F. Terms relating to structures or building environments as used with reference to anchors and fasteners:
1. Corrosive locations: Describes interior and exterior locations as follows:
    a. Locations used for delivery, storage, transfer, or containment (including spill containment) of chemicals used for plant treatment processes.
    b. Exterior and interior locations at the following treatment structures:
        1) Chemical Building.
2. Wet and moist locations: Describes locations, other than "corrosive locations," that are submerged, are immediately above liquid containment structures, or are subject to frequent wetting, splashing, or wash down. Includes:
    a. Exterior portions of buildings and structures.
    b. Liquid-containing structures:
        1) Locations at and below the maximum operating liquid surface elevation.

2) Locations above the maximum operating liquid surface elevation and:
a) Below the top of the walls containing the liquid.
b) At the inside faces and underside surfaces of a structure enclosing or spanning over the liquid (including walls, roofs, slabs, beams, or walkways enclosing the open top of the structure).

c. Liquid handling equipment:
1) Bases of pumps and other equipment that handles liquids.

d. Indoor locations exposed to moisture, splashing, or routine wash down during normal operations, including floors with slopes toward drains or gutters.

e. Other locations indicated on the Drawings.

3. Other locations:
a. Interior dry areas where the surfaces are not exposed to moisture or humidity in excess of typical local environmental conditions.

1.04 SUBMITTALS

A. General:
1. Submit as specified in Section 01330 - Submittal Procedures.
2. Submit information listed for each type of anchor or fastener to be used.

B. Action submittals:
1. Product data:
a. Cast-in anchors:
1) Manufacturer's data including catalog cuts showing anchor sizes and configuration, materials, and finishes.

b. Post-installed anchors:
1) For each anchor type, manufacturer's data including catalog cuts showing anchor sizes and construction, materials and finishes, and load ratings.

2. Samples:
a. Samples of each type of anchor, including representative diameters and lengths, if requested by the Engineer.

3. Certificates:
a. Cast-in anchors:
1) Mill certificates for steel anchors that will be supplied to the site.

b. Post-installed anchors:
1) Manufacturer's statement or certified test reports demonstrating that anchors that will be supplied to the site comply with the materials properties specified.

4. Test reports:
a. Post-installed anchors: For each anchor type used for the Work:
1) Current ICC-ES Report (ESR) demonstrating:
a) Acceptance of that anchor for use under the building code.

5. Manufacturer's instructions:
a. Requirements for storage and handling.
b. Recommended installation procedures including details on drilling, hole size (diameter and depth), hole cleaning and preparation procedures, anchor insertion, and anchor tightening.
c. Requirements for inspection or observation during installation.

6. Qualification statements:
    a. Post-installed anchors: Installer qualifications:
        1) Submit list of personnel performing installations and include date of manufacturer's training for each.

1.05 QUALITY ASSURANCE

A. Qualifications:
    1. Post installed anchors shall be in accordance with building code.
    2. Installers: Post-installed mechanical anchors:
        a. Installations shall be performed by trained installers having at least 3 years of experience performing similar installations with similar types of anchors.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver post-installed anchors in manufacturer's standard packaging with labels visible and intact. Include manufacturer's installation instructions.

B. Handle and store anchors and fasteners in accordance with manufacturer's recommendations and as required to prevent damage.

C. Protect anchors from weather and moisture until installation.

1.07 PROJECT CONDITIONS

A. As specified in the General Conditions.

B. Seismic Design Category (SDC) for structures is indicated on the Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. General:
    1. Furnish threaded fasteners with flat washers and hex nuts fabricated from materials corresponding to the material used for threaded portion of the anchor.
        a. Cast-in anchors: Provide flat washers and nuts as listed in the ASTM standard for the anchor materials specified.
        b. Post-installed anchors: Provide flat washers and nuts supplied for that product by the manufacturer of each anchor.
    2. Size of anchors and fasteners, including diameter and length or minimum effective embedment depth: As indicated on the Drawings or as specified in this Section. In the event of conflicts, contact Engineer for clarification.
    3. Where anchors and connections are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.

B. Materials:
    1. Provide and install anchors of materials as in this Section.

2.02 CAST-IN ANCHORS AND FASTENERS

A. Anchor bolts:
   1. Description:
      a. Straight steel rod having one end with an integrally forged head, and one threaded end. Embedded into concrete with the headed end cast into concrete at the effective embedment depth indicated on the Drawings or specified, and with the threaded end left to project clear of concrete face as required for the connection to be made.
      b. Furnish anchor bolts with heavy hex forged head or equivalent acceptable to Engineer.
         1) Rods or bars with angle bend for embedment in concrete (i.e., "L" or "J" shaped anchor bolts) are not permitted in the Work.
   2. Materials:
      a. Ship anchor bolts with properly fitting nuts attached.
      b. Type 316 stainless steel:
         1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
         2) Bolts: ASTM F593, Group 2, Condition CW, coarse threads.
         3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
         4) Washers: Type 316 stainless steel.
      c. Type 304 stainless steel:
         1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
         2) Bolts: ASTM F593, Group 1, Condition CW, coarse threads.
         3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
         4) Washers: Type 304 stainless steel.
      d. Galvanized steel:
         1) Hot-dip galvanized coating in accordance with ASTM F2329.
         2) Bolt: ASTM F1554, Grade 36, heavy hex, coarse thread.
         3) Nuts: ASTM A563, Grade A heavy hex, threads to match bolt.
         4) Washers: ASTM F436, Type 1.

B. Anchor rods:
   1. Description: Straight steel rod having threads on each end or continuously threaded from end to end. One threaded end is fitted with nuts or plates and embedded in concrete to the effective depth indicated on the Drawings, leaving the opposite threaded end to project clear of the concrete face as required for the connection to be made at that location.
   2. Materials:
      a. Stainless steel: Type 316:
         1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
         2) Rod: ASTM F593, Group 2, Condition CW, coarse threads.
         3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of rods.
         4) Washers: Type 316 stainless steel.
         5) Plates (embedded): ASTM A240.

b. Stainless steel: Type 304:
    1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
    2) Rod: ASTM F593, Group 1, Condition CW, coarse threads.
    3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads or rods.
    4) Washers: Type 304 stainless steel.
    5) Plates (embedded): ASTM A240.
c. Galvanized: steel:
    1) Hot-dip galvanized with coating in accordance with ASTM F2329.
    2) Rod: ASTM F1554, Grade 36, coarse thread.
    3) Nuts: ASTM A563, Grade A, threads to match rod.
    4) Washers: ASTM F436, Type 1.
    5) Plates (embedded): ASTM A36.

C. Welded studs:
1. Description: Anchor with forged head for embedment into concrete on one end, and welding ferrule for attachment to steel on the other. Welded to steel members or plates to provide anchorage for steel connections to concrete.
2. Acceptance criteria:
    a. Welded studs in accordance with AWS D1.1, Type B.
3. Manufacturers: One of the following or equal:
    a. Nelson Stud Welding Co., H4L Concrete Anchors or S3L Shear Connectors as indicated on the Drawings.
    b. Stud Welding Products, Headed Concrete Anchors (HCA) or Headed Shear Connectors (HSC) as indicated on the Drawings.
4. Materials:
    a. Stainless steel: Type 316L:
    b. Galvanized steel:
        1) Hot-dip galvanized after fabrication with coating in accordance with ASTM A123.
        2) Steel: Carbon steel in accordance with ASTM A108 with 50,000 pounds per square inch minimum yield strength, and 60,000 pounds per square inch minimum tensile strength.

D. Steel plates or shapes for fabrications including assemblies with welded studs or deformed bar anchors:
1. Stainless steel: Type 316L or Type 304L:
    a. Plates (embedded): ASTM A240.
2. Galvanized steel:
    a. Hot dip galvanized in accordance with ASTM A123.
    b. Steel: ASTM A36.

2.03 POST-INSTALLED ANCHORS AND FASTENERS - MECHANICAL

A. General:
1. Post-installed anchors used for the Work shall hold a current ICC Evaluation Service Report demonstrating acceptance for use under the building code. Reports prepared by other recognized evaluation agencies may be submitted for consideration if acceptable to the Engineer and to the authority having jurisdiction.

a. Conditions of use: The acceptance report shall indicate acceptance of the product for use under the following conditions:
    1) In regions of concrete where cracking has occurred or may occur.
    2) To resist short-term loads due to wind forces.
    3) To resist short-term loading due to seismic forces for the Seismic Design Category of the structure where the product will be used.
2. Substitutions: When requesting product substitutions, submit calculations, indicating the diameter, effective embedment depth and spacing of the proposed anchors, and demonstrating that the substituted product will provide load resistance that is equal to or greater than that provided by the anchors listed in this Section.
    a. Calculations shall be prepared by and shall bear the signature and seal of a Professional Engineer licensed in the State of Florida.
    b. Decisions regarding the acceptability of proposed substitutions shall be at the discretion of the Engineer.

B. Concrete anchors:
1. Description. Post-installed anchor assembly consisting of a threaded stud and a surrounding wedge expansion sleeve that is forced outward by torqueing the center stud to transfer loads from the stud to the concrete through bearing, friction, or both. (Sometimes referred to as "expansion anchors" or "wedge anchors."
    a. Do not use slug-in, lead cinch, and similar systems relying on deformation of lead alloy or similar materials to develop holding power.
2. Concrete anchors for anchorage to concrete:
    a. Acceptance criteria:
        1) Concrete anchors shall have a current ICC-ES Report demonstrating that the anchors have been tested and qualified for performance in both cracked and un-cracked concrete, and for short-term loading due to wind and seismic forces for Seismic Design Categories A through F in accordance with ACI 355.2 and with ICC-ES AC193 (including all mandatory tests and optional tests for seismic tension and shear in cracked concrete).
        2) Concrete anchor performance in the current ICC-ES Report shall be "Category 1" as defined in ACI 355.2.
    b. Manufacturers: One of the following or equal:
        1) Hilti, Kwik Bolt TZ Expansion Anchor.
        2) DeWalt/Powers, PowerStud+ SD2.
        3) Simpson Strong-Tie, Strong Bolt 2 Wedge Anchor.
    c. Materials. Integrally threaded stud, wedge, washer, and nut:
        1) Stainless steel: Type 316.
            a) Type 304 stainless steel acceptable for use at wet and moist locations when accepted in writing by the Engineer.
        2) Galvanized: Carbon steel, zinc plated in accordance with ASTM B633, minimum 5 microns (Fe/Zn 5).
3. Concrete anchors for anchorage to concrete masonry (fully grouted cells):
    a. Acceptance criteria: Concrete anchors shall have a current ICC-ES Report demonstrating that the anchors have been tested and qualified in accordance with ICC-ES AC01, including all mandatory tests and optional seismic tests.
    b. Manufacturers: One of the following or equal:
        1) Hilti, Kwik Bolt 3 Expansion Anchor.

2) DeWalt/Powers, Power-Stud+ SD1.
3) Simpson Strong-Tie, Wedge-All Anchor.

c. Materials. Integrally threaded stud, wedge, washer, and nut:
1) Stainless steel: Type 316.
a) Type 304 stainless steel acceptable for use at wet and moist locations when accepted in writing by the Engineer.
2) Galvanized: Carbon steel, zinc plated in accordance with ASTM B633, minimum 5 microns (Fe/Zn 5) or mechanically galvanized in accordance with ASTM B695, Class 55, Type 1.

C. Flush shells:
1. Description: Post-installed anchor assembly consisting of an internally threaded mandrel that is forced into a pre-drilled concrete hole with a setting tool until the top of the anchor is flush with the face of the concrete. Once installed, a removable threaded bolt is installed in the mandrel.
2. Flush shell anchors are not permitted in the Work.

2.04 APPURTENANCES FOR ANCHORING AND FASTENING

A. Anchor bolt sleeves:
1. Having inside diameter approximately 2 inches greater than bolt diameter and minimum 10-bolt diameters long.
2. Plastic sleeves:
a. High-density polyethylene, corrugated sleeve, threaded to provide adjustment of location on the anchor bolt.
b. Manufacturers: The following or equal:
1) Portland Bolt & Manufacturing Co.

B. Forged steel hardware:
1. See Section 05120 - Structural Steel for forged steel hardware connectors, including clevises, turnbuckles, eye bolts, eye nuts, and sleeve nuts.

C. Isolating sleeves and washers:
1. Manufacturers: One of the following or equal:
a. Central Plastics Co.
b. Allied Corrosion Industries.
2. Sleeves: Mylar, 1/32-inch thick, 4,000 volts per mil dielectric strength, of proper size to fit bolts and extending half way into both steel washers.
3. One sleeve required for each bolt.
4. Washers: The inside diameter of all washers shall fit over the isolating sleeve, and both the steel and isolating washers shall have the same inside diameter and outside diameter.
a. Proper size to fit bolts.
b. Two 1/8-inch thick steel washers for each bolt.
c. G3 Phenolic: 2 insulating washers are required for each bolt:
1) Thickness: 1/8 inch.
2) Base material: Glass.
3) Resin: Phenolic.
4) Water absorption: 2 percent.
5) Hardness (Rockwell): 100.
6) Dielectric strength: 450 volts per mil.
7) Compression strength: 50,000 pounds per square inch.

8) Tensile strength: 20,000 pounds per square inch.
9) Maximum operating temperature: 350 degrees Fahrenheit.

D. Coating for repair of galvanized surfaces:
1. Manufacturers: The following or equal:
a. Jelt, Galvinox.

E. Thread coating: For use with threaded stainless steel fasteners:
1. Manufacturers: One of the following or equal:
a. Bostik, Never-Seez.
b. Oil Research, Inc., WLR No. 111.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION: GENERAL

A. Where anchors and fasteners are not specifically indicated on the Drawings or specified, make attachments with materials specified in this Section.

B. Substitution of anchor types:
1. Post-installed anchors may not be used as an alternative to cast-in/built-in anchors at locations where the latter are indicated on the Drawings.
2. Cast-in/built-in anchors may be used as an alternative to post-installed mechanical anchors at locations where the latter are indicated on the Drawings.

C. Protect products from damage during installation. Take special care to protect threads and threaded ends.

D. Accurately locate and position anchors and fasteners:
1. Unless otherwise indicated on the Drawings, install anchors perpendicular to the surfaces from which they project.
2. Install anchors so that at least 2 threads, but not more than 1/2 inch of threaded rod, projects past the top nut.

E. Interface with other products:
1. Where steel anchors come in contact with dissimilar metals (aluminum, stainless steel, etc.), use stainless steel anchors and separate or isolate dissimilar metals using isolating sleeves and washers.
2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.

3.03 INSTALLATION: CAST-IN ANCHORS

A. General:
1. Accurately locate cast-in and built-in anchors.

a. Provide anchor setting templates to locate anchor bolts and anchor rods. Secure templates to formwork.
b. Brace or tie off embedments as necessary to prevent displacement during placement of plastic concrete or of surrounding masonry construction.
c. Position and tie cast-in and built-in anchors in place before beginning placement of concrete or grout. Do not "stab" anchors into plastic concrete, mortar, or grout.
d. Do not allow cast-in anchors to touch reinforcing steel. Where cast-in anchors are within 1/4 inch of reinforcing steel, isolate the metals by wrapping the anchors with a minimum of 4 wraps of 10-mil polyvinyl chloride tape in area adjacent to reinforcing steel.

2. For anchoring at machinery bases subject to vibration, use 2 nuts, with 1 serving as a locknut.
3. Where anchor bolts or anchor rods are indicated on the Drawings as being for future use, thoroughly coat exposed surfaces that project from concrete or masonry with non-oxidizing wax. Turn nuts down full length of the threads, and neatly wrap the exposed thread and nut with a minimum of 4 wraps of 10-mil waterproof polyvinyl tape.

B. Anchor bolts:
1. Minimum effective embedment: 10-bolt diameters, unless a longer embedment is indicated on the Drawings.
2. Where indicated on the Drawings, set anchor bolts in plastic, galvanized steel or stainless steel sleeves to allow for adjustment. Fill sleeves with grout when a machine or other equipment is grouted in place.

C. Anchor rods:
1. Install as specified for anchor bolts.

D. Welded studs:
1. Butt weld to steel fabrications with automatic stud welding gun as recommended by the manufacturer.
2. Ensure that butt weld develops full strength of the stud.

3.04 INSTALLATION: POST-INSTALLED MECHANICAL ANCHORS

A. General:
1. Install anchors in accordance with the manufacturer's instructions, ACI 355.2, the anchor's ICC-ES Report. Where conflict exists between the ICC-ES Report and the requirements in this Section, the requirements of the ICC-ES Report shall control.
2. Where anchor manufacturer recommends the use of special tools and/or specific drill bits for installation, provide and use such tools.
3. After anchors have been positioned and inserted into concrete or masonry, do not:
a. Remove and reuse/reinstall anchors.
b. Loosen or remove bolts or studs.

B. Holes drilled into concrete and masonry:
1. Do not drill holes in concrete or masonry until the material has achieved its minimum specified compression strength (f'c or f'm).

2. Accurately locate holes:
    a. Before drilling holes, use a reinforcing bar locator to identify the position of all reinforcing steel, conduit, and other embedded items within a 6-inch radius of each proposed hole.
    b. If the hole depth exceeds the range of detection for the rebar locator, the Engineer may require radiographs of the area designated for investigation before drilling commences.
3. Exercise care to avoid damaging existing reinforcement and other items embedded in concrete and masonry.
    a. If embedments are encountered during drilling, immediately stop work and notify the Engineer. Await Engineer's instructions before proceeding.
4. Unless otherwise indicated on the Drawings, drill holes perpendicular to the concrete surface into which they are placed.
5. Drill using anchor manufacturer's recommended equipment and procedures:
    a. Unless otherwise recommended by the manufacturer, drill in accordance with the following:
        1) Drilling equipment: Electric or pneumatic rotary type with light or medium impact. Where edge distances are less than 2 inches, use lighter impact equipment to prevent micro-cracking and concrete spalling during drilling process.
        2) Drill bits: Carbide-tipped in accordance with ANSI B212-15. Hollow drills with flushing air systems are preferred.
6. Drill holes at manufacturer's recommended diameter and to depth required to provide the effective embedment indicated.
7. Clean and prepare holes as recommended by the manufacturer and as required by the ICC-ES Report for that anchor.
    a. Unless otherwise recommended by anchor manufacturer, remove dust and debris using brushes and clean compressed air.
    b. Repeat cleaning process as required by the manufacturer's installation instructions.
    c. When cleaning holes for stainless steel anchors, use only stainless steel or non-metallic brushes.

C. Insert and tighten (or torque) anchors in full compliance with the manufacturer's installation instructions.
1. Once anchor is tightened (torque), do not attempt to loosen or remove its bolt or stud.

D. Concrete anchors: Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Concrete Anchors			
Nominal Diameter	**Minimum Effective Embedment Length**		**Minimum Member Thickness**
	In Concrete	**In Grouted Masonry**	
3/8 inch	2 1/2 inch	2 5/8 inch	8 inch
1/2 inch	3 1/2 inch	3 1/2 inch	8 inch
5/8 inch	4 1/2 inch	4 1/2 inch	10 inch
3/4 inch	5 inch	5 1/4 inch	12 inch

E. Flush shell anchors:
   1. Flush shell anchors are not permitted in the Work.
   2. If equipment manufacturer's installation instructions recommend the use of flush shell anchors, contact Engineer for instructions before proceeding.

3.05 FIELD QUALITY CONTROL

A. Contractor shall provide quality control over the Work of this Section as specified in Section 01450 - Quality Control.
   1. Expenses associated with work described by the following paragraphs shall be paid by the Contractor.

B. Post-installed anchors:
   1. Review anchor manufacturer's installation instructions and requirements of the Evaluation Service Report (hereafter referred to as "installation documents") for each anchor type and material.
   2. Observe hole-drilling and cleaning operations for conformance with the installation documents.
   3. Certify in writing to the Engineer that the depth and location of anchor holes, and the torque applied for setting the anchors conforms to the requirements of the installation documents.

C. Field-testing Load tests on installed anchors:
   1. In addition to special inspections for field quality assurance, the Engineer may select up to 10 percent of each type and size of cast-in anchor, built-in anchor, and post-installed mechanical anchor for proof-load testing (pullout or shear). Tests will be non-destructive whenever possible.
   2. Testing procedures and acceptance criteria are described under Field Quality Assurance.
   3. Cooperate in providing access and anchors for testing.

3.06 FIELD QUALITY ASSURANCE

A. Owner's Representative will provide on-site observation and field quality assurance for the Work of this Section.
   1. Expenses associated with work described by the following paragraphs shall be paid by the Owner.

B. Field inspections and special inspections:
   1. Required inspections: Observe construction for conformance to the approved Contract Documents, the accepted submittals, and manufacturer's installation instructions for the products used.
   2. Record of inspections:
      a. Maintain record of each inspection.
      b. Submit copies to Engineer upon request.
   3. Statement of special inspections: At the end of the project, prepare and submit to the Engineer and the authority having jurisdiction inspector's statement that the Work was constructed in general conformance with the approved Contract Documents, and that deficiencies observed during construction were resolved.

C. Special inspections: Anchors cast into concrete and built into masonry.

1. Provide special inspection during positioning of anchors and placement of concrete or masonry (including mortar and grout) around the following anchors:
    a. Anchor bolts.
    b. Anchor rods.
    c. Welded studs.
2. During placement, provide continuous special inspection at each anchor location to verify that the following elements of the installation conform to the requirements of the Contract Documents.
    a. Anchor:
        1) Type and dimensions.
        2) Material: Galvanized steel, Type 304 stainless steel, or Type 316 stainless steel as specified in this Section or indicated on the Drawings.
        3) Positioning: Spacing, edge distances, effective embedment, and projection beyond the surface of the construction.
        4) Reinforcement at anchor: Presence, positioning, and size of additional reinforcement at anchors indicated on the Drawings.
3. Following hardening and curing of the concrete or masonry surrounding the anchors, provide periodic special inspection to observe and confirm the following:
    a. Base material (concrete or grouted masonry):
        1) Solid and dense concrete or grouted masonry material within required distances surrounding anchor.
        2) Material encapsulating embedment is dense and well-consolidated.

D. Special Inspections: Post-installed mechanical anchors placed in hardened concrete and in grouted masonry.
1. Provide special inspection during installation of the following anchors:
    a. Concrete anchors.
2. Unless otherwise noted, provide periodic special inspection during positioning, drilling, placing, and torqueing of anchors.
    a. Provide continuous special inspection for post-installed anchors in "overhead installations" as defined in this Section.
3. Requirements for periodic special inspection:
    a. Verify items listed in the following paragraphs for conformance to the requirements of the Contract Documents and the Evaluation Report for the anchor being used. Observe the initial installation of each type and size of anchor, and subsequent installation of the same anchor at intervals of not more than 4 hours.
        1) Any change in the anchors used, in the personnel performing the installation, or in procedures used to install a given type of anchor shall require a new "initial inspection."
    b. Substrate: Concrete or masonry surfaces receiving the anchor are sound and of a condition that will develop the anchor's rated strength.
    c. Anchor:
        1) Manufacturer, type, and dimensions (diameter and length).
        2) Material (galvanized, Type 304 stainless steel, or Type 316 stainless steel).
    d. Hole:
        1) Positioning: Spacing and edge distances.
        2) Drill bit type and diameter.

3) Diameter, and depth.
4) Hole cleaned in accordance with manufacturer's required procedures. Confirm multiple repetitions of cleaning when recommended by the manufacturer.
5) Anchor's minimum effective embedment.
6) Anchor tightening/installation torque.

4. Requirements for continuous special inspection:
   a. The special inspector shall observe all aspects of anchor installation, except that holes may be drilled in his/her absence provided that he/she confirms the use of acceptable drill bits before drilling, and later confirms the diameter, depth, and cleaning of drilled holes.

E. Field tests:
1. Owner's Representative may, at any time, request testing to confirm that materials being delivered and installed conform to the requirements of the Specifications.
   a. If such additional testing shows that the materials do not conform to the specified requirements, the Contractor shall pay the costs of these tests.
   b. If such additional testing shows that the materials do conform to the specified requirements, the Owner shall pay the costs of these tests.
2. Field testing: Post-installed anchors:
   a. Proof load testing:
      1) In addition to performing special inspections, the Owner's Representative may select up to 10 percent of each type and size of post-installed mechanical anchor for proof-load testing for pullout or shear. Tests shall be non-destructive whenever possible.
      2) Perform tension testing in accordance with ASTM E488. Apply proof loads using a calibrated hydraulic ram.
   b. Torque load testing:
      1) Using a calibrated torque wrench, apply manufacturer's recommended installation torque.
   c. Acceptance criteria:
      1) Minimum anchor embedment, proof load for pullout and shear, and torque shall be as specified in this Section.
      2) Anchors that fail to resist their designated proof load or installation torque requirements shall be regarded as non-performing.
      3) If more than 10 percent of the tested anchors fail to achieve their specified torque or proof load, all anchors of the same diameter and type as the failed anchors shall be tested.
      4) Remediate non-performing anchors as specified in "non-conforming work."

3.07 NON-CONFORMING WORK

A. Remove misaligned or non-performing anchors.

B. Fill empty anchor holes and repair failed anchor locations using high-strength, non-shrink, non-metallic grout.

C. If more than 10 percent of all tested anchors of a given diameter and type fail to achieve their specified torque or proof load, the Engineer will provide directions for required modifications. Make such modifications, up to and including replacement of all anchors, at no additional cost to the Owner.

3.08 SCHEDULES

A. Stainless steel. Provide and install stainless steel anchors at the following locations:
   1. "Corrosive locations" as defined in this Section: Type 316 stainless steel
   2. "Wet and moist locations" as defined in this Section: Type 316 stainless steel.
   3. "Other locations:"
      a. For connecting stainless steel members to concrete or masonry: Type 304 stainless steel.
      b. For connecting aluminum members to concrete or masonry.
      c. For connecting fiber-reinforced plastic (FRP) members to concrete or masonry.
   4. At locations indicated on the Drawings.

B. Galvanized: Provide and install galvanized carbon steel anchors at the following locations:
   1. Locations not requiring stainless steel.
   2. At locations indicated on the Drawings.

END OF SECTION

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SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Concrete inserts.
   2. Handrails and guardrails.
   3. Ladders.
   4. Manhole frames and covers.
   5. Manhole steps.
   6. Metal gratings.
   7. Metal tread plate.
   8. Preformed channel pipe supports.
   9. Miscellaneous metals.
   10. Associated accessories to the above items.

1.02 REFERENCES

A. Aluminum Association (AA):
   1. DAF-45: Designations from Start to Finish.
      a. M12-C22-A41.

B. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

C. ASTM International (ASTM):
   1. A36 - Standard Specification for Carbon Structural Steel.
   2. A48 - Standard Specification for Gray Iron Castings.
   3. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
   4. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   5. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications.
   6. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   7. A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   8. A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   9. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   10. A489 - Standard Specification for Carbon Steel Lifting Eyes.
   11. A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat-Treated, 150 ksi Minimum Tensile Strength.
   12. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

13. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
14. A635 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
15. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
16. A992 - Standard Specification for Structural Steel Shapes.
17. B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
18. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
19. B308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
20. B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
21. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.

D. American Welding Society (AWS):
   1. A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

E. National Association of Architectural Metal Manufacturers (NAAMM):
   1. Metal Finishes Manual.

F. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

A. Passivation: Removal of exogenous iron or iron compounds from the surface of a stainless steel by means of chemical dissolution resulting from treatment with an acid solution that removes the surface contamination but does not significantly affect the stainless steel itself.

1.04 SUBMITTALS

A. Product Data:
   1. Handrails and guardrails.
   2. Manhole frames and covers.
   3. Manhole steps.
   4. Metal grating.

B. Shop drawings:
   1. Handrails and guardrails:
      a. Including details on connection attachments, gates, kick plates, ladders, and angles.
      b. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
      c. Include erection drawings, elevations, and details where applicable.
      d. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

2. Ladders.
3. Metal grating.
4. Metal tread plate.
5. Stairs.
6. Miscellaneous metals.

C. Samples:
   1. Guardrails with specified finishes.

D. Quality control submittals:
   1. Design data.
   2. Test reports:
      a. Guardrails: 3 copies of certified tests performed by an independent testing laboratory certifying that guardrails meet current State and OSHA strength requirements.
      b. Gratings:
         1) Grating manufacturers' calculations showing that gratings will meet specified design load, stress, and deflection requirements for each size grating for each span.
         2) Reports of tests performed.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Unless otherwise specified or indicated on the Drawings, structural and miscellaneous metals in accordance with the standards of the ASTM, including the following:

   1. Stainless steels are designated by type or series defined by ASTM.
   2. Where stainless steel is welded, use low-carbon stainless steel.

2.02 MANUFACTURED UNITS

A. Concrete inserts:
   1. Concrete inserts for supporting pipe and other applications are specified in Section 15061 - Pipe Supports.

B. Handrails and guardrails:
   1. General:
      a. Design and fabricate assemblies to conform to current local, State, and OSHA standards and requirements.
      b. Coordinate layout of assemblies and post spacings to avoid conflicts with equipment and equipment operators:
         1) Indicate on the shop drawings locations of such equipment.
         2) Highlight locations where railings cannot be made continuous and obtain Engineer's directions on how to proceed before fabricating or installing railings.

2. Aluminum handrails and guardrails (nonwelded pipe):
    a. Rails, posts, and fitting-assembly spacers:
        1) In accordance with ASTM B429, 6005, 6063 or 6105, minimum Schedule 40, extruded aluminum pipe of minimum 1.89-inch outside diameter and 0.14-inch wall thickness.
    b. Kick plates: 6061 or 6105 aluminum alloy.
    c. Fastenings and fasteners: As recommended or furnished by the manufacturer.
    d. Other parts: 6063 extruded aluminum, or F214 or F514.0 aluminum castings:
        1) Fabrications: In accordance with ASTM B209 or ASTM B221 extruded bars:
            a) Bases: 6061 or 6063 extruded aluminum alloy.
        2) Plug screws or blind rivets: Type 305 stainless steel.
            a) Other parts: Type 300 series stainless steel.
    e. Finish of aluminum components:
        1) Anodized finish, 0.7 mil thick, applied to exposed surfaces after cutting. Aluminum Association Specification M12-C22-A41, mechanical finish non specular as fabricated, chemical finish-medium matte, anodic coating-clear Class I Architectural.
        2) Pretreat aluminum for cleaning and removing markings before anodizing.
    f. Fabrication and assembly:
        1) Fabricate posts in single, unspliced pipe length.
        2) Perform without welding.
        3) Do not epoxy bond the parts.
        4) Maximum clear opening between assembled railing components as indicated on the Drawings.
    g. Manufacturers: One of the following or equal:
        1) Moultrie Manufacturing Co., Wesrail.
        2) Golden Railings, Riveted System.
        3) Craneveyor Corp. Enerco Metals, C-V Rail.
3. Fastenings and fasteners: As recommended or furnished by guardrail manufacturer for use with this system.

C. Ladders:
    1. General:
        a. Type: Safety type conforming to local, State, and OSHA standards as minimum. Furnish guards for ladder wells.
        b. Size: 18 inches wide between side rails of length, size, shape, detail, and location indicated on the Drawings.
    2. Aluminum ladders:
        a. Materials: 6063-T5 aluminum alloy.
        b. Rungs:
            1) 1-inch minimum solid square bar with 1/8-inch grooves in top and deeply serrated on all sides.
            2) Capable of withstanding 1,000-pound load without failure.
        c. Side rails: Minimum 4-inch by 1/2-inch flat bars.

d. Finish of aluminum components:
    1) Anodized finish, 0.7 mil thick, applied to exposed surfaces after cutting. Aluminum Association Specification M12-C22-A41, mechanical finish non specular as fabricated, chemical finish-medium matte, anodic coating-clear Class I Architectural.
    2) Pretreat aluminum for cleaning and removing markings before anodizing.
e. Fabrication:
    1) Welded construction, of size, shape, location, and details indicated on the Drawings.
    2) For ladders over 20 feet high, furnish standard ladder cages or fall prevention system designed in accordance with State and OSHA requirements.
f. Fall prevention system: Include but not limit to railing, brackets, clamps, 2 sleeves, and 2 belts, satisfying OSHA safe climbing requirements:
    1) Manufacturers: One of the following or equal:
        a) North Consumer Products, Saf-T-Climb.
        b) Swager Communications, Climbers Buddy System.

D. Manhole frames and covers:
1. Material: Gray iron castings, in accordance with ASTM A48, Class 30-B.
2. Type: Heavy-duty traffic type, with combined minimum set weight of 265 pounds.
3. Machine horizontal and vertical bearing surfaces to fit neatly, with easily removable cover bearing firmly in frame without rocking.
4. Frame:
    a. Bottom flange type.
    b. Approximately 4-1/2 inches frame height.
    c. Dimensions as indicated on the Drawings.
        1) Minimum inside clear dimension may not be smaller than nominal diameter minus 2 inches.
5. Cover:
    a. Skid-resistant grid pattern design stamped with name of utility service provided by manhole, such as "ELECTRICAL," "SEWER," "TELEPHONE," or "WATER."
    b. Solid type without ventilation holes.
6. Finish: Unpainted.

E. Manhole steps:
1. Type 316 stainless steel, of size, shape, and spacing indicated on the Drawings.

F. Metal gratings:
1. General:
    a. Fabricate grating to cover areas indicated on the Drawings.
    b. Unless otherwise indicated on the Drawings, grating over an opening shall cover entire opening.
    c. Make cutouts in grating where required for equipment access or protrusion, including valve operators or stems, and gate frames.
    d. Band ends of grating and edges of cutouts in grating:
        1) End banding: 1/4 inch less than height of grating, with top of grating and top edge of banding flush.

2) Cutout banding: Full height of grating.
3) Use banding of same material as grating.
4) Panel layout: Enable installation and subsequent removal of grating around protrusions or piping.
5) Openings 6 inches and larger: Lay out grating panels with edges of 2 adjacent panels located on centerline of opening.
6) Openings smaller than 6 inches: Locate opening at edge of single panel.
7) Where an area requires more than 1 grating section to cover area, clamp adjacent grating sections together at 1/4-points with fasteners acceptable to Engineer.
8) Fabricate steel grating sections in units weighing not more than 50 pounds each.
9) Fabricate aluminum grating sections in units of weighing not more than 50 pounds each.
10) Gaps between adjacent grating sections shall not be more than the clear spacing between bearing bars.

e. When requested by Engineer, test 1 section of each size grating for each span length involved on the job under full load:
1) Furnish a suitable dial gauge for measuring deflections.

f. Grating shall be aluminum, unless otherwise specified or indicated on the Drawings.

2. Aluminum grating:
a. Material for gratings, shelf angles, and rebates: 6061-T6 or 6063-T6 aluminum alloy, except crossbars may be 6063-T5 aluminum alloy.
b. Shelf angle concrete anchors: Type 304 or Type 316 stainless steel.
c. Grating rebate rod anchors: 6061-T6 or 6063-T6 aluminum alloy.
d. Bar size and spacing: As determined by manufacturer to enable grating to support design load.
e. Design live load: A minimum of 100 pounds per square foot uniform live load on entire grating area, but not less than the live load indicated on the Drawings for the area where grating is located.
f. Maximum fiber stress for design load: 12,000 pounds per square inch.
g. Maximum deflection due to design load: 1/240 of grating clear span.
h. Maximum spacing of main grating bars: 1-1/8 inches clear between bars.
i. Minimum grating height: 1-1/2 inches.
j. Manufacturers: The following or equal:
1) Harsco Industrial IKG , Grooved aluminum I-bar.

G. Metal tread plate:
1. Plate having a raised figured pattern on 1 surface to provide improved traction.

H. Miscellaneous aluminum:
1. Fabricate aluminum products, not covered separately in this Section, in accordance with the best practices of the trade and field assemble by riveting or bolting.
2. Do not weld or flame cut.

I. Miscellaneous cast iron:
1. General:
a. Tough, gray iron, free from cracks, holes, swells, and cold shuts.

b. Quality such that hammer blow will produce indentation on rectangular edge of casting without flaking metal.
c. Before leaving the foundry, clean castings and apply 16-mil dry film thickness coating of coal-tar epoxy, unless otherwise specified or indicated on the Drawings.

J. Miscellaneous stainless steel:
1. Provide miscellaneous stainless steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
a. Fabricate and install in accordance with the best practices of the trade.
2. Cleaning and passivation:
a. Following shop fabrication of stainless steel members, clean and passivate fabrications.
b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a passive finished surface.
c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated.
1) Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.
d. Pre-clean, chemically descale (pickle), and final clean fabrications in accordance with the requirements of ASTM A380 to remove deposited contaminants before shipping.
1) Passivation by citric acid treatment is not allowed.
a) If degreasing is required before cleaning to remove scale or iron oxide, cleaning (pickling) treatments with citric acid are permissible; however, these treatments shall be followed by inorganic cleaners such as nitric-hydrofluoric acid.
2) Provide acid descaling (pickling) in accordance with Table A1.1 of Annex A1 of ASTM A380.
3) After pickling, final cleaning of stainless steel shall conform to Part II of Table A2.1 of Annex A2 of ASTM A380.
e. After cleaning, inspect using methods specified for "gross inspection" in ASTM A380.
f. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the job site.

K. Miscellaneous structural steel:
1. Provide miscellaneous steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
a. Fabricate and install in accordance with the best practices of the trade.

L. Isolating sleeves and washers:
1. As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Examine work in place to verify that it is satisfactory to receive the work of this Section.
   2. If unsatisfactory conditions exist, do not begin this work until such conditions have been corrected.

3.02 INSTALLATION

A. General:
   1. Install products as indicated on the Drawings, and in accordance with shop drawings and manufacturer's printed instructions, as applicable except where specified otherwise.
   2. Interface between materials:
      a. Dissimilar metals: Where steel comes in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals.
         1) Make application so that the isolating or protective barrier is not visible in the completed construction.
         2) Isolating sleeves and washers: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
      b. Aluminum in contact with concrete or masonry: Coat aluminum surfaces as specified in Section 09960 - High Performance Coatings.
      c. Aluminum in contact with concrete or masonry.

B. Handrails and guardrails:
   1. General:
      a. Fasten pipe rails to fittings with Series 300 stainless steel pop rivets or flush set screws.
      b. Make pipe cuts clean and straight, free of burrs and nicks, and square and accurate for minimum joint gap.
      c. Drill and countersink holes to proper size, as required for a tight flush fit of screws and other component parts.
      d. Space attachment brackets as indicated in the manufacturer's instructions.
   2. Aluminum pipe handrails and guardrails:
      a. During construction, keep exterior surfaces of handrails and guardrails covered with minimum 0.4 millimeter of heat shrink polyethylene film.
      b. Do not remove protective film before handrails and guardrails have been accepted by Engineer nor before other work in proximity of handrails and guardrails has been completed.
      c. Discontinue handrails and guardrails at lighting fixtures.
      d. Provide 1/8-inch diameter weep hole at base of each post.
      e. Space posts as indicated on the Drawings.
      f. Anchor posts into concrete by grouting posts into formed holes in concrete, into stainless steel sleeves cast in concrete; or bracket mount to face of concrete surfaces as specified and indicated on the Drawings.
      g. Space rails as indicated on the Drawings.

h. Make adequate provision for expansion and contraction of kick plates and rails.
    1) Make provisions for removable sections where indicated on the Drawings.
i. Make lower rails a single, unspliced length between posts, or continuous.
j. Make top rails continuous whenever possible, and attach single, unspliced lengths to 3 posts minimum.
k. Draw up fasteners tight with hand wrench or screwdriver.
l. Space attachment brackets as indicated on shop drawings or in manufacturer's installation instructions.
m. Completed installation shall have handrails and railings rigid and free of play at joints and attachments.
n. Protect handrail and guardrail finish from scratches, gouges, dents, stains, and other damage.
o. Replace damaged or disfigured handrails and guardrails with new.
p. Shortly before final acceptance of the work, and after removal of protective polyethylene film, clean handrails and guardrails with mild detergent or with soap and water.
    1) After cleaning, thoroughly rinse handrails and guardrails and wipe with soft cloth.
q. Erect guardrail straight, level, plumb, and true to the positions as indicated on the Drawings. Correct deviations from true line of grade, which are visible to the eye.

C. Ladders:
1. Secure to supporting surface with bent plate clips providing minimum 8 inches between supporting surface and center of rungs.
2. Where exit from ladder is forward over top rung, extend side rails 3 feet 3 inches minimum above landing, and return the rails with a radius bend to the landing.
3. Where exit from ladder is to side, extend ladder 5 feet 6 inches minimum above landing and rigidly secure at top.
4. Erect rail straight, level, plumb, and true to position indicated on the Drawings:
    a. Correct deviations from true line or grade which are visible to the eye.

D. Manhole frames and covers:
1. Installation: Per Florida Department of Transportation.

E. Manhole steps:
1. Space as indicated on the Drawings.

F. Metal gratings:
1. General:
    a. Allow 1/8-inch maximum clearance between ends of grating and inside face of vertical leg of shelf angles.
    b. Horizontal bearing leg of shelf angles shall be 2 inches minimum.
    c. Install aluminum plate or angles where necessary to fill openings at changes in elevation and at openings between equipment and grating.
    d. Install angle stops at ends of grating.
    e. Installed grating shall not slide out of rebate or off support.
    f. Weld stops in place, unless otherwise specified or indicated on the Drawings.

g. Top surfaces of grating sections adjacent to each other shall lie in same plane.

2. Aluminum grating:
   a. Aluminum grating: Support on aluminum shelf angles or rebates.
3. Heavy-duty steel grating:
   a. Support on hot-dip galvanized structural steel rebates embedded and anchored in concrete.
   b. Use for roadways, traffic areas, and where indicated on the Drawings.

G. Stainless Steel:
   1. Welding:
      a. Passivate field-welded surfaces:
         1) Provide cleaning, pickling and passivating as specified in this Section.
         2) Clean using Derustit Stainless Steel Cleaner, or equal.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES:

A. Concealed wood blocking, nailers, and supports.

1.02 REFERENCE STANDARDS

A. ASTM A153/A153m - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

B. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.

1.03 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Normal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including shims, bracing, and blocking.

3.02 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to 2 or more studs or other method of support is explicitly indicated.

D. Specifically, provide the following non-structural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.
   7. Chalkboards and marker boards.
   8. Wall paneling and trim.
   9. Joints of rigid wall coverings that occur between studs.

END OF SECTION

SECTION 06174

SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Wood trusses, including bridging, temporary and permanent bracing, associated components, and accessories.

1.02 REFERENCES

A. American Forest and Paper Association (AF&PA):
   1. National Design Specification for Wood Construction.

B. ASTM International (ASTM):
   1. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

C. Truss Plate Institute (TPI):
   1. Design Specifications for Metal Plate Connected Wood Trusses.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Design and fabricate of wood trusses in accordance with:
      a. National Design Specifications for Wood Construction.
      b. Design Specifications for Metal Plate Connected Wood Trusses.

1.04 SUBMITTALS

A. Shop drawings: For each type and size truss, include:
   1. Species and grades of lumber used.
   2. Design loadings.
   3. Design calculations for trusses and connections.
   4. Pitch, span, and spacing of trusses.
   5. Metal plate connectors, gauges, sizes, and name of manufacturer.
   6. Bearing and anchorage details.
   7. Truss supports.
   8. Camber.
   9. Permanent bracing and bridging.
   10. Details of field splice connections of subcomponents.

B. Product Data.

C. Handling and erection instructions.

D. Design Data.

E. Certificates.

1.05 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of wood trusses for minimum 5 years with satisfactory performance record.

B. Lumber shall bear grade mark stamp of recognized grading association or licensed lumber inspection agency.

C. Fabricate trusses and other roof structural components in properly equipped manufacturing facility of permanent nature.

D. Employ only experienced workmen, using precision cutting and truss fabricating equipment, under direct supervision of qualified foreman.

E. Fabricate trusses under strict rules of inspection and quality control.

F. Erector qualifications: Erector of wood trusses on minimum 5 projects of similar scope as Project with satisfactory performance record.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle fabricated trusses and subassemblies with care so trusses are not subject to damage.

B. When trusses are stockpiled or stored prior to erection, set trusses in vertical positions, resting upon temporary bearing supports and braced so trusses will not be subject to unusual bending or tip over.

C. Provide means for adequate distribution of concentrated loads so carrying capacity of trusses are not exceeded.

PART 2 PRODUCTS

2.01 LUMBER

A. Species and grades: In accordance with stress ratings for species and grades in grading rules of appropriate lumber association or as listed in referenced quality assurance standards, unless otherwise indicated on the Drawings.

B. Moisture content: Within limits as stipulated in quality assurance standards, but not exceeding 19 percent or less than 7 percent at time of fabrication.

C. Nominal sizes: As indicated on the Drawings.

2.02 LIGHT METAL PLATE CONNECTORS

A. Connector plate shall have series of nail-like projections.

B. Practically parallel side throughout their length.

C. No offsets except at ends. Ends shaped to blunt points or wedges.

D. Lengths not less than 5 times their greater width.

E. Form which permits projections to separate rather than to cut wood fibers in accordance with accepted nailing techniques.

F. Minimum 20 gauge, ASTM A653, Grade 33, sheet steel, hot-dip galvanized in accordance with ASTM A653, G60 coating designation.

G. Yield strength: Minimum 33,000 pounds per square inch.

H. Ultimate tensile strength: Minimum 48,000 pounds per square inch.

I. Corrosion-resistant coating: Minimum 1.25 ounces per square foot.

J. Stamp manufacturer's name on each plate connector.

2.03 FIELD CONNECTIONS

A. One of the following as required for trusses:
   1. Nail-on splice plates.
   2. Plates bolted connections with steel side.

2.04 TRUSS FABRICATION

A. Cut truss members accurately to length, angle, and true to line to ensure tight joints for finished truss.

B. Brush apply 2 coats of wood preservative on members in contact with sheet metal and cementitious materials.
   1. Protect sawn ends.

C. Place truss members jigs with members tightly clamped in place until.
   1. For trusses fabricated using 2x members: Plate connectors have been pressed into lumber simultaneously on both sides of joints.

D. Do not allow open joints which depend on stiffness of metal connector plates to transmit stresses of improperly fitted joints.

E. Build camber into trusses, as indicated on the shop drawings, by properly positioning members in fabrication jigs.

F. Permanently stamp each truss with name and address of truss fabricator.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for erection of products as specified in Section 01600 - Product Requirements.

3.02 PREPARATION

A. Where field assembly of truss subcomponents is necessary, make approved connections.

3.03 ERECTION

A. Set and secure wood trusses level, plumb, and in correct locations.

B. Install erection bracing to hold trusses true and plumb and in safe condition until permanent truss bracing and bridging can be solidly fastened in place.

C. Keep horizontal bending of trusses to minimum.

D. Ensure truss ends have sufficient bearing area.

E. Install permanent bracing and bridging, and permanently fasten components before application of live loads.

F. Connect continuous lines of 2x minimum bridging to trusses at chord members during erection stage. Provide 1 line along top and 1 line along bottom chord.

G. Erect trusses with top and bottom chords in true vertical alignment.

H. Align top chords of trusses parallel to each other and straight with no point in plane on top chords more than 3/8 inch out of true horizontal line.

I. Do not cut or alter truss members.

END OF SECTION

SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items.

1.02 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.

1.03 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum 5 years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect work from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI Architectural Woodwork Standards for Custom Grade.

B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

C. Interior Woodwork Items:
   1. Per Drawings.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

B. Fasteners: Of size and type to suit application.

2.04 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribbling and site cutting.

2.05 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

D. Finish work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5 - Finishing for Grade specified and as follows:
   1. Transparent
      a. System - 1, Laquer, Nitrocellulose.
      b. Stain: As selected by Owner / Architect
      c. Sheen: Flat.
   2. Opaque:
      a. System - 1, Laquer, Nitrocellulose.
      b. Color: As selected by Owner / Architect.
      c. Sheen: Flat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards requirements for grade indicated.

B. Set and secure materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (1 millimeter). Do not use additional overlay trim to conceal larger gaps.

3.03 PREPARATION FOR SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

B. Site Finishing: See Section 09900 - Painting and Coating.

3.04 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (1.5 millimeter).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.7 millimeter).

END OF SECTION

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SECTION 06400

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cabinetwork and shelving.

B. Plastic Laminate Countertops.

C. Solid Surface Countertops.

D. Cabinet hardware.

1.02 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.

B. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).

C. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.

1.03 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

C. Samples: Submit samples, in full color and pattern ranges for selection by Owner, for plastic laminate.

1.04 QUALITY ASSURANCE

A. Comply with all applicable local governing codes and regulations.

B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum 5 years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store materials in accordance with manufacturer’s instructions.

B. Protect units from moisture damage.

1.06 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI Architectural Woodwork Standards for Custom Grade.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Cabinets:
   1. Cabinet Style: Flush overlay.
   2. Cabinet Doors and Drawer Fronts: Flush style.

2.02 WOOD SHEET MATERIALS

A. Plywood - PS 1 Exterior Grade, A-C veneer grade; graded in accordance with AWI, veneer core. Minimum 3/4-inch thickness. Use at all counters with plumbing fixtures.

B. Wood Particleboard: ANSI A201.8 Grade 2-M-2; AWI standard, composed of wood chips made with waterproof resin binders, sanded faces. Minimum 3/4-inch thickness.

C. Wood fabricated from old growth timber is not permitted.

2.03 PLASTIC LAMINATES

A. Manufacturers:
   1. Wilsonart International, Inc.; www.wilsonart.com.
   2. Formica Corporation; www.formica.com.
   3. Lamin-Art, Inc.; www.laminart.com.
   4. Substitutions: See Section 01330 - Submittal Procedures.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as schedules.
   1. Horizontal Surfaces: HGS, 0.048 inch (1.22 millimeter) nominal thickness.
   2. Vertical Surfaces: VGS, 0.028 inch (0.71 millimeter) nominal thickness.
   3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch (1.0 millimeter) nominal thickness.
   4. Cabinet Liner: CLS, 0.020 inch (0.51 millimeter) nominal thickness.

D. Application: Provide plastic laminate countertops at non-wet area counters.

E. Back and End Splashes: Same sheet material, square top, minimum 4 inches (102 millimeters) height.

F. Surface Color and Pattern (unless otherwise indicated):
   1. Exterior Surfaces: Wilsonart 4872-60 Western Storm.
   2. Interior Surfaces: White Melamine.

2.04 SOLID SURFACING

A. Manufacturers:
   1. DuPont; www.dupont.com
   2. Formica Corporation; www.formica.com
   3. Avonite Surfaces; www.avonitesurfaces.com
   4. Substitutions: See Section 01330 - Submittal Procedures,

B. Solid Surface Countertops: solid, homogeneous sheet plastic resin casting over continuous substrate, color and pattern consistent throughout thickness. Provide adhesives and finish products per manufacturer's specifications.

C. Application: Provide solid surface countertops at wet area counters.

D. Back and End Splashes: Same sheet material, square top, minimum 4 inches (102 millimeters) height.

E. Surface colors and patterns to be selected by Owner from manufacturer's standard samples.

2.05 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Fasteners: Size and type to suit application.

C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

D. Concealed Joint Fasteners: Threaded steel.

E. Joint Sealant: Mildew-resistant silicone sealant, white.

2.06 HARDWARE

A. Manufacturers:
   1. Hafele; www.hafele.com.
   2. Knape & Vogt; www.knapeandvogt.com.
   3. Ives; www.ives.ingersollrand.com.
   4. Substitutions: See Section 01330 - Submittal Procedures.

B. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

C. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch (25 millimeter) spacing adjustments.

D. Drawer and Door Pulls: “U” shaped wire pull, US26D steel wire, 4-inch length minimum.

E. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Commercial grade.
   3. Mounting: Side mounted.

F. Hinges: Concealed type with pivot bearing, adjustable, self-closing. Provide door bumpers and silencers.

2.07 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Provide back and end splash wherever counter edge abuts vertical surface unless otherwise indicated.

C. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactures sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet (600 millimeters) from sink cut-outs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units.

D. Secure cabinets to floor using appropriate angles and anchorages.

E. Securely attach countertops to cabinets using concealed fasteners for plastic laminate countertops or compatible adhesives for solid surface countertops. Make flat surfaces level, shim where required.

3.03 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, countertops, shelves, hardware, fittings, and fixtures.

END OF SECTION

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SECTION 06608

FIBERGLASS REINFORCED PLASTIC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: General fabrication and design requirements for fiberglass reinforced plastic fabrications.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. RTP-1 - Reinforced Thermoset Plastic Corrosion Resistant Equipment.

B. ASTM International (ASTM):
   1. C582 - Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
   2. D883 - Standard Terminology Relating to Plastics.
   3. D2563 - Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.
   4. D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
   5. D2584 - Standard Test Method for Ignition Loss of Cured Reinforced Resins.
   6. D3299 - Standard Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Corrosion-Resistant Tanks.
   7. D4097 - Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

1.03 DEFINITIONS

A. The terminology of this specification is in accordance with ASTM D883. Fabricators using this specification are responsible for correct interpretation.

B. Fiberglass reinforced plastic: Fiberglass Reinforced Plastic or glass fiber and resin fabrication consisting of approximately 35 to 55 percent glass fiber reinforcement by weight for hand lay-up structural laminates and 55 to 70 percent glass for filament wound structural laminates, unless otherwise specified.

C. Equipment: The fiberglass reinforced plastic equipment, including ancillary equipment, work, and materials as described in this specification.

D. Fabrication drawings: Those drawings produced by the Fabricator or Contractor, with the intention of providing the necessary information to construct or install the equipment.

E. Mat: Fibrous material consisting of randomly oriented chopped or swirled filaments loosely held together with a binder.

F. Chopped glass: Fibrous material consisting of randomly oriented chopped filaments applied directly to a mold surface or laminated under construction by a chopper gun.

G. Fiber prominence (jackstraw): The distinct visibility of individual glass strands causing a loss of translucency of the laminate.

1.04 DESIGN REQUIREMENTS

A. Design fiberglass reinforced plastic tanks, scrubbers, and other vessels following the procedures and methods, utilizing the equations and formulas, and incorporating safety factors and allowable design stresses and strains set forth in ASME RTP-1. Base the design of duct and other fiberglass reinforced plastic equipment not covered by ASME RTP-1 on the engineering rationale, applicable formulas, and safety factors set forth in ASME RTP-1.

B. Perform calculations necessary to ensure long-term, low risk service of the fiberglass reinforced plastic equipment with minimum reasonable maintenance requirements.
   1. Long-term, low risk service is defined as a service life of 20 years without major structural failure or leakage.
   2. The design shall ensure proper functioning of the equipment at the stated operating conditions.
   3. The design shall include as a minimum, engineering calculations, materials selection and documented physical and mechanical properties, and detailed drawings required for fabrication and assembly of the equipment.

C. Design in accordance with applicable national, regional, and local design and building codes.
   1. Wind and seismic forces shall be determined in accordance with the building code.

D. Resistance to overturning shall not include the weight of the liquid contained in the equipment.

E. Consider the interaction of the installed system including but not limited to thermal expansion of duct, tanks, and vessels and the effects of external loading from piping, fans, pumps, platforms, and other attached items.

F. Allow for the most severe combination of conditions which may include, but not be limited to, the following:
   1. Internal or external pressure.
   2. Static head of contents (working and test conditions).
   3. Mass of structure and contents.
   4. Design temperature including upset conditions.
   5. Superimposed loads, such as seismic and wind forces.
   6. Bending moments due to eccentric loads.
   7. Localized loads acting at supports, lugs, and other attachments.
   8. Shock loads.
   9. Loads due to heating or cooling and thermal gradients.
   10. Loads applied during transport or erection.
   11. Loads imposed by personnel during erection and operations.
   12. Fatigue.

G. Use safety factors and allowable strains specified in ASME RTP-1 unless otherwise specified. Do not use safety factors and allowable strains less than the following:
   1. Allowable hoop and axial strain shall be 0.001 inch per inch for filament wound tanks.
   2. A safety factor of 10 for hand lay-up components in tension, flexure, or other loading conditions where elastic stability is not in question.
   3. A safety factor of 5 for external loading (vacuum) or local buckling due to seismic or wind loading.

H. Safety factors for upset conditions or infrequent loading situations may be less than the above values for the specific condition if acceptable to the Engineer.

I. There will typically be other aspects which should be considered. Identify and consider their effects, identify design limitations, and submit this information.

J. Provide test reports or other documentation for laminate properties used in the design. Laminates shall be similar in construction, layer sequence, resin type, and cure to those used to determine tested properties. Properties shall be adjusted to reflect reductions at operating temperatures. Test reports shall be provided for:
   1. Grating: Indicate grating strength and deflection.
   2. Physical properties of test cover panels.
   3. Tanks showing conformance with specified strength requirements.

K. The corrosion liner shall be a minimum of 100 mils in thickness, unless otherwise specified, and documentation shall be provided verifying veil type, liner thickness, and resin cure.
   1. Consider 50 mils of the corrosion liner as sacrificial and do not include it in determining structural wall thickness.
   2. Use structural wall thickness not less than 0.375 inches for tanks and vessels and 0.1875 inches for ductwork.
   3. Submit minimum structural thicknesses of other types of fiberglass reinforced plastic fabrications.

L. Laminate types may include hand layup, helical winding, and hoop/chop construction methods.
   1. In laminates with helix angles greater than 80 degrees and in hoop/chop laminates, orientate approximately 10 percent of the structural wall thickness at 0 degrees (longitudinal direction).
   2. Apply this reinforcement in at least 2 layers of weft unidirectional fabric and equally spaced within the structural wall.

M. For tanks and scrubbers; nozzles, determine manways and shell reinforcements according to the tables and formulas in ASME RTP-1.

N. Anchor tanks and vessels using lugs and a continuous filament wound band or an integral filament wound load ledge with external stainless steel anchor clips.
   1. The anchor clips shall be bolted to the concrete foundation; use non-shrink grout to level anchor clips.
   2. The design shall resolve the sum of the moments and the sum of the force equal to 0.

O. Design internal beams and support attachments using a maximum of 200 pounds per square inch shear stress for secondary bonds. Also apply this to design of external lugs required for ladders, platforms, and other attached items.

1.05 SUBMITTALS

A. Shop drawings and calculations:
   1. Submit general arrangement and fabrication drawings, calculations, and elements of the design.
   2. Include submittal information which describes specifically how the equipment is to be built and details necessary to ascertain that products meet specified requirements. Provide in the form of drawings, standards, specifications, or other shop instructions, but may also be partially contained in quality control records. The submittal shall include, but not be limited to:
      a. Fabrication drawings.
      b. General arrangement drawings signed by an Engineer registered in the state where the project is located, showing complete structural, fasteners, and erection procedures for a complete assembly.
      c. Quality control programs.
      d. Verification that the manufacturer has been engaged in fabrication of similar fiberglass reinforced plastic equipment for a minimum of 5 years.
      e. Statement of compliance with contract design requirements, codes, and standards.
      f. Recommendation for each resin selection from resin manufacturer.
      g. Type and amounts of fillers.
      h. Nominal corrosion liner description.
      i. Reinforcement types and glass content range for hand lay-up laminates.
      j. For filament wound laminates:
         1) Helix angle.
         2) Glass content range.
         3) Strand yield.
         4) Strand per inch in the winding band.
         5) Ply thickness.
         6) Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate.
      k. For other components:
         1) Construction type.
         2) Laminate thicknesses.
         3) Ply sequences.
         4) Glass content range.
      l. For secondary overlays (both interior and exterior):
         1) Laminate thicknesses.
         2) Ply sequences and widths.
      m. Construction details: Construction details for assembly and other special configurations, including:
         1) Tank bottom/top attachments with knuckle configuration and overlays and thicknesses.
         2) Tank support and anchor lugs, including attachment details.
         3) Tank nozzles and installation, including cutout reinforcement, gusseting, and similar items.
         4) Tank lateral or other support fabrication details, including platform attachment clips and/or shoulders.

5) Scrubber configuration and fabrication details of internal support system and other specialty items.
6) Cover panel joints, anchorage detail, and details of doors and inspection ports and their attachment or incorporation within the cover.

n. Miscellaneous equipment required.
o. Test reports and certification of compliance with physical property requirements.
p. Color samples.
q. Manufacturer's installation instructions.
r. ASME RTP-1 certification.

B. Operation and Maintenance Data.

C. Warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer qualifications: Fiberglass reinforced plastic manufacturer with experienced personnel, physical facilities, and management capacity sufficient to produce custom-made glass fiber and resin products of quality and size specified for minimum 5 years with satisfactory performance record.

B. Quality assurance plan: Fabricator shall be responsible for implementation of a comprehensive quality assurance plan. The quality assurance plan describes procedures with the following minimum requirements:
1. Fabricator shall designate personnel to inspect equipment while in process and after completion to ensure compliance to every aspect of the section and fabrication drawings.
a. Inspection shall include, as a minimum, checks for visual defects, laminate thickness and sequence, glass content, Barcol hardness, dimensional tolerances, adherence to construction details, surface preparation, and environmental conditions.
b. Fabricator's inspector shall complete a report of the findings including method of measurement for each separate assembly.
2. Prior to use of resins in fabrication, fabricator shall extract samples of resins and retain them for use by the Engineer. Sample size shall be 100 cubic centimeters minimum:
a. Take 1 sample for each manufacturer's batch number if resin is received in the form it will be used.
b. If the fabricator alters the resin after receipt, such as through the addition of styrene, promoters, or other additives, take samples from each drum or portion thereof mixed with additives.
c. Fabricator shall provide documentation for each sample including resin type, manufacturer, batch and lot number, drum number, complete listing of additives with amounts added, and description and manufacturer of each additive.
3. Fabricator shall inspect glass reinforcement prior to use in fabrication.
a. Do not use glass that does not meet the manufacturer's acceptance standards.
b. Do not use glass material that is wet or has been wet.

c. For each type of glass and lot number used, fabricator shall record the manufacturer, product description, binder type, product code, production date, and lot number.
d. For mat, woven roving, unidirectional roving, and cloth, also include in records actual measured weight per square yard of material.

4. Fabricator shall retain nozzle cutouts and other excess laminate, clearly marking each piece to identify its original location. These laminate samples become the property of the Owner.
5. For areas where valid laminate samples are not available, take sample plugs at the Engineer's request.
   a. Repair subsequent holes in a manner acceptable to the Engineer.
6. Fabricator shall verify glass content on available samples in accordance with ASTM D2584. Complete this test and submit the results complete for each major component where samples are available.
7. Prior to final shipment of the equipment, fabricator shall submit to the Engineer a complete quality control report, consisting of copies of records maintained for compliance with this Section.

PART 2 PRODUCTS

2.01 RESIN AND REINFORCEMENT MATERIALS

A. General physical properties: In accordance with applicable specifications PS15-69, ASTM C582, ASTM D3299, ASTM D4097, and ASME RTP-1 with verification of properties. Physical properties may include tensile, flexural, and compression modulus of elasticity and ultimate strengths, limiting strains, Poisson ratios, coefficients of expansion, and other directional properties as required for the design of the equipment.

B. Resin:
1. Fabricate equipment using the corrosion-resistant resin(s) specified in the fiberglass reinforced plastic equipment specifications. The fabricator is required to obtain independent endorsement of each resin selection from the resin manufacturer. Unless otherwise specified, use the resin throughout laminates.
2. The type of catalyst recommended varies between resin manufacturers. Submit resin/catalyst before fabrication begins to verify compliance to the resin manufacturer's recommended procedures.
3. Employ no fillers, additives, or pigments in the resin.
   a. A thixotropic agent for viscosity control may be used in the proportion and type recommended by the resin manufacturer.
   b. Use no thixotropic agent in the corrosion liner or on surfaces to be in contact with the corrosive environment.
4. Make resin putty using the same resin as was used in the original fabrication and shall contain milled glass fibers.
   a. The use of silica flour, grinding dust, or other fillers is not allowed.
5. When specified, add antimony trioxide or antimony pentoxide to the resin in the amount necessary to achieve the required fire retardancy rating in the structural wall only. Follow resin manufacturer's recommendations.
   a. Unless otherwise specified, the corrosion liner shall not contain this additive.

C. Reinforcement:
   1. Show the type and sequence of reinforcements to be used on the fabrication drawings.
   2. Use as commercial grade corrosion-resistant borosilicate glass fiber reinforcement, unless otherwise specified.
   3. Use glass fiber reinforcing having a surface finish and binder that is specifically recommended by the glass manufacturer for the particular resin system to be used.
   4. Use Type C (chemical grade) glass, 10 mils (0.01 inches) thickness, or polyester surfacing veil, such as Nexus surfacing veils.
   5. Use Type E (electrical grade) glass, 1-1/2 ounces or 3/4-ounce per square foot, with nominal fiber length of 1.25, within 0.75 inches mat.
   6. Continuous glass roving used in chopper guns for spray up shall be Type E chopper roving.
   7. Woven roving shall be 24 ounces per square yard Type E glass and have a 5-by-4 plain weave.
   8. Continuous roving used in filament wound structures shall be Type E glass winder roving with a yield of 200 yards or more per pound.
   9. Use Type E glass unidirectional fabric. Weft unidirectional fabric shall be 15.7 ounces per square yard.
   10. When specified, use Type ECR glass reinforcements supplied in similar fabric styles to those specified above.

2.02 FABRICATION

A. Molds:
   1. Construct molds of a suitable material to produce a smooth and glossy corrosion liner surface on the fiberglass reinforced plastic equipment.
   2. Covering of mandrels with cardboard must be accepted by the Engineer prior to start of fabrication.

B. Laminates:
   1. Determine specified glass content in accordance with ASTM D2584.
   2. Consider laminate thicknesses shown on the fabrication drawings as construction minimums. Verify that minimum thicknesses are obtained using the laminate sequences specified. When only total laminate thicknesses are specified or indicated on the Drawings, the minimum allowable structural laminate thickness shall be the total laminate thickness less the specified corrosion liner thickness.
   3. Interruptions in laminating sequence shall follow the application of a ply of mat and be succeeded by a ply of mat.
   4. The interruption shall not exceed 24 hours, and the in-process surface must retain acetone sensitivity until laminating is resumed. Lack of compliance with these aspects or indication that contamination of the surface has occurred shall require that surface preparation be accomplished before resuming.
   5. Chopped strand glass applied by chopper gun is allowed in lieu of mat layers in the structural laminates only.
      a. Chopper gun application of the corrosion liner is not allowed.
   6. Coat non-mold surfaces with resin containing wax additive in the amount necessary to allow full cure of the surface. In the case of exterior surfaces, this wax coat shall also contain an ultraviolet stabilizer in the type and amount recommended by the resin manufacturer.

7. The exterior surface of equipment shall be resin-rich and reinforced with 1-layer C glass surfacing veil, unless otherwise specified.
8. When specified, the exterior coat shall be an opaque pigmented surface coat, applied only after Engineer's inspection. Color shall be selected by the Engineer.

C. Corrosion liner laminates:
   1. The inner surface of laminates shall be resin-rich and reinforced with surfacing veil of the type and number of layers as shown on the fabrication drawings.
   2. The interior layer of the corrosion liner shall consist of 1-1/2 ounces per square foot mat in the number of layers specified on the fabrication drawings. An exotherm interruption is specifically prohibited within the corrosion liner.
   3. Chopped glass applied by chopper gun is not allowed in the corrosion liner.
   4. Plies of the inner surface and interior layer are to gel completely before proceeding with the structural laminates.
   5. Completed corrosion liner as described above shall contain not less than 20 percent nor more than 30 percent glass by weight.
      a. Use no thixotropic material in the resin for the liner, nor in the fabrication of fiberglass reinforced plastic components intended for internal service.
      b. The completed liner shall be the minimum thickness specified or indicated on the Drawings.
   6. Do not use a separately cured unreinforced gel coat.

D. Hand lay-up structural laminates:
   1. The corrosion liner laminate shall be followed by hand lay-up structural laminates of varying reinforcement sequences as indicated on the fabrication drawings.
   2. For hand lay-up structural laminates, reinforcement shall consist of mat and woven roving in the sequence specified on the fabrication drawings.
   3. Woven roving shall have a ply of mat on each side. Two adjacent plies of woven roving are not permitted.
   4. Laminates containing primarily 1-1/2 ounces per square foot mat layers in conjunction with woven roving shall contain not less than 35 percent or more than 45 percent glass (by weight).
   5. Laminates containing primarily 3/4-ounce per square foot mat layers in conjunction with woven roving are considered to be high strength laminates and shall contain not less than 45 percent or more than 55 percent glass by weight.

E. Filament wound structural laminates:
   1. The corrosion liner laminate shall be followed by filament wound structural laminates as indicated on the fabrication drawings.
   2. For filament wound structural laminates, reinforcement shall consist of continuous strand fiberglass roving applied with a minimum of interruptions until the specified minimum thickness is attained.
      a. This laminate shall contain 55 to 70 percent glass by weight as indicated on the fabrication drawings.
   3. Each complete cycle of filament winding shall form a closed pattern of winding bands which completely covers the surface with 2 bi-directional layers.
      a. Each layer shall be a maximum of 1 roving in thickness.
      b. Uniformly space the filaments across the winding band without bunching or gaping.

4. Specify the helix angle of winding on the approved fabrication drawings, as measured from the centerline of revolution of the equipment shell.
5. Tolerance on helix angle is plus or minus 2 degrees, unless otherwise specified.
6. The fabrication drawings may require that layers of unidirectional roving be interspersed within the continuous filament winding.
7. Apply the unidirectional roving with the glass strand aligned in the axial direction, to within plus or minus 5 degrees.
8. If layers of mat or chopped glass are needed to ensure proper bonding of unidirectional roving, or within the filament winding to accommodate the Fabricator's manufacturing methods, consider the layers' extra material that will result in a thickness greater than specified. The amount of filament winding and unidirectional roving specified must still be applied.

F. Joining laminates:
1. Fiberglass reinforced plastic joining laminates are subject to applicable requirements specified in other sections for laminates.
2. Reinforce fiberglass reinforced plastic joints with an overlay of glass reinforcement and resin which extends equally within plus or minus 1/2 inch on each side of the joint. Use minimum thickness, ply sequence, and ply widths of fiberglass reinforced plastic joints as indicated on fabrication drawings.
3. Restrain parts to be joined to prevent movement until completion and cure of the joint overlay.
4. Fit-up parts and verify that tolerances and assembly requirements are satisfied. Completely fill the void between component parts with resin putty, taking care not to extrude an excessive amount of putty into the interior.

G. Environment:
1. The fabrication process and materials at the point of fabrication are to be maintained within a range of 60 to 95 degrees Fahrenheit. This temperature must also be at least 5 degrees greater than wet bulb temperature, as measured with a sling psychrometer.
2. Store materials in a dry area and within the temperature and humidity limits recommended by the manufacturers.

H. Flanges:
1. Make flanges by hand lay-up construction with nozzle neck and flange made integrally in 1 piece and fabricated in accordance with the dimensions indicated on the fabrication drawings. Extend layers of reinforcement in the nozzle neck and hub uninterrupted into the flange.
2. Build-up additional hub thickness using alternating layers of 1-1/2 ounces per square foot mat and 24 ounces per square yard woven roving.
3. Build-up additional thickness in the flange using "ring" cutouts of mat, evenly distributed throughout the flange thickness.
4. Press molded or filament wound flanges are not allowed.
5. Overall machine facing of the back of flanges is not permitted.
    a. To obtain proper seating, spotface bolt holes for SAE size washers.
    b. Resin coat bolt holes and other cut surfaces so that no fibers are exposed.
    c. Spotfacing shall not produce a flange thickness less than indicated in the fabrication drawings.

6. Bolt holes in flanges shall straddle principal centerlines of the Equipment. Tolerance in bolt hole locations and in diameter of bolt circle shall be plus 1/16 inch.
7. Depressions or projections in flange face shall be no greater than 1/32 inch.

I. Allowable visual defects:
1. Visual defects in areas of the equipment shall not exceed the maximum allowable levels of visual defects set forth in Table A, unless acceptable to Engineer.
2. Visual defects in accordance with ASTM D2563.
3. Presence of visual defects in excess of the allowable levels of Table A shall be grounds for rejection of the equipment. Listed quantities apply to small, localized areas and shall not be averaged over larger areas.
4. For the purpose of Table A, use of the following definitions apply:
   a. INNER surface - Interior process surface, thickness of surfacing veil(s), and interface between veils and mat layers. Includes surfacing veils on internal joints.
   b. Interior mat layers - Layers of mat following the inner surface, and interface between liner and structural wall. Includes mat layers on internal joints.
   c. Structural wall - Layers of filament winding or alternating layers of mat and woven roving following the corrosion liner, and layers of mat and woven roving in internal overlays.
   d. Exterior surface - The exterior surface of the laminate and the thickness of the surfacing veil.
   e. Dimensions listed in Table A refer to the largest dimension measured for defects.

TABLE A
MAXIMUM ALLOWABLE LEVELS OF VISUAL DEFECTS

Condition/ Defect	Inner Surface	Interior Mat Layers	Structural Wall	Exterior Surface
Chip	None	None	None	
Crack	None	None	None	
Crazing	None	None	None	
Delamination	None	None	See Air Bubble	
Dry Spot	None	See Air Bubble	See Air Bubble	
Foreign Inclusion	None	Maximum Diameter 1/32"	See Air Bubble	
Fracture	None	None	None	None
Air Bubble/ Void	Less than 1/64" Ø unlimited. 1/64" to 1/16" Ø 2 / sq. in. Maximum Diameter 1/16"	Less than 1/32" Ø unlimited. 1/32" to 1/8" Ø 5 / sq. in. Maximum Diameter 1/8"	Less than 3/16" Ø unlimited. 3/16" to 1/4" Ø 2 / sq. in. Maximum Diameter 1/4"	
Blister	See Air Bubble	See Air Bubble	See Air Bubble	

TABLE A MAXIMUM ALLOWABLE LEVELS OF VISUAL DEFECTS				
Condition/ Defect	**Inner Surface**	**Interior Mat Layers**	**Structural Wall**	**Exterior Surface**
Burned	None	None	None	
Pit (Pinhole)	Less than 1/32" Ø 50/square feet 1/32" to 1/16" Ø 10/square feet Maximum Diameter 1/16" Maximum Depth 1/32"	N/A	N/A	
Resin Pocket	None	Maximum 1 square inch per occurrence.	Maximum 1 square inch per occurrence.	
Wrinkle	Allowable if laminate is glass reinforced. No sharp edges allowed.	Allowable if laminate is glass reinforced and full mat layer thickness and total thick- ness are maintained.	Allowable if laminate is glass reinforced and full mat layer thickness and total thick- ness are maintained.	
Scratch	None	N/A	N/A	
Fiber Prominence	None	Maximum 10 fibers visible per square inch	Maximum 20 fibers visible per square inch	

2.03 SOURCE QUALITY CONTROL

A. Inspection:
   1. Owner's inspection: Permit the Engineer access to the equipment during fabrication and upon completion for the purpose of verifying compliance to the Contract Documents. The inspection is not intended to replace the Fabricator's own quality control procedures.
   2. In no respect does inspection of equipment by Engineer relieve the Fabricator of compliance with the Contract Documents.
      a. A final inspection will be performed by the Engineer.
   3. The Fabricator shall notify the Engineer at the completion of particular milestones during fabrication. The milestones are as follows:
      a. View tooling prior to fabrication.
      b. Beginning application of corrosion liner for each part, extraction of each part prior to beginning assembly.
      c. Upon completion of each separate assembly, Engineer reserves the right to include additional milestones.
   4. Allow Engineer to photograph the equipment while in process and/or upon completion.
   5. Engineer may use magnification or other special viewing or measurement devices during inspection.
   6. Evidence of poor workmanship or lack of compliance with aspects of the Contract Documents will be grounds for rejection of the equipment.

7. Subsequent repair of rejected equipment may, at the Engineer's option, be undertaken in an attempt to bring the equipment to an acceptable state.
    a. Repair procedures must be accepted by the Engineer prior to implementation.

2.04 TESTING

A. The Engineer may employ destructive testing, such as ultimate tensile or flexure strength tests or glass content ignition tests, on available samples or use other non-destructive test methods, such as acoustic emission or ultrasonic polygauge thickness measurement, on the completed equipment for verification of compliance to the contract documents.

B. Testing performed by the Engineer will be accomplished through use of applicable ASTM test methods when appropriate.

C. Hardness tests will be made for acceptance by the Engineer on the liner surface using the Barcol impressor, Model GYZJ 934 1, calibrated at 2 points in accordance with ASTM D2583.
    1. Ten readings will be taken in a localized area, deleting the 2 highest and 2 lowest, and averaging the remaining 6.
    2. Minimum acceptable Barcol hardness will be a reading of 30 unless otherwise specified.

D. An acetone sensitivity test will also be performed by the Engineer as an acceptance criteria. Evidence of a sticky or tacky surface following rubbing with an acetone-saturated cloth will be grounds for rejection of the equipment.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 07212

BATT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Batt insulation as shown.

B. Batt insulation above all ceiling

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

PART 2 PRODUCTS

2.01 BATT INSULATION MATERIALS

A. Batt Insulation: ASTM C 665; preformed batt; conforming to the following:
   1. Material: Glass or mineral fiber.
   2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E 84.
   3. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E 84.
   4. Combustibility: Non-combustible, when tested in accordance with ASTM E 136, except for facing, if any.
   5. Facing: Asphalt treated Kraft paper, one side.

B. Acoustical Batt Insulation: three inch batt insulation specifically manufactured for acoustical sound attenuation.

2.02 ACCESSORIES

A. Tape: Bright aluminum self-adhering type, 2 inch (50 mm) wide.

B. Adhesive: Vapor retarder type, trowel consistency; fire retardant, compatible with insulation and substrate, conforming to the following:

PART 3 EXECUTION

3.01 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Install acoustical batt insulation in accordance w/ manufacturer's recommendations.

END OF SECTION

SECTION 07260

BELOW-GRADE VAPOR RETARDER MEMBRANE

PART 1 GENERAL

1.01 SUMMARY

A. Products supplied under this section:
   1. Vapor barrier and installation accessories for installation under concrete slabs.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM E1745-11 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
   2. ASTM E1643-11 - Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.

B. Technical reference - American Concrete Institute (ACI):
   1. ACI 302.2R-06 - Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.03 SUBMITTALS

A. Quality control/assurance:
   1. Summary of test results per paragraph 9.3 of ASTM E 1745.
   2. Manufacturer's samples and literature.
   3. Manufacturer's installation instructions for placement, seaming and penetration repair instructions.
   4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.

PART 2 PRODUCTS

2.01 MATERIALS

A. Vapor retarder must have all of the following qualities:
   1. Permeance of 0.03 perms (grains per square foot per hour per inch of mercury) or less per ASTM F 1249 or ASTM E 96.
   2. ASTM E 1745 Class A. Minimum of 10 mils thickness.

B. Vapor retarder products:
   1. Stego Wrap Class A vapor retarder (10-mil) by Stego Industries, LLC (877) 464-7834 www.stegoindustries.com.
   2. Substitutions: See Section 01600 - Product Requirements.

2.02 ACCESSORIES

A. Seams :
   1. Stego tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.

B. Penetration of vapor barrier:
   1. Stego Mastic by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
   2. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.

C. Perimeter/edge seal:
   1. Stego Crete Claw by Stego Industries LLC, (887) 464-7834 www.stegoindustries.com.
   2. StegoTack Tape (double sided) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
   3. Stego Term Bar by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.

PART 3 EXECUTION

3.01 PREPARATION

A. Ensure that subsoil is approved by Structural or Geotechnical Engineer. Level and compact base material.

3.02 INSTALLATION

A. Install vapor barrier in accordance with ASTM E1643.
   1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
   2. Extend vapor barrier over footings and grade beams to a distance acceptable to the structural engineer or stop at impediments such as dowels and waterstops.
      a. Seal vapor barrier to slab perimeter/edge using Stego Crete Claw and remove dirt, debris, and mud from Crete Claw prior to concrete placement.
      b. Seal vapor barrier to footing/grade beam with StegoTack Tape, Stego Term Bar, or both.
   3. Overlap joints 6 inches and seal with manufacturer's tape.
   4. Apply tape/crete claw to a clean and dry vapor barrier.
   5. Seal all penetrations (including pipes) per manufacturer's instructions.
   6. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
   7. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.

END OF SECTION

SECTION 07610

STANDING-SEAM METAL ROOF PANELS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes finish roofing components for curved roof:
   1. Standing-seam metal roof panels.
   2. Gable Flashing (Fascia).
   3. Gutters and Downspouts.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
   2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
   4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
   5. Review structural loading limitations of deck during and after roofing.
   6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
   7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
   8. Review temporary protection requirements for metal panel systems during and after installation.
   9. Review procedures for repair of metal panels damaged after installation.
   10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Sustainable Protocol Submittals:
   1. Product Data: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
   2. Product Test Reports: For roofing materials, documentation indicating that roofing materials comply with Solar Reflectance Index requirement.

C. Shop Drawings:
   1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
   2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
   1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
   1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockup of typical roof area and eave, including fascia, and soffit as shown on Drawings; approximately 12 feet (3.5 m) square by full thickness, including attachments, underlayment, and accessories.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.09 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including rupturing, cracking, or puncturing.
      b. Deterioration of metals and other materials beyond normal weathering.
   2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
   1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980.

B. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for low -slope roof products.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings.
   3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680 or ASTM E 283 at the following test-pressure difference:
   1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:
   1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
   1. Uplift Rating: UL 90.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
   1. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels : Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Peterson Aluminum Corporation Tite-Loc Plus or comparable product. – OR APPROVED EQUAL
   2. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
      a. Thickness: 24 gauge.
      b. Surface: Smooth, flat finish.
      c. Exterior Finish: Two-coat fluoropolymer .
      d. Color: As selected by Architect / Owner’s agent from manufacturer's full range.
   3. Clips: One-piece fixed to accommodate thermal movement.
   4. Joint Type: As standard with manufacturer.
   5. Panel Coverage: 18 inches (457 mm).
   6. Panel Height: 2.0 inches (51 mm) .

2.03 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
   1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
   2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
   3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT.

2.04 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
   1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
   2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Gable Flashing (Fascia), Flashing, and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match roof fascia and rake trim.

E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

F. Splash Pans: Formed from same material as roof panels, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish to match downspouts.

G. Panel Fasteners: Self-tapping screws designed to withstand design loads.

H. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
   1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.05 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
   1. Form Roof Panels, Gable Flashing (Fascia), and all other components for curved roof to match the curve shown on drawings without cutting or kinks in metal.

B. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
   1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
   2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
   3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
   4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
   5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
   6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
      a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.06 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:
   1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
   1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
   2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
      a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.03 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below , wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
   1. Apply over the entire roof surface.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07620 "Sheet Metal Flashing and Trim."

3.04 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Locate and space fastenings in uniform vertical and horizontal alignment.
   2. Install flashing and trim as metal panel work proceeds.
   3. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:
   1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
   1. Install clips to supports with self-tapping fasteners.
   2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
   3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
   4. Watertight Installation:
      a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
      b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
      c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.
   1. Provide elbows at base of downspouts to direct water on splash pans.
   2. Provide splash pan for each downspout; set in bed of sealant.

J. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.05 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.07 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07620

FLASHING AND SHEET METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including:
   1. Flashings, counterflashings, coping, fascia, exposed trim, edges, cleats, caps, sills, drips, etc.
   2. Scuppers, leaderheads and downspouts.
   3. Sheet metal accessories.

1.02 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.

B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2011.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012)E1.

F. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

1.03 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

B. Shop drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.04 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for 3 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer’s instructions.

B. Perform work in accordance with the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Pre-finished galvanized steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge (0.025 inch) thick base metal, shop pre-coated with polyvinylidene fluoride (PVDF) coating.
   1. PVDF (Polyvinylidene fluoride) coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Architect from manufacturer's standard colors.

B. Aluminum: ASTM B209; minimum 20-gauge (0.032 inch) thick; anodized finish of color as selected.
   1. Clear anodized finish: AAMA 611 AA-M12C22A41 Class I clear anodic coating not less than 0.7 mils (0.018 millimeters) thick.
   2. Color anodized finish: AAMA 611 AA-M12C22A42/44 Class I integrally or electrolytically colored anodic coating not less than 0.7 mils (0.018 millimeters) thick.

2.02 ACCESSORIES

A. Fasteners: Same metal as flashing/sheet metal or other noncorrosive metal as Solder recommended by sheet metal manufacturer. Match finish of exposed heads with materials being fastened.

B. Solder: ASTM B 32, 50-50 tin/lead solder, with rosin flux.

C. Roofing cement: ASTM D 2822, asphaltic.

D. Bituminous isolation coating. SSPC- Paint 12, solvent-type bituminous mastic, nominally free of sulfur, compound for 15-mil dry film thickness per coat.

E. Mastic and elastomeric sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

F. Reglets and metal accessories: Sheet metal clips, cleats, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

G. Adhesives: Type recommended by flashing sheet metal manufacturer for water/weather resistant seaming and adhesive application of flashing sheet.

H. Epoxy seam sealer: 2-Part noncorrosive metal seam cementing compound, recommended by manufacturer for non-moving joints including riveted joints.

I. Primer: Zinc chromate type.

J. Plastic cement: ASTM D4586, Type I.

2.03 FABRICATION

A. Fabricate flashing, counterflashing and other sheet metal work not exposed to view of aluminum. Fabricate flashing, gutters, downspouts, conductor heads, scuppers, copings, caps, edges, trim, and other exposed sheet metal work of pre-finished galvanized steel sheets.

B. Fabricate for waterproof and weather resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates.

C. Fabricate pre-finished steel with strippable film in place. If soldering is necessary, mechanically remove coating. Touch up with color matched paint.

D. Seams: Fabricate non-moving seams in sheet metal with flat-lock seams. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.

E. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

F. Expansion provisions: Where lapped or bayonet-type expansion provisions cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with mastic sealant (concealed within joints).

G. Sealant joints: Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant.

H. Separate dissimilar metals from each other to prevent electrolytic action by painting each metal surface in area of contact with a heavy application of bitumastic coating, or by other permanent separation as recommended by manufacturers of dissimilar metals.

I. Form sections true to shape, accurate in size, square, and free from distortion or defects.

J. Form pieces in longest possible lengths.

K. Hem exposed edges on underside 1/2 inch (13 millimeters); miter and seam corners.

L. Fabricate corners from one piece with minimum 18 inch (450 millimeters) long legs; seam for rigidity, seal with sealant.

2.04 SCUPPERS, LEADERHEADS AND DOWNSPOUTS FABRICATION

A. Materials: Pre-finished galvanized steel; ASTM A653; minimum 24-gauge (0.025 inch) thick; anodized finish of color as selected by Architect.

B. Downspouts:
   1. Profile: Rectangular.
   2. Size: 6 inches by 6 inches typical, unless otherwise indicated on drawings.

C. Accessories: Profiled to suit scuppers, leaderheads and downspouts.
   1. Anchorage devices: In accordance with SMACNA requirements.
   2. Downspout supports: Brackets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION

A. Follow recommendations of SMACNA and AA Manuals for specific application.

B. Install materials and systems in accordance with manufacturer's instructions. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

C. Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams, which will be permanently watertight and weatherproof.

D. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.

E. Apply plastic cement compound between metal flashings and felt flashings.

F. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

G. Remove strippable film from prepainted steelwork. Restore damaged components and finishes. Clean and protect work from damage.

END OF SECTION

SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide joint sealers at interior and exterior vertical and horizontal joints. Work includes joints around frames of doors, windows, louvers, or other openings in exterior walls, flooring joints, joints at penetrations of walls, decks, roofs, and floors by piping and other services and equipment, joints between items of equipment and other construction, joints at plumbing fixtures, joints at dissimilar material transitions, expansion and contraction joints of masonry and concrete, and other joints indicated to be sealed.

1.02 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants; 2010.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2011.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2011a.

D. ASTM D1667 - Standard Specification for Flexible Cellular Materials - Poly(Vinyl Chloride) Foam (Closed-Cell); 2005 (Reapproved 2011).

1.03 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

B. Product data: Provide data indicating sealant chemical characteristics.

C. Manufacturer’s installation instructions: Indicate special procedures.

1.04 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for 3 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer’s instructions.

1.05 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Gunnable and pourable sealants:
   1. BASF Construction Chemicals-Building Systems: www.buildingsytems.basf.com.
   2. Bostic Inc.: www.bostic-us.com.
   3. Dow Corning Corporation: www.dowcorning.com.
   4. Pecora Corporation: www.pecora.com.
   5. Tremco Global Sealants: www.tremcosealants.com.
   6. Substitutions: See Section 01330 - Submittal Procedures.

2.02 MATERIALS

A. Compatibility: Provide joint sealers, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.

B. Colors: As selected by Owner from Manufacturers' standard colors or match color of material applied, unless otherwise indicated.

2.03 ELASTROMERIC JOINT SEALANTS

A. Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C920 requirements, including those for type, grade class, and uses.

B. Nonsag (gunnable) polyurethane sealant: ASTM C920, Type M, Grade NS, Class 25, single or multi-component.
   1. Color: Match adjacent finished surfaces.
   2. Applications: Use for the following joints in secure areas.
      a. Joints between door and window frames and wall surfaces.
      b. Vertically oriented exterior and interior joints where metal or aluminum is used.

C. Self-leveling (pourable) polyurethane sealant: ASTM C920, Type M, Grade P, Class 25, single or multi-component.
   1. Color: Match adjacent finished surfaces.
   2. Applications: Use for the following joints in secure areas:
      a. Horizontally oriented exterior and interior joints where metal or aluminum is used.
      b. Use minimum 35 Shore A hardness single or multi-component pourable polyurethane sealant for horizontal joints subject to pedestrian and vehicular traffic.
   3. Mildew-resistant silicone sealant: ASTM C920, Type S, Grade NS, Class 25, single component.
      a. Color: White.
      b. Applications: Use for:
         1) Joints between plumbing fixtures and floor and wall surfaces.
         2) Joints between countertops and wall surfaces.
         3) Other interior wet work.

2.04 ACRYLIC EMULSION SEALANT

A. Acrylic emulsion latex sealant: ASTM C834, single component, non-staining, non-bleeding, non-sagging, paintable, mildew-resistant.
   1. Color: Standard colors matching finished surfaces, Type OP (opaque).
   2. Movement capability: 2 to 5 percent.
   3. Grade: ASTM C834 grade minus 18 degrees Celsius.
   4. Shore A Hardness Range: 15 to 40.
   5. Applications: Use for:
      a. All interior joints except with metal, aluminum or wet work.

2.05 ACCESSORIES

A. Joint cleaner: Type of joint cleaning compound recommended by sealant manufacturer for the joint surfaces to be cleaned.

B. Joint primer/sealer: Type recommended by the sealant manufacturer for the joint surfaces to be primed or sealed.

C. Bond breaker tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to the substrate or joint filer must be avoided for proper performance of sealant. Provide self-adhesive tape wherever applicable.

D. Sealant backer rod: Compressible rod stock polyethylene foam, polyethylene permanent, durable non-absorptive material as recommended for compatibility with sealant by the sealant manufacturer. Provide size and shape of rod which will control the joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide a highly compressible backer to minimize the possibility of sealant extrusion when joint is compressed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION.

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer’s instructions.

C. Perform preparation in accordance with manufacturer’s instructions and ASTM C1193.

D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer; except where specific dimensions are indicated.

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.

3.04 CLEANING

A. Clean adjacent soiled surfaces.

3.05 PROTECTION

A. Protect sealants until cured.

END OF SECTION

SECTION 08100

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. Provide steel doors and frames.
   1. Exterior and interior steel doors.
   2. Hollow metal steel frames.

1.02 SUBMITTALS

A. None required unless submitting for approved equals.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Standards: Comply with the provisions of the following specifications and standards, except as otherwise noted or specifies, or as accepted or directed by the Owner.
   1. ANSI/SDI-100, Recommended Specifications for Standard Steel Doors and Frames.
   2. SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames".
   3. Fire-Rated Assemblies: NFPA 80, and acceptable testing agency listing.
   4. Thermal-Rated Assemblies at Exterior: ASTM C 236 or ASTM C 976.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Ceco Door Products; www.cecodoor.com.

B. Curries Co. (Assa Abloy); www.curries.com.

C. Steelcraft; www.steelcraft.com
   1. Substitutions: See Section 01330 - Submittal Procedures.

D. Provide metal doors and frames from a single manufacturer.

2.02 MATERIALS

A. Fabrication: Fabricate steel doors and frames rigid, neat in appearance and free from defects, warp, or buckle. Provide clean cut, straight, and true molded members, well formed and aligned miters, dressed and ground smooth, and where applicable, concealed fasteners. Reinforce at corners as required to prevent sagging. Accurately form metal to required sizes and profiles including astragals. Fit, assemble, and weld units at factory or shop.

B. Anchors, fasteners, accessories: Manufacturers standard, hot-dipped galvanized at exterior. Provide not less than 3 anchors per jamb.

C. Fire rated units: Provide fire-rated units complying with NFPA 80 “Standard for Fire Doors and Window,” and units tested, listed, and labeled in accordance with NFPA 252 “Standard Methods of Fire Test of Door Assemblies” by a nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction. Labels must be affixed to the frame. DO NOT paint labels.

D. Steel doors:
   1. Exterior doors: ANSI/SDI-100, Grade II, heavy-duty, minimum 18-gauge (.0358 inch) cold-rolled sheet steel, 1-3/4 inches thick with face sheets zinc coating (ASTM A 525 G60), mill phosphatized. Provide thermally improved doors with maximum U-value of 0.24 British thermal unit per hour per square foot per degree Fahrenheit (ASTM C236), “R” factor 14.97, STC rating 26 (ASTM E 90 and ASTM E 413).
   2. Interior doors: ASNI/SDI-100, Grade II, heavy-duty, minimum 18-gauge (.0358 inch) cold-rolled steel, 1-3/4 inches thick. Provide acoustically improved doors with minimum STC of 33 (ASTM E 90 and ASTM E 413) where indicated.
   3. Cores: Continuously reinforced with a full core of resin-impregnated kraft honeycomb with 1-inch nested, hexagonal-shaped cells. Bond core to inside of both face sheets or polystyrene insulated panel core.
   4. Channel fillers: Flush steel channel fillers for top channel of exterior doors.
   5. Vision panels: Provide glazing stops/moldings for glazed panels. Glass and glazing is specified in Section 08800 - Glazing.
   6. Astragals: Provide T and U astragal for pairs of exterior and fire-rated doors and as indicated on door schedule.

E. Steel Frames:
   1. Exterior and interior frames: Welded type, 16 gage (.0598 inch) sheet steel oil or cold rolled. At exterior openings provide frames with ASTM A 525 G60 zinc coating, mill phosphatized. Joints to be mitered or coped corners.
   2. Accessories: Door silencers and plaster guards, minimum 3 on strike jamb.
   3. Glazing frames: Provide manufacturers standard steel channel or tubular stops, predrilled for screws and factory finished as specified for doors and frames. Glass and glazing is specified in Section 08800 - Glazing.

2.03 HARDWARE

A. Preparation: Prepare hollow metal units to receive mortised and concealed finished hardware, including cutouts, reinforcing, drilling, and tapping in accordance with door hardware schedule and templates provided by the hardware supplier. Reinforce hollow metal units to receive surface-applied hardware. Drilling and tapping for surface-applied hardware will be done on the job site.

B. Location of hardware: Locate finish hardware as indicated in door hardware supplier templates and/or in compliance with Door and Hardware Institute publication "Recommended Location for Builder's Hardware."

2.04 FINISH

A. Finish: Factory finished. Provide manufacturers standard rust inhibitive primer compatible with finish paint specified in Section 09900 - Painting and Coating. Provide asphalt emulsion sound deadening coating on concealed frame interiors. DO NOT prime or paint testing agency labels.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install doors and frames in compliance with SDI-100. Set frames accurately in position, plumb and aligned, and securely anchor to adjacent construction.

B. Install hardware, adjust as required to provide smooth and proper operation with secure latching or locking.

C. Erect fire doors and frames in compliance with NFPA 80 and requirements of authorities having jurisdiction.

D. Clearances: Provide clearances of not more than 1/8-inch at jambs and heads, and not more than 3/4-inch from floor or 3/16-inch from thresholds. Exterior doors provide 3/8-inch undercut for accessibility threshold standards.

E. Touch-up damaged coatings and leave ready to receive finish painting.

END OF SECTION

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SECTION 08200

FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior solid core flush wood doors; fire-rated and non-rated.

1.02 RELATED REQUIREMENTS

A. Section 08100 - Steel Doors and Frames.

B. Section 08700 - Door Hardware.

C. Section 08800 - Glazing.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.

B. ICC (IBC) - International Building Code; 2012.

C. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.

D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2010.

E. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2012.

F. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

G. WDMA I.S.1-A - Architectural Wood Flush Doors; Window and Door Manufacturers Association; 2011.

1.04 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

B. Product data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   1. Provide the information required by AWI/AWMAC/WI Architectural Woodwork Standards.

D. Manufacturer's installation instructions: Indicate special installation instructions.

1.05 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for 3 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer’s instructions.

B. Installed fire-rated door and transom panel assembly: Conform to NFPA 80 for fire-rated class as indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior solid core flush wood doors:
   1. Graham Wood Doors: www.grahamdoors.com.
   2. Eggers Industries; www.eggersindustries.com.
   3. Haley Brothers; www.haleybros.com.
   4. Marshfield DoorSystems, Inc.; www.marshfielddoors.com.
   5. Substitutions: See Section 01330 - Submittal Procedures.

2.02 DOORS AND PANELS

A. All doors: See drawings for locations and additional requirements.
   1. Quality level: Custom grade, in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, unless otherwise indicated.
   2. Wood veneer-faced doors: 7-ply unless otherwise indicated.

B. Interior doors: 1-3/4 inches (44 millimeters) thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at all locations.
   2. Fire-rated doors: Tested to ratings indicated on drawings in accordance with Florida building code ("positive pressure"); UL or WH (ITS) labeled without any visible seals when door is open.

2.03 DOOR AND PANEL CORES

A. Non-rated solid core and 20-minute rated doors: Type particleboard core (PC), plies and faces as indicated above.

B. Fire-rated doors: Mineral core, Type FD, plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

A. Wood veneer facing for transparent finish: Natural birch, veneer grade as specified by quality standard, rotary cut, book veneer match, running assembly match; unless otherwise indicated.

B. Veneer facing for opaque finish: Close grain hardwood.

2.05 ACCESSORIES

A. Glazing frames: Provide manufacturers standard steel channel or tubular stops, 18-gauge cold rolled steel, factory primed, and approved for use in door of fire rating indicated, pre-drilled for screws and factory finished as specified for doors and frames. Glass and glazing is specified is Section 08800 - Glazing.

2.06 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

C. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

D. Provide edge clearances in accordance with the quality standard specified.

2.07 FACTORY FINISHING - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5 - Finishing for grade specified and as follows:
   1. Comply with requirements of Section 09900 - Painting and Coating. Do NOT prime or finish testing agency labels.

B. Color: Equal to Graham #300 medium brown. Any variance requires submittal of sample for prior approved by Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-finished doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

3.03 TOLERANCES

A. Conform to specified quality standard for fit and clearance tolerances.

B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

SECTION 08400

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 SUMMARY

A. Provide aluminum entrances and storefront:
   1. Exterior entrance doors.
   2. Frames for entrances.
   3. Storefront-type framing system.
   4. Transoms.
   5. Sidelights.

1.02 SUBMITTALS

A. See Section 01330 - Submittals and Substitutions.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Provide five year warranty under provisions of General Conditions including coverage for insulated glass units.

1.04 TEST PROCEDURES AND PERFORMANCE

A. Provision for Thermal Movements: System performance to provide for expansion and contraction within system components caused by temperature cycling resulting from a surface temperature ranging from 0° F to 180° F without causing buckling, stressing on glass, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or other detrimental effects. Operating doors and windows shall function normally over this temperature range.

B. Test Procedures and Performance:
   1. Air Infiltration:
      a. Test units in accordance with ASTM E 283 at static air pressure difference of 6.24 psf.
      b. Air infiltration shall not exceed 0.06 cmf/ft maximum per square foot of fixed wall area.
   2. Water Resistance:
      a. Test unit in accordance with ASTM E 331.
      b. There shall be no water leakage at a static test pressure of 12.0 psf.
   3. Uniform Load Deflection:
      a. Test in accordance with ASTM E 330.

b. Design and size members to withstand not less than 30 psf minimum positive and negative design wind pressure normal to the plane of the wall, unless greater loads are required by local code requirements.
c. Deflection under design load shall not exceed L/175 of the clear span.

4. Structural Uniform Load:
   a. Test in accordance with ASTM 330 at not less than 1.5 times the design wind pressure specified, minimum 60 psf.
   b. At conclusion of the test, there shall be no glass breakage, permanent damage to fasteners, storefront parts, or any other damage would cause the storefront to be defective.
5. Condensation Resistance Factor:
   a. Test unit in accordance with ASTM 1503.1.
   b. Condensation Resistance Factor (CRF) shall not be less than 59.
6. Thermal Transmittance:
   a. Test unit in accordance with ASTM 1503.1.
   b. Conductive thermal transmittance (U-Value) shall not be less than 0.63 BTU/hr/degree F/SF.

PART 2 PRODUCTS

2.01 MATERIALS

A. Glazing: Meeting requirements of Section 08800 and as scheduled on drawings.

B. Manufacturers: Kawneer “Trifab 451T” or approved equal.

C. Aluminum Entrances and Storefront:
1. Framing:
   a. Size: 2” x 4-1/2”, heavy duty mullion.
   b. Aluminum: 6063 T5 or T6 alloy and tempered, meeting requirements of ASTM B 221, alloy GS 10A-T5.
   c. Construction: Thermal broken with screw spline connections per manufacturers’ standards.
   d. Glazing Stops: Snap-in type with “Dry” EPDM gaskets on both exterior and interior. Units shall be 1-inch insulated double glazed consisting of ¼-inch exterior pane, ½-inch air space, ¼-inch interior pane install from exterior side.
   e. Fasteners: Aluminum or non-magnetic stainless steel. Concealed fastenings shall be cadmium or zinc-plated steel.
2. Door Type:
   a. Size: As scheduled.
   b. Aluminum: 6063 T5 or T6 alloy and tempered, meeting requirements of ASTM B 221, alloy GS 10A-T5.
   c. Stiles & Top Rails: 3-1/2” x 1-3/4” x 0.125” thick, plus or minus 0.005, glazing stop section 0.050” wall thickness.
   d. Bottom Rail: 10” minimum x 1-3/4” x 0.125” thick, plus or minus 0.005, glazing stop section 0.050” wall thickness.
   e. Construction: Manufacturers’ standard.
   f. Glazing Stops: Snap-in type with “Dry” EPDM or neoprene bulb-type glazing. Units shall be double glazed, 1-inch insulated unit, from exterior side.

g. Weatherstripping: Neoprene bulb-type, replaceable.

3. Finish: Organic, AA-M12-C42-R1X, Kynar 500/Hylar 5000 Fluropon, in accordance with AAMA 605.2. Color as selected from Manufacturers standards and scheduled on drawings.
4. Door Hardware: Refer to drawing door hardware schedule and Section 08 71 00.

D. Auxiliary Materials:
1. Provide all other materials, not specifically described but required for a complete, weathertight, and proper installation of doors and framing systems, subject to acceptance by the Architect.
a. Deflection channels: As recommended by system manufacturer.
b. Continuous sill flashing sheet metal: 0.040-inch thick aluminum sheet, finish to match mullion sections where exposed.
c. Column cladding sheet metal: 0.040-inch thick aluminum sheet, finish to match mullion sections where exposed.
d. Thermal Barrier: Barrier material shall be poured-in-place two part polyurethane. A nonstructural thermal barrier is unacceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Take field measurements before fabrication where possible; DO NOT delay job progress.

B. Install materials and systems in accordance with manufacturer's instructions. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

C. Anchor securely in place to structure; install plumb, level and in true alignment. Isolate dissimilar materials to prevent corrosion.

D. Coordinate with glass and glazing work; install hardware and adjust for smooth, proper operation.

E. Seal frames with an approved sealant, in compliance with Section 07 92 00, in color to match frames, make a neat fully weatherproof job.

F. Clean and protect completed system; repair damage.

END OF SECTION

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SECTION 08700

DOOR HARDWARE

PART 1 GENERAL

1.01 SUMMARY

A. Provide door hardware where indicated.

1.02 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

B. Shop drawings: Hardware supplier shall submit complete hardware schedule to Owner for approval.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for 3 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Qualification of supplier: The finish hardware supplier shall have in his employ a member of the American Society of Architectural Hardware Consultants.

C. Hardware for fire-rated openings: NFPA 80 and local requirements.

D. Handicapped accessibility: ANSI A117.1, AADAG, and local requirements.

E. Materials and application: ANSI A156 series standards.

PART 2 PRODUCTS

2.01 MATERIALS

A. Schedule: Refer to drawing door hardware schedule. Furnish in amounts and finish indicated or as required for complete and operable facility.

B. Manufacturers: Products of the following manufacturers will be considered acceptable provided products are of equivalent weight, function, materials, and design. Submit others for prior approval by Architect.
   1. Locksets and cylinders: Schlage (NO Substitutes).
   2. Deadbolts and deadlock levers: Adams Rite (NO Substitutes).
   3. Panic devices with alarms (battery powered): Detex, Corbin Russwin, Von Duprin.
   4. Panic devices without alarms: Yale, Dorma.
   5. Hinges and butts: Hager, Soss, Stanley, PBB.
   6. Closers: LCN, Norton, Reading, Cal Royal.

7. Storefront pivots: Rixon.
8. Storefront push/pulls: EFCO, Kawneer, Vistawall.
9. Stops, bumpers, weatherstripping, sweeps, and thresholds: Pemco, Rockwood, Trimco, Reese, National Guard, Hager.
10. Knox box for fire emergency keys: As required and approved by local governing agency.

2.02 KEYING

A. Exterior doors with removable core lock cylinders shall be keyed alike. Include construction keying and control keying with removable core cylinders.

B. Supply 2 change keys for each lock.

2.03 FASTENINGS

A. Furnish all necessary screws, bolts, and other fasteners of suitable size and type to properly anchor the hardware.

B. Furnish fastenings, where necessary, with expansion shields, toggle bolts, hex bolts, and other anchors, according to the material to which hardware is to applied and the recommendations of the hardware manufacturer.

C. Furnish fastenings compatible with both hardware and substrate material and if exposed, matching hardware finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. Follow guidelines of the Door and Hardware Institute “Recommended Locations for Builders Hardware” and hardware manufacturer’s instructions.

B. Install materials and systems in accordance with manufacturer’s instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

C. Drill and countersink units, which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

D. Set thresholds in full bed of butyl-rubber or polyisobutylene mastic sealant.

E. Adjust operation, clean, and protect.

END OF SECTION

SECTION 08800

GLAZING

PART 1 GENERAL

1.01 SUMMARY

A. Provide glazing at the following locations where indicated.
   1. Exterior entrances and storefront.
   2. Exterior windows.
   3. Interior windows and glazed openings.
   4. Doors.

1.02 SUBMITTALS

A. None required unless submitting for approved equals.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for 3 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Perform work in accordance with Flat Glass Marketing Association Glazing Manual, Laminators Safety Glass Association - Standards Manual for Glazing Installation Methods.

C. Provide safety glass (tempered, laminated) complying with requirements of ANSI Z97.1 and CPSC 26 CFR 1201 CII. Label each piece of glass indicating compliance with requirements. DO NOT remove label prior to installation.

1.04 WARRANTY

A. Provide 5-year warranty including coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers:
   1. PPG.
   2. AFG Industries.
   3. Cardinal.
   4. Libby Owens Ford.
   5. Viracon.
   6. Approved equal.

B. Schedule: Refer to drawings door schedule and glazing schedule for glazing types, combinations, and locations.

2.02 GLASS

A. General: Comply with ASTM C 1036, ASTM C 1048, and ASTM E774, of the types, classes, and forms specified.

B. Float glass: Type I, Class 1 (transparent), Quality q3 (glazing select); thickness as indicated.

C. Tinted glass: Type I, Class 3 (light reducing), Quality q3 (glazing select); tint and thickness as indicated. PPG “Solex” or approved equal.

D. Reflective tinted glass: Tinted glass as specified with reflective pyrolytic metal oxide coating on one surface; PPG “Solarcool (2) Azurlite” or approved equal.

E. Security glass: One-way vision (transparent) inside with chemical vapor deposit on 1 side for a reflective coating, 1/4-inch thickness, safety type where indicated.

F. Wire glass: Type II, Class I (translucent) Form 1 (wired and polished both sides), 1/4-inch thick welded square mesh.

G. Tempered glass: Types specified, heat-strengthened (after cutting to final size) to 4 times normal strength, by process designed to eliminate tong marks or by vertical process if glass is installed to conceal tong marks.

H. Sealed insulated units: 1-inch thick, composed of 1/4-inch thick exterior pane of glass type specified, 1/2-inch air space, and 1/4-inch thick clear interior pane of glass type specified. Air space purged dry hermetic air. Edge with elastomer edge seal.

I. Mirror glass: Type 1, Class 1 (transparent), Quality q2 (mirror), with silver coating, copper protective coating complying with CS27, and 2 mil thick painting coating; 1/4-inch thick.

2.03 GLAZING MATERIALS

A. Provide materials with proven record of compatibility with surfaces contacted in installation.

B. Glazing sealants: Elastomeric type. Tremco “Proglaze,” Bostik “Chem-Calk 1200,” Pecora “836,” Sonneborn “Omniglaze,” or other approved by system manufacturer.

C. Glazing tape: Preformed type. Bostik “Chem Tape 60,” Pecora “Shim-Seal,” or Tremco “Pre-shimmed Tremco 440 Tape.”

D. Setting blocks: Neoprene or other resilient blocks of 70 to 90 Shore A durometer hardness, adhesively backed on one face only, tested for compatibility with specified glazing sealants.

E. Spacers: Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness, tested for compatibility with specified glazing sealant.

F. Compressible filler rod: Closed-cell or waterproof-jacketed foam of polyethylene, butyl rubber, neoprene, polyurethane or vinyl, tested for compatibility with specified glazing sealants, of 5 to 10 pounds per square inch compression strength (25 percent deflection), recommended by sealant manufacturer for use in glazing channel to prevent sealant exudation from the channel.

PART 3 EXECUTION

3.01 PERFORMANCE REQUIREMENTS

A. Watertight and airtight installation of each piece of glass is required. Each installation must withstand normal temperature changes, wind loading, impact loading without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials, and other defects in work.

3.02 INSTALLATION

A. Comply with Flat Glass Marketing Association Glazing Manual and manufacturer's instructions and recommendations. Use manufacturers recommended spacers, blocks, primers, sealers, gaskets and accessories.

B. Clean channel surfaces and prime as recommended by sealant manufacturer.

C. Cut glass to size as required for measured opening, provide adequate edge clearance and glass bite all around. Cut prior to tempering.

D. DO NOT install sheets which have edge damage or face imperfections. Install glass with uniformity of pattern, draw, bow, and roller marks.

E. Miter-cut and bond (weld) ends of channel gaskets at corners to provide a continuous gasket.

F. Install sealants to provide complete wetting and bond and to create a substantial wash away from glass.

G. Seal face gaskets at corners with liquid elastomeric sealant to close openings and prevent withdrawal of gaskets from corners.

H. Remove and replace damaged glass and glazing. Wash, polish and protect all glass supplied under this section.

END OF SECTION

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SECTION 09200

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SUMMARY

A. Provide gypsum board assemblies where indicated.
   1. Interior walls, partitions, and ceilings.
   2. Fire rated assemblies.

1.02 SUBMITTALS

A. None required unless submitting for approved equals.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Tolerances: Not more than 1/16-inch difference in true plane at joints between adjacent boards before finishing. After finishing, joints shall not be visible. Not more than 1/8-inch in 10 feet deviation from true plane, plumb, level, and proper relation to adjacent surfaces in finished work.

C. Fire resistant for fire rated assemblies: Where work is indicated for fire-resistance ratings, provide materials and installations identical with assemblies whose fire resistance rating has been determined per ASTM E 119 by a testing and inspection organization acceptable to authorities having jurisdiction.

D. Performance: Structural and seismic performance meeting requirements of building code and local authorities.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers of gypsum board: Domtar Gypsum, Georgia-Pacific Corp., National Gypsum Co., United States Gypsum Co., or approved equal.

B. Gypsum board:
   1. Gypsum wallboard: ASTM C 36, Type X fire-rated type, 5/8-inch typical thickness, tapered edges.
   2. Water-resistant gypsum backing board: ASTM C 630, Type X fire-rated type, 5/8-inch typical thickness, tapered edges.

3. Exterior fiberglass reinforced gypsum sheathing: ASTM E 136 and ASTM C 1177, fiberglass matt faced gypsum core, water resistant, Type X, square edges, flame spread rating not to exceed 10, smoke development rating less than 450.
4. Shaftwall coreboard: ASTM C 442, Type X fire-rated type gypsum core with additives to enhance fire resistance of core, surfaced with water repellant paper on front, back, and long edges, 1 inch typical thickness, beveled edges, width required for blind installation in framing spacing and type indicated.

C. Joint treatment materials: ASTM C 475 and ASTM C 840, 2-coat joint compound, and other materials, paper, or fiberglass tape.

D. Trim accessories: Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for attachment, and beaded for concealment of flanges in joint compound. Provide all corner beads, edge trim-beads, and one-piece control joint beads. Provide decorative profiles factory primed of types indicated.

E. Fasteners: ASTM C 1002, self-drilling, self-tapping screws for power driving with special head design for gypsum board attachment (Type S), producing surface depression for proper concealment; 1-inch long for single ply, 1-5/8-inch long for double ply, 2-inch long for multiple plies. Use other fasteners as required.

F. Water-resistant sealer: Type recommended by gypsum wallboard manufacturer for sealing cut edges and holes in water resistant gypsum board.

G. Laminating adhesive: Type recommended by gypsum wallboard manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Inspection: Coordinate with carpenter and insulator in placing of backing, blocking, bracing, and insulation where required in walls for acoustical treatment, millwork, fixtures, fittings, and accessories. Examine substrates for proper application of gypsum board systems. Beginning work means acceptance of conditions.

B. Install gypsum board assemblies in compliance with ASTM C 840 and GA 216, Recommended Specifications for the Application and Finishing of Gypsum Board. Install gypsum board assemblies true, plumb, level, and in proper relation to adjacent surfaces.

C. Provide fire-rated systems where indicated and where required by authorities having jurisdiction.

D. Partitions: Install boards vertically parallel to studs. DO NOT allow butt-to-butt joints and joints that do not fall over framing members. Arrange gypsum board joints on opposite sides of partitions to occur on different studs.

E. Ceilings and soffits: Install boards across framing members in manner which minimizes number of end-butt joints and which avoids end joints in central area of each ceiling and soffit. Stagger end joints at least 24 inches.

F. Fastening: Fasten gypsum board to metal studs with specified screws spaced 16 inches on center for walls and 12 inches on center for ceilings of single layer application, 24 inches on center for wall and 16 inches on center for base layer, and 16 inches on center for wall and 12 inches on center for ceilings of double layer applications.

G. Expansion/control joints: Install expansion/control joints in ceilings exceeding 2,500 square feet in area and in partition and wall runs exceeding 30 feet unless otherwise indicated. DO NOT exceed a distance of 50 feet in either direction, between ceiling control joints and install a control joint where ceiling framing of furring changes direction. DO NOT exceed a distance of 30 feet between control joints in walls unless otherwise indicated.

H. Transitions, trim, and corners:
   1. Provide casing beads where edges of gypsum board meet dissimilar materials.
   2. Treat all internal angles formed by the intersection of either wallboard surfaces with metal trim and/or a taped joint system as indicated or required.
   3. Treat all vertical and horizontal external corners with metal bead corner reinforcement applied in accordance with manufacturer's recommendations.
   4. Where new partitions meet existing construction, remove existing corner beads to provide a smooth transition.

I. Finishing:
   1. Apply joint treatment at joints (both directions); flanges of corner bead, edge trim, and control joints, penetrations, fastener heads, surface defects and elsewhere as required to prepare work for finish.
   2. Pre-fill open joints and beveled edges using setting-type joint compound.
   3. Apply joint tape at joints between gypsum board, except where trim accessories are indicated.
   4. Finish by applying joint compound in two coats (not including pre-fill) and sand between coats and after last coat. Leave ready for finish painting or wall treatment.

END OF SECTION

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SECTION 09300

TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications (Refer to drawings for finish, types, locations, and substrate conditions).

B. Cementitious backer board as tile substrate.

1.02 REFERENCE STANDARDS

A. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2011.

B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2011.

C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar; 2011.

D. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex Portland Cement.

E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2011.

F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 2011.

G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and - Grouting Epoxy; 2011.

H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 2011.

I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2011.

J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2011.

K. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 2011.

L. ANSI A118.4 - American National Standard Specifications for Latex-Portland Cement Mortar; 2011.

M. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2011.

N. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-set Ceramic Tile and Dimension Stone Installation; 2011.

O. ANSI A136.1 - American National Standard for Organic Adhesives for Installation of Ceramic Tile; 2011.

P. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2008.

Q. Tile Council of North America (TCNA) (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2011.

1.03 SUBMITTALS

A. See Section 01330 - Submittal Procedures, for submittal procedures.

B. Selection Samples: Color charts illustrating full range of colors and patterns.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.04 QUALITY ASSURANCE

A. Maintain 1 copy of The Tile Council of North America Handbook and ANSI A108 Series/A118 Series on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

D. Deliver, handle, and store materials in accordance with manufacturer's instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

B. Deliver and store products in manufacturer's unopened packaging until ready for installation.

C. Store tile and setting materials on elevated platforms, under cover and in a dry location and protect from contamination, dampness, freezing or overheating.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers: All products by the same manufacturer.
   1. American Olean: www.americanolean.com.
   2. Dal-Tile Corporation: www.daltile.com.
   3. Summitville Tiles, Inc.: www.summitville.com.
   4. Dal-Tile: www.daltile.com
   5. Substitutions: See Section 01330 - Submittal Procedures.

B. B.Porcelain Tile (Refer to drawings interior finish schedule)
   1. Floor Field Tile Size: 8 by 8 inches.
   2. Color: To be selected by Architect from manufacturer's standard samples.
   3. Grout: Joint width 1/4 inch.
   4. Moisture Absorption: Less than .5 percent.
   5. Surface Finishes: Plain.

2.02 SETTING MATERIALS

A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
   1. Products:
      a. ARDEX Engineered Cements; ARDEX X 77 MICROTEC: www.ardexamericas.com.
      b. AVM Industries, Inc; Thin-Set 780: www.avmindustries.com.
      c. LATICRETE International, Inc.; LATICRETE 254 Platinum: www.laticrete.com.
      d. Merkrete, by Parex USA, Inc.; Merkrete 720 Marble Pro: www.merkrete.com.
      e. ProSpec, an Oldcastle brand; Permalastic System: www.prospec.com.
      f. Substitutions: See Section 01330 - Submittal Procedures.

B. Organic Adhesive: ANSI A136.1, thinset mastic type.

2.03 GROUTS

A. Manufacturers:
   1. ARDEX Engineered Cements: www.ardexamericas.com.
   2. ProSpec, an Oldcastle brand; www.prospec.com.
   3. Bostik Inc.; www.bostik-us.com.
   4. LATICRETE International, Inc.; www.laticrete.com.
   5. Substitutions: See Section 01330 - Submittal Procedures.

B. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
   1. Applications: Where indicated.
   2. Color(s): As selected by Architect from manufacturer's full line.
   3. Products:

C. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
   1. Composition: Water-based colorless silicone.

2.04 THIN-SET ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12.
   1. Thickness: 20 mils (0.5 millimeters), maximum.
   2. Crack Resistance: No failure at 1/16 inch (1.6 millimeters) gap, minimum.
   3. Products:
      a. Merkrete, by Parex USA, Inc.; Merkrete Fracture Guard 5000: www.merkrete.com.
      b. Laticrete "Blue 92".
      c. Substitutions: See Section 01330 - Submittal Procedures.

B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10. Provide reinforcing fabric as recommended by manufacturer for specific project conditions.
   1. Type: Fluid-applied.
   2. Products:
      a. ARDEX Engineered Cements; ARDEX 8+9: www.ardexamericas.com.
      b. AVM Industries, Inc.; System 750 with polyester fabric reinforcing at edges, corners, joints, and cracks: www.avmindustries.com.
      c. Laticrete; #9235.
      d. Substitutions: See Section 01330 - Submittal Procedures.

C. Cementitious Backer Board: ANSI A118.9; High density, cementitious, glass fiber reinforced, 1/2 inch (13 millimeters) thick; 2 inch (50 millimeters) wide coated glass fiber tape for joints and corners.
   1. Product: 1/2 inch Dur-Rock.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.

C. Examine the areas and conditions under which tile work is to be installed. Notify Architect in writing of defects or conditions that will prevent satisfactory tile installation. Do not proceed with work until unsatisfactory conditions have been corrected. Beginning of tile work shall imply acceptance of substrate conditions.

D. Neutralize and seal substrates in accordance with mortar manufacturer's instructions.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and The Tile Council of North America Handbook recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bull nosed.

F. Sound tile after setting. Replace hollow sounding units.

G. Keep expansion joints free of adhesive or grout. Apply sealant to joints.

H. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

I. Grout tile joints. Use standard grout unless otherwise indicated.

J. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with The Tile Council of North America Handbook Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
   1. .Where epoxy bond coat and grout are indicated, install in accordance with The Tile Council of North America Handbook Method F131.

3.05 INSTALLATION - FLOORS - MORTAR BED METHODS

A. Over interior concrete substrates, install in accordance with The Tile Council of North America Handbook Method F111, with cleavage membrane, unless otherwise indicated.
   1. Where epoxy bond coat and grout are indicated, install in accordance with The Tile Council of North America Handbook Method F132, bonded.

B. Cleavage Membrane: Lap edges and ends.

C. Mortar Bed Thickness: 5/8 inch (15 millimeters), unless otherwise indicated.

3.06 CLEANING

A. Clean tile and grout surfaces.

3.07 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09510

ACOUSTICAL TILE CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 RELATED SECTIONS

A. Coordinate the work of this section for the above-ceiling ductwork and for ceiling-mounted air diffusers.

B. Coordinate the work of this section with the work for above-ceiling electrical conduits and raceways and for ceiling-mounted lighting fixtures and speaker boxes.

1.03 REFERENCE STANDARDS

A. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2007.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2008.

C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2008e1.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

A. See Section 01330 - Submittal Procedures, for submittal procedures.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Acoustical Units: Quantity equal to 2 percent of total installed for use of owner's use in maintenance of the project.

1.06 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 3 years documented experience.

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 3 years documented experience.

1.07 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees Fahrenheit (16 degrees Celsius), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Manufacturers:
   1. Armstrong World Industries, Inc.; www.armstrong.com.
   2. Acoustic Ceiling Products, Inc.; www.acpideas.com.
   3. CertainTeed Corporation; www.certainteed.com.
   4. Hunter Douglas Contract; www.hunterdouglascontract.com.
   5. USG; www.usg.com.
   6. Substitutions: See Section 01330 - Submittal Procedures.

B. Acoustical Units - General: ASTM E1264, Class A.

C. Acoustical Panels Type ACT-1: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
   1. Size: 24 by 48 inches (600 by 1,200 millimeters).
   2. Thickness: 5/8 inches.
   3. Panel Edge: Square.
   4. Surface Color: White.

D. Acoustical Panels Type ACT-2: Glass fiber base with membrane-faced overlay, ASTM E1264 Type XII, with the following characteristics:
   1. Size: 24 by 48 inches (600 by 1,200 millimeters).
   2. Thickness: 5/8 inches.
   3. Panel Edge: Square.
   4. Surface Color: White.
   5. Mold/Mildew Inhibitor: The front and back of the product have been treated with a membrane that contains a biocide that inhibits or retards the growth of mold or mildew, ASTM D 3273.

2.02 SUSPENSION SYSTEM(S)

A. Manufacturers:
   1. Same as for acoustical units.
   2. Substitutions: See Section 01600 - Product Requirements.

B. Suspension Systems - General: All main beams and cross tees shall be commercial quality hot-dipped galvanized (galvanized steel, aluminum, or stainless steel) as per ASTM A 653. Structural Classification: ASTM C635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required. Exposed surfaces chemically cleansed, capping pre-finished galvanized steel (aluminum or stainless steel) in baked polyester paint. Main beams and cross tees shall have rotary stitching (exception: extruded aluminum or stainless steel).

C. Exposed Steel Suspension System Type ACT-1: intermediate-duty.
   1. Profile: Tee; 15/16 inch (24 millimeters) wide face.
   2. Finish: White.

D. Exposed Steel Suspension System Type ACT-2: intermediate-duty, unless otherwise noted.
   1. Profile: Tee; 15/16 inch (24 millimeters) wide face.
   2. Finish: High Humidity Finish: Comply with ASTM C 635 requirements for Coating Classification for Severe Environment Performance where ceiling type is indicated.

E. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

F. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least time three design load, but not less than 12 gauge.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Perimeter Moldings: Same material and finish as grid.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

B. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

C. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

F. Support fixture loads using supplementary hangers located within 6 inches (150 millimeters) of each corner, or support components independently.

G. Do not eccentrically load system or induce rotation of runners.

H. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Lay directional patterned units with pattern parallel to longest room axis.

D. Fit border trim neatly against abutting surfaces.

E. Install units after above-ceiling work is complete.

F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

G. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

H. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 millimeters in 3 meters).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09650

RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient vinyl base.

B. Installation accessories including trim, edge strips, and transitions.

1.02 REFERENCE STANDARDS

A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008.

1.03 SUBMITTALS

A. None required unless submitting for approved equals.

B. Provide 2 percent extra stock matching each type of different material provided at substantial completion.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect roll materials from damage by storing on end.

1.05 FIELD CONDITIONS

A. Maintain temperature in storage area between 55 degrees Fahrenheit (13 degrees Celsius) and 90 degrees Fahrenheit (72 degrees Celsius).

B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees Fahrenheit (21 degrees Celsius) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees Fahrenheit (13 degrees Celsius).

1.06 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer’s instructions.

B. Performance: Fire performance meeting requirements of building code and local authorities.

C. Provide materials and adhesives which do not contain asbestos.

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TV, vinyl, thermoplastic; top set Style B, Cove, and as follows:
   1. Height: 4 inch (100 millimeter), 6 inch (304.8 millimeter) (see room finish schedule).
   2. Thickness: 0.125 inch (3.2 millimeter) thick.
   3. Finish: Satin.
   4. Color: Color as selected from manufacturer's standards.
   5. Manufacturers:
      a. Burke Flooring; www.burkemercer.com.
      b. Johnsonite, Inc; www.johnsonite.com.
      c. Roppe Corp; www.roppe.com.
      d. Substitutions: See Section 01330 - Submittal Procedures.

2.02 MISCELLANEOUS MATERIALS

A. Provide adhesives, primers, seam sealers, external corners and end stops, crack fillers and other materials required but not specifically described and recommended by the resilient flooring and accessories.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02 PREPARATION

A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

B. Prohibit traffic until filler is cured.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Comply with manufacturer’s instructions and recommendations. Install in proper relation to adjacent work.

C. Examine the areas and conditions under which resilient base and accessory work is to be placed. Moisture content of concrete slabs, building air temperature, and relative humidity must be within limits recommended by flooring manufacturer. DO NOT proceed until unsatisfactory conditions have been corrected. Maintain minimum temperature of 70 degrees Fahrenheit for minimum of 48 hours prior to installation. Maintain 70 degrees Fahrenheit temperature continuously during and after installation as recommended by manufacturer, but in any case not less than 48 hours.

D. Prepare surfaces by cleaning, leveling, and priming as required. Test adhesive for bond before general installation.

E. Resilient Base: Apply resilient base to walls, columns, pilasters, casework, and other permanent fixtures in rooms or areas where base is indicated. Install base in as long lengths as practicable. Tightly bond base to backing throughout the length of each piece, with continuous contact at horizontal and vertical surfaces. DO NOT stretch resilient base during installation.

F. Resilient Edge Strip: Place edge strips tightly butted and secured to flooring with adhesive. Install edge strips at all unprotected edges of flooring unless otherwise indicated.

G. Fit joints tightly.

H. Clean and protect work per manufacturer's recommendations until final acceptance.

3.04 VINYL RESILIENT BASE (REFER TO ROOM FINISH SCHEDULE)

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 millimeters) between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.05 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 09900

PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints, stains, varnishes, and other coatings.

C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Elevator pit ladders.
   3. Exposed surfaces of steel lintels and ledge angles.
   4. Surfaces inside cabinets.
   5. Mechanical and electrical:
      a. In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. In finished areas, paint shop-primed items.
      c. On the roof and outdoors, paint all equipment that is exposed to weather or to view, including that which is factory-finished.
      d. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

D. Do not paint or finish the following items:
   1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne, and lead items.
   6. Floors, unless specifically so indicated.
   7. Ceramic and other tiles.
   8. Glass.
   9. Concrete masonry in utility, mechanical, and electrical spaces unless specified.
   10. Acoustical materials, unless specifically so indicated.
   11. Concealed pipes, ducts, and conduits.

1.02 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

B. Product data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Maintenance materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra paint and coatings: 1 gallon (4 liters) of each color; store where directed by end user.
   2. Label each container with color in addition to the manufacturer's label.

1.03 QUALITY ASSURANCE

A. Manufacturer qualifications: Company specializing in manufacturing the products specified, with minimum 3 years' documented experience.

B. Applicator qualifications: Company specializing in performing the type of work specified with minimum 5 years' experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint materials: Store at minimum ambient temperature of 45 degrees Fahrenheit (7 degrees Celsius) and a maximum of 90 degrees Fahrenheit (32 degrees Celsius), in ventilated area, and as required by manufacturer's instructions.

1.05 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum application temperatures for latex paints: 45 degrees Fahrenheit (7 degrees Celsius) for interiors; 50 degrees Fahrenheit (10 degrees Celsius) for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 foot candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.

B. Provide all paint and coating products from the same manufacturer to the greatest extent possible.

C. Paints:
   1. Duron, Inc: www.duron.com.
   2. Benjamin Moore & Co: www.benjaminmoore.com.
   3. Sherwin-Williams Company: www.sherwin-williams.com.
   4. PPG Architectural Finishes, Inc: www.ppgaf.com.

D. Primer Sealers: Same manufacturer as top coats.

E. Substitutions: See Section 01330 - Submittal Procedures.

2.02 PAINTS AND COATINGS - GENERAL

A. Paints and coatings: Ready mixed, unless intended to be a field-catalyzed coating.
   1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each coating material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Volatile organic compound (VOC) content:
   1. Provide coatings that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   2. Determination of VOC content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

D. Colors: As indicated on drawings.
   1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint EC-OP - All exterior concrete and masonry surfaces Indicated to be painted, unless otherwise indicated: Including concrete, cement board, and tilt-up wall panels.
   1. Preparation as specified by manufacturer.
   2. 2 top coats and 1 coat primer recommended by manufacturer.

B. Paint CE-OP-3L - Masonry/concrete, opaque, latex, 3-coat:
   1. 1 coat of block filler.
   2. Semi-gloss: 2 coats of latex enamel.

C. C.Paint GE-OP-3L - Gypsum board and plaster, opaque, latex, 3-coat:
   1. 1 coat of latex primer sealer.
   2. Flat: 2 coats of latex.

D. Paint ME-OP-3A - Ferrous metals, unprimed, alkyd, 3-coat:
   1. 1 coat of alkyd primer.
   2. Semi-gloss: 2 coats of alkyd enamel.

E. Paint MgE-OP-3A - Galvanized metals, alkyd, 3-coat:
   1. 1 coat galvanize primer.
   2. Semi-gloss: 2 coats of alkyd enamel.

F. Paint E-Pav - Pavement marking paint:
   1. Yellow: 1 coat, with reflective particles.
   2. White: 1 coat, with reflective particles.

G. Block sealer - saver system - MasonrySaver water repellent for split face block:
   1. Manufacture Info: SaverSystems.
   2. Richmond, In 47374.
   3. 800-860-6327.
   4. Fax: 765-935-4999.
   5. www.masonry sever.com.
   6. As per manufacture suggested details.

2.04 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - All interior surfaces indicated to be painted, unless otherwise indicated: Including gypsum board, concrete, concrete masonry, uncoated steel, shop primed steel, galvanized steel, aluminum.
   1. 2 top coats and one coat primer.
   2. Primer(s): As recommended by manufacturer of top coats.

B. Paint I-OP-MD-DT - Medium duty door/trim: For surfaces subject to frequent contact by occupants, including metals, wood.
   1. 2 top coats and one coat primer.

C. Paint CI-OP-3L - Concrete/masonry, opaque, latex, 3-coat:
   1. 1 coat of block filler.
   2. Semi-gloss: 2 coats of latex enamel.

D. Paint MI-OP-3A - Ferrous metals, unprimed, alkyd, 3-coat:
   1. 1 coat of alkyd primer.
   2. Semi-gloss: 2 coats of alkyd enamel.

E. Paint MgI-OP-3A - Galvanized metals, alkyd, 3-coat:
   1. 1 coat galvanize primer.
   2. Semi-gloss: 2 coats of alkyd enamel.

F. Paint GI-OP-3LA - Gypsum board/plaster, latex-acrylic, 3-coat:
   1. 1 coat of alkyd primer sealer.
   2. Eggshell: 2 coats of latex-acrylic enamel.

2.05 ACCESSORY MATERIALS

A. Accessory materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.

B. Patching material: Latex filler.

C. Fastener head cover material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of coatings until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum wallboard: 12 percent.
   2. Masonry, concrete, and concrete unit masonry: 12 percent.
   3. Concrete floors and traffic surfaces: 8 percent or as specified by manufacture whichever is more stringent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to coating application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete and unit masonry surfaces to be painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

G. Gypsum board surfaces to be painted: Fill minor defects with filler compound. Spot prime defects after repair.

H. Asphalt, creosote, or bituminous surfaces to be painted: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.

I. Aluminum surfaces to be painted: Remove surface contamination by steam or high-pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

J. Galvanized surfaces to be painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

K. Corroded steel and iron surfaces to be painted: Prepare using at least SSPC-PC 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).

L. Uncorroded uncoated steel and iron surfaces to be painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

M. Shop-primed steel surfaces to be finish painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

N. Metal doors to be painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's instructions.

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance.

F. Sand wood and metal surfaces lightly between coats to achieve required finish.

G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. Owner will provide field inspection.

B. Architect shall provide punch list for any field inspections - walk through

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finished coatings until completion of project.

B. Touch-up damaged coatings after Substantial Completion.

END OF SECTION

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SECTION 09960

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Field-applied coatings.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
   2. D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

B. International Concrete Repair Institute (ICRI):
   1. Guideline 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

C. NACE International (NACE):
   1. SP0178 - Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service.
   2. SP0188 - Discontinuity (Holiday) Testing of Protective Coatings.

D. National Association of Pipe Fabricators (NAPF):
   1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.

E. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

F. Society for Protective Coatings (SSPC):
   1. SP COM - Surface Preparation Commentary for Steel and Concrete Substrates.
   2. SP 1 - Solvent Cleaning.
   3. SP 2 - Hand Tool Cleaning.
   4. SP 3 - Power Tool Cleaning.
   5. SP 5 - White Metal Blast Cleaning.
   6. SP 6 - Commercial Blast Cleaning.
   7. SP 7 - Brush-Off Blast Cleaning.
   8. SP 10 - Near-White Blast Cleaning.
   9. SP 13 - Surface Preparation of Concrete.

G. United States Environmental Protection Agency (EPA):
   1. Method 24 - Surface Coatings.

1.03 DEFINITIONS

A. Submerged metal: Steel or iron surfaces below tops of channel or structure walls that will contain water even when above expected water level.

B. Submerged concrete and masonry surfaces: Surfaces that are or will be:
   1. Underwater.
   2. In structures that normally contain water.
   3. Below tops of walls of water-containing structures.

C. Exposed surface: Any metal or concrete surface, indoors or outdoors, that is exposed to view.

D. Dry film thickness (DFT): Thickness of fully cured coating, measured in mils.

E. Volatile organic compound (VOC): Content of air polluting hydrocarbons in uncured coating product measured in units of grams per liter or pounds per gallon, as determined by EPA Method 24.

F. Ferrous: Cast iron, ductile iron, wrought iron, and all steel alloys except stainless steel.

G. Where SSPC surface preparation standards are specified or implied for ductile iron pipe or fittings, the equivalent NAPF surface preparation standard shall be substituted for the SSPC standard.

1.04 PERFORMANCE REQUIREMENTS

A. Coating materials shall be especially adapted for use in water treatment plants.

B. Coating materials used in contact with potable water supply systems shall be certified to NSF 61.

1.05 SUBMITTALS

A. General: Submit as specified in Section 01330 - Submittal Procedures.

B. Shop drawings:
   1. Schedule of proposed coating materials.
   2. Schedule of surfaces to be coated with each coating material.

C. Product data: Include description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips:
   1. Regulatory requirements: Submit data concerning the following:
      a. VOC limitations.
      b. Coatings containing lead compounds and polychlorinated biphenyls.
      c. Abrasives and abrasive blast cleaning techniques, and disposal.
      d. NSF certification of coatings for use in potable water supply systems.

D. Samples: Include 8-inch square drawdowns or brush-outs of topcoat finish when requested. Identify each sample as to finish, formula, color name and number, sheen name, and gloss units.

E. Certificates: Submit in accordance with requirements for Product Data.

F. Manufacturer's instructions: Include the following:
   1. Special requirements for transportation and storage.
   2. Mixing instructions.
   3. Shelf life.
   4. Pot life of material.
   5. Precautions for applications free of defects.
   6. Surface preparation.
   7. Method of application.
   8. Recommended number of coats.
   9. Recommended DFT of each coat.
   10. Recommended total DFT.
   11. Drying time of each coat, including prime coat.
   12. Required prime coat.
   13. Compatible and non-compatible prime coats.
   14. Recommended thinners, when recommended.
   15. Limits of ambient conditions during and after application.
   16. Time allowed between coats (minimum and maximum).
   17. Required protection from sun, wind, and other conditions.
   18. Touch-up requirements and limitations.
   19. Minimum adhesion of each system submitted in accordance with ASTM D4541.

G. Manufacturer's Representative's Field Reports.

H. Operations and Maintenance Data: Submit as specified in Section 01770 - Closeout Procedures.
   1. Reports on visits to project site to view and approve surface preparation of structures to be coated.
   2. Reports on visits to project site to observe and approve coating application procedures.
   3. Reports on visits to coating plants to observe and approve surface preparation and coating application on items that are "shop coated."

I. Quality Assurance Submittals:
   1. Quality assurance plan.
   2. Qualifications of coating applicator including List of Similar Projects.

J. Certifications:
   1. Submit notarized certificate that:
      a. All paints and coatings to be used on this project comply with current federal, state, and local VOC regulations.

1.06 QUALITY ASSURANCE

A. Applicator qualifications:
   1. Minimum of 5 years of experience applying specified type or types of coatings under conditions similar to those of the Work:
      a. Provide qualifications of applicator and references listing 5 similar projects completed in the past 2 years.
   2. Manufacturer-approved applicator when manufacturer has approved applicator program.

3. Approved and licensed by polymorphic polyester resin manufacturer to apply polymorphic polyester resin coating system.
4. Approved and licensed by elastomeric polyurethane (100 percent solids) manufacturer to apply 100 percent solids elastomeric polyurethane system.

B. Regulatory requirements: Comply with governing agencies regulations by using coatings that do not exceed permissible VOC limits and do not contain lead:
1. Do not use coal-tar epoxy in contact with drinking water or exposed to ultraviolet radiation.

C. Field samples:
1. Prepare and coat a minimum 100-square-foot area between corners or limits such as control or construction joints of each system.
2. Approved field sample may be part of the Work.
3. Obtain approval before painting other surfaces.

D. Pre-installation conference: Conduct as specified in Section 01312 - Project Meetings.

E. Compatibility of coatings: Use products by same manufacturer for prime coats, intermediate coats, and finish coats on same surface, unless specified otherwise.

F. Services of coating manufacturer's representative: Arrange for coating manufacturer's representative to attend pre-installation conferences. Make periodic visits to the project site to provide consultation and inspection services during surface preparation and application of coatings, and to make visits to coating plants to observe and approve surface preparation procedures and coating application of items to be "shop-primed and coated."

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products as specified in Section 01600 - Product Requirements.

B. Remove unspecified and unapproved paints from Project site immediately.

C. Deliver new unopened containers with labels identifying the manufacturer's name, brand name, product type, batch number, date of manufacturer, expiration date or shelf life, color, and mixing and reducing instructions.
1. Do not deliver materials aged more than 12 months from manufacturing date.

D. Store coatings in well-ventilated facility that provides protection from the sun weather, and fire hazards. Maintain ambient storage temperature between 45 and 90 degrees Fahrenheit, unless otherwise recommended by the manufacturer.

E. Take precautions to prevent fire and spontaneous combustion.

1.08 PROJECT CONDITIONS

A. Surface moisture contents: Do not coat surfaces that exceed manufacturer-specified moisture contents, or when not specified by the manufacturer, with the following moisture contents:
1. Plaster and gypsum wallboard: 12 percent.

2. Masonry, concrete, and concrete block: 12 percent.
3. Interior located wood: 15 percent.
4. Concrete floors: 7 percent.

B. Do not apply coatings:
1. Under dusty conditions or adverse environmental conditions, unless tenting, covers, or other such protection is provided for structures to be coated.
2. When light on surfaces measures less than 15 foot-candles.
3. When ambient or surface temperature is less than 55 degrees Fahrenheit unless manufacturer allows a lower temperature.
4. When relative humidity is higher than 85 percent.
5. When surface temperature is less than 5 degrees Fahrenheit above dew point.
6. When surface temperature exceeds the manufacturer's recommendation.
7. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
8. Apply clear finishes at minimum 65 degrees Fahrenheit.

C. Provide fans, heating devices, dehumidifiers, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.

D. Provide adequate continuous ventilation and sufficient heating facilities to maintain minimum 55 degrees Fahrenheit for 24 hours before, during, and 48 hours after application of finishes.

E. Dehumidification and heating for coating to the interior of tanks and high humidity enclosed spaces:
1. Provide dehumidification and heating of interior tank spaces in which surface preparation, coating application, or curing is in progress to maintain the relatively humidity to allow application of the specified coating.
2. Equipment requirements:
a. Capacity: Provide dehumidification, heating, and air circulation equipment with minimum capacity to perform the following:
1) Maintain the dew point of the air in the tanks at a temperature at least 5 degrees Fahrenheit less than the temperature of the coldest part of the structure where work is underway.
2) Reduce dew point temperature of the air in the tanks by at least 10 degrees Fahrenheit in 20 minutes.
3) Maintain air temperature in the tanks at 60 degrees Fahrenheit minimum.
b. Systems:
1) Dehumidification: Provide desiccant or refrigeration drying. Desiccant types shall have a rotary desiccant wheel capable of continuous operation. No liquid, granular, or loose lithium chloride drying systems will be allowed.
2) Heating: Electric, indirect combustion, or steam coil methods may be used. Direct-fired combustion heaters will not be allowed during abrasive blasting, coating application, or coating cure time.
3. Design and submittals:
a. Contractor shall prepare dehumidification and heating plan for this project, including all equipment and operating procedures.

b. Suppliers of services and equipment shall have not less than 3 years' experience in similar applications.
    1) Supplier: The following or equal:
        a) Cargocaire Corporation (Munters) or equal.
c. Submit dehumidification and heating plan for Engineer's review.

4. Monitoring and performance:
    a. Measure and record relative humidity and temperature of air, and structure temperature twice daily (beginning and end of work shifts) to verify that proper humidity and temperature levels are achieved inside the work area after the dehumidification equipment is installed and operational. Test results shall be made available to the Engineer upon request.
    b. Interior space of the working area and tank(s) shall be sealed, and a slight positive pressure maintained as recommended by the supplier of the dehumidification equipment.
    c. The filtration system used to remove dust from the air shall be designed so that it does not interfere with the dehumidification equipment's ability to control the dew point and relative humidity inside the reservoir.
        1) The air from the tank, working area, or dust filtration equipment shall not be recirculated through the dehumidifier during coating application or when solvent vapors are present.

1.09 SEQUENCING AND SCHEDULING

A. Sequence and Schedule: As specified in Section 01140 - Work Restrictions.

1.10 MAINTENANCE

A. Extra materials: Deliver as specified in Section 01770 - Closeout Procedures. Include minimum 1 gallon of each type and color of coating applied:
    1. When manufacturer packages material in gallon cans, deliver unopened labeled cans as comes from factory.
    2. When manufacturer does not package material in gallon cans, deliver material in new gallon containers, properly sealed and identified with typed labels indicating brand, type, and color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Special coatings: One of the following or equal:
    1. Carboline: Carboline, St. Louis, MO.
    2. Ceilcote: International Protective Coatings, Berea, OH.
    3. Dampney: The Dampney Company, Everett, MA.
    4. Devoe: International Protective Coatings, Louisville, KY.
    5. Dudick: Dudick, Inc., Streetsboro, OH.
    6. GET: Global Eco Technologies, Pittsburg, CA.
    7. Henkel: Henkel North America, Madison Heights, MI.
    8. IET: Integrated Environmental Technologies, Santa Barbara, CA.
    9. PPC: Polymorphic Polymers Corp., North Miami, FL.
    10. PPG Amercoat: PPG Protective & Marine Coatings, Brea, CA.
    11. Rustoleum: Rustoleum Corp., Sommerset, NJ.

12. Sanchem: Sanchem, Chicago, IL.
13. Superior: Superior Environmental Products, Inc., Addison, TX.
14. S-W: Sherwin-Williams Co., Cleveland, OH.
15. Tnemec: Tnemec Co., Kansas City, MO.
16. Wasser: Wasser High Tech Coatings, Kent, WA.
17. ZRC: ZRC Worldwide Innovative Zinc Technologies, Marshfield, MA.

2.02 PREPARATION AND PRETREATMENT MATERIALS

A. Metal pretreatment: As manufactured by one of the following or equal:
   1. Henkel: Galvaprep 5.
   2. International: AWLGrip Alumiprep 33.

B. Surface cleaner and degreaser: As manufactured by one of the following or equal:
   1. Carboline Surface Cleaner No. 3.
   2. Devoe: Devprep 88.
   3. S-W: Clean and Etch.

2.03 COATING MATERIALS

A. Wax coating: As manufactured by the following or equal:
   1. Sanchem: No-Ox-Id A special.

B. High solids epoxy (self-priming) not less than 72 percent solids by volume: As manufactured by one of the following or equal:
   1. Carboline: Carboguard 891.
   2. Devoe: Bar Rust 233H.
   3. PPG Amercoat: Amerlock 2.
   4. S-W: Macropoxy 646.

C. Aliphatic or aliphatic-acrylic polyurethane: As manufactured by one of the following or equal:
   1. Carboline: Carbothane 134 VOC.
   2. Devoe: Devthane 379.
   3. PPG Amercoat: Amershield VOC.
   4. Non-submerged: S-W High Solids Polyurethane.
   5. Tnemec: Endura-Shield II Series 1075 (U).

D. Polymorphic polyester resin coating system: 2-component, modified styrene based thermoset resin, EPA approved for potable water, with 100 percent solids and maximum 10 grams per liter VOC. As manufactured by one of the following or equal:
   1. IET: IET Prime Coat DS-101, Intermediate Coat DS-301, and Finish Coat DS 401.
   2. PPC: PPC Prime Coat, IC-Filler Coat, and FC-Final Coat.

E. Asphalt varnish: AWWA C 500.

F. Vinyl ester: Glass mat reinforced, total system 125 mils DFT. As manufactured by one of the following or equal:
   1. Carboline: Semstone 870.
   2. Ceilcote: 6640 Ceilcrete.
   3. Dudick: Protecto-Flex 800.

4. Tnemec: Chembloc Series 239SC.

G. Elastomeric polyurethane, 100 percent solids, ASTM D16, Type V, (Urethane P): As manufactured by the following or equal:
   1. GET: Endura-Flex EF-1988.

H. Concrete floor coatings: As manufactured by one of the following or equal:
   1. Carboline: Semstone 140SL.
   2. Devoe: Devran 124.
   3. Dudick: Polymer Alloy 1000.
   4. Tnemec: Tneme-Glaze Series 282.

I. Waterborne acrylic emulsion: As manufactured by one of the following or equal:
   1. S-W: DTM Acrylic B66W1.
   2. Tnemec: Tneme-Cryl Series 6.

J. Galvanizing zinc compound: As manufactured by one of the following or equal:
   1. ZRC: Cold Galvanizing Compound.

2.04 MIXES

A. Mix in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 GENERAL PROTECTION

A. Protect adjacent surfaces from coatings and damage. Repair damage resulting from inadequate or unsuitable protection.

B. Protect adjacent surfaces not to be coated from spatter and droppings with drop cloths and other coverings:
   1. Mask off surfaces of items not to be coated or remove items from area.

C. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being coated and, in particular, surfaces within storage and preparation areas.

D. Place cotton waste, cloths, and material that may constitute a fire hazard in closed metal containers and remove daily from site.

E. Remove electrical plates, surface hardware, fittings, and fastenings prior to application of coating operations. Carefully store, clean, and replace on completion of coating in each area. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finish.

3.02 GENERAL PREPARATION

A. Prepare surfaces in accordance with coating manufacturer's instructions, unless more stringent requirements are specified in this Section.

B. Protect the following surfaces from abrasive blasting by masking or other means:
   1. Threaded portions of valve and gate stems, grease fittings, and identification plates.
   2. Machined surfaces for sliding contact.
   3. Surfaces to be assembled against gaskets.
   4. Surfaces of shafting on which sprockets are to fit.
   5. Surfaces of shafting on which bearings are to fit.
   6. Machined surfaces of bronze trim, including slide gates.
   7. Cadmium-plated items except cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment requiring abrasive blasting.
   8. Galvanized items, unless scheduled to be coated.

C. Protect installed equipment, mechanical drives, and adjacent coated equipment from abrasive blasting to prevent damage caused by entering sand or dust.

D. Concrete:
   1. Allow new concrete to cure for minimum of 28 days before coating.
   2. Clean concrete surfaces of dust, mortar, fins, loose concrete particles, form release materials, oil, and grease. Fill voids so that surface is smooth. Prepare concrete surface for coating in accordance with SSPC SP 13. Provide ICRI 310.2 CSP-3 surface profile, or as recommended by coating manufacturer. All concrete surfaces shall be vacuumed clean prior to coating application.

E. Ferrous metal surfaces:
   1. Remove grease and oil in accordance with SSPC SP 1.
   2. Remove rust, scale, and welding slag and spatter, and prepare surfaces in accordance with appropriate SSPC standard as specified.
   3. Abrasive blast surfaces prior to coating.
      a. When abrasive blasted surfaces rust or discolor before coating, abrasive blast surfaces again to remove rust and discoloration.
      b. When metal surfaces are exposed because of coating damage, abrasive blast surfaces and feather in to a smooth transition before touching up.
      c. Ferrous metal surfaces not to be submerged: Abrasive blast in accordance with SSPC SP 10, unless blasting may damage adjacent surfaces, prohibited, or specified otherwise. Where not possible to abrasive blast, power tool clean surfaces in accordance with SSPC SP 3.
      d. Ferrous metal surfaces to be submerged: Unless specified otherwise, abrasive blast in accordance with SSPC SP 5 to clean and provide roughened surface profile of not less than 2 mils and not more than 4 mils in depth when measured with Elcometer 123, or as recommended by the coating manufacturer.
   4. All abrasive blast cleaned surfaces shall be blown down with clean dry air and/or vacuumed.

F. Ductile iron pipe and fittings to be lined or coated: Abrasive blast clean in accordance with NAPF 500-03.

G. Sherardized, aluminum, copper, and bronze surfaces: Prepare in accordance with coating manufacturer's instructions.

H. Galvanized surface:
   1. Degrease or solvent clean (SSPC SP 1) to remove oily residue.
   2. Power tool or hand tool clean or whip abrasive blast.
   3. Test surface for contaminants using copper sulfate solution.
   4. Apply metal pretreatment within 24 hours before coating galvanized surfaces that cannot be thoroughly abraded physically, such as bolts, nuts, or preformed channels.

I. Shop-primed metal:
   1. Certify that primers applied to metal surfaces in the shop are compatible with coatings to be applied over such primers in the field.
   2. Remove shop primer from metal to be submerged by abrasive blasting in accordance with SSPC SP 10, unless greater degree of surface preparation is required by coating manufacturer's representative.
   3. Correct abraded, scratched, or otherwise damaged areas of prime coat by sanding or abrasive blasting to bare metal in accordance with SSPC SP 2, SP 3, or SP 6, as directed by the Engineer. When entire shop priming fails or has weathered excessively (more than 25 percent of the item), or when recommended by coating manufacturer's representative, abrasive blast shop prime coat to remove entire coat and prepare surface in accordance with SSPC SP 10.
   4. When incorrect prime coat is applied, remove incorrect prime coat by abrasive blasting in accordance with SSPC SP 10.
   5. When prime coat not authorized by Engineer is applied, remove unauthorized prime coat by abrasive blasting in accordance with SSPC SP 10.
   6. Shop applied bituminous paint or asphalt varnish: Abrasive blast clean shop applied bituminous paint or asphalt varnish from surfaces scheduled to receive non-bituminous coatings.

J. Cadmium-plated, zinc-plated, or sherardized fasteners:
   1. Abrasive blast in the same manner as unprotected metal when used in assembly of equipment designated for abrasive blasting.

K. Abrasive blast components that are to be attached to surfaces that cannot be abrasive blasted before components are attached.

L. Grind sharp edges to approximately 1/16-inch radius before abrasive blast cleaning.

M. Remove and grind smooth all excessive weld material and weld spatter before blast cleaning in accordance with NACE SP0178.

N. Poly vinyl chloride (PVC) and FRP surfaces:
   1. Prepare surfaces to be coated by light sanding (de-gloss) and wipe-down with clean cloths, or by solvent cleaning in strict accordance with coating manufacturer's instructions.

O. Cleaning of previously coated surfaces:
   1. Utilize cleaning agent to remove soluble salts such as chlorides and sulfates from concrete and metal surfaces:
      a. Cleaning agent: Biodegradable non-flammable and containing no VOC.
      b. Manufacturer: The following or equal:
         1) CHLOR*RID International, Inc.
   2. Steam clean and degrease surfaces to be coated to remove oils and grease.

3. Cleaning of surfaces utilizing the decontamination cleaning agent may be accomplished in conjunction with abrasive blast cleaning, steam cleaning, high-pressure washing, or hand washing as approved by the coating manufacturer's representative and the Engineer.
4. Test cleaned surfaces in accordance with the cleaning agent manufacturer's instructions to ensure all soluble salts have been removed. Additional cleaning shall be carried out as necessary.
5. Final surface preparation prior to application of new coating system shall be made in strict accordance with coating manufacturer's printed instructions.

3.03 MECHANICAL AND ELECTRICAL EQUIPMENT PREPARATION

A. Identify equipment, ducting, piping, and conduit as specified in Section 15075 - Equipment Identification and Section 16075 - Identification for Electrical Systems.

B. Remove grilles, covers, and access panels for mechanical and electrical system from location and coat separately.

C. Prepare and finish coat primed equipment with color selected by the Engineer.

D. Prepare and prime and coat insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are covered with prefinished coating.

E. Replace identification markings on mechanical or electrical equipment when coated over or spattered.

F. Prepare and coat interior surfaces of air ducts, and convector and baseboard heating cabinets that are visible through grilles and louvers with 1 coat of flat black paint, to limit of sight line.

G. Prepare and coat dampers exposed immediately behind louvers, grilles, and convector and baseboard heating cabinets to match face panels.

H. Prepare and coat exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.

I. Prepare and coat both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

J. Color code equipment, piping, conduit, and exposed ductwork and apply color banding and identification, such as flow arrows, naming, and numbering, in accordance with the Contract Documents.

3.04 GENERAL APPLICATION REQUIREMENTS

A. Apply coatings in accordance with manufacturer's instructions.

B. Coat metal unless specified otherwise:
1. Aboveground piping to be coated shall be empty of contents during application of coatings.

C. Verify metal surface preparation immediately before applying coating in accordance with SSPC SP COM.

D. Allow surfaces to dry, except where coating manufacturer requires surface wetting before coating.

E. Wash coat and prime sherardized, aluminum, copper, and bronze surfaces, or prime with manufacturer's recommended special primer.

F. Prime shop-primed metal surfaces. Spot prime exposed metal of shop-primed surfaces before applying primer over entire surface.

G. Multiple coats:
   1. Apply minimum number of specified coats.
   2. Apply additional coats when necessary to achieve specified thicknesses.
   3. Apply coats to thicknesses specified, especially at edges and corners.
   4. When multiple coats of same material are specified, tint prime coat and intermediate coats with suitable pigment to distinguish each coat.
   5. Lightly sand and dust surfaces to receive high-gloss finishes, unless instructed otherwise by coating manufacturer.
   6. Dust coatings between coats.

H. Coat surfaces without drops, overspray, dry spray, runs, ridges, waves, holidays, laps, or brush marks.

I. Remove spatter and droppings after completion of coating.

J. Apply coating by brush, roller, trowel, or spray, unless particular method of application is required by coating manufacturer's instructions or these Specifications.

K. Plural component application: Drums shall be premixed each day. All gauges shall be in working order prior to the start of application. Ratio checks shall be completed prior to each application. A spray sample shall be sprayed on plastic sheeting to ensure set time is complete prior to each application. Hardness testing shall be performed after each application.

L. Spray application:
   1. Stripe coat edges, welds, nuts, bolts, and difficult-to-reach areas by brush before beginning spray application, as necessary, to ensure specified coating thickness along edges.
   2. When using spray application, apply coating to thickness not greater than that recommended in coating manufacturer's instructions for spray application.
   3. Use airless spray method, unless air spray method is required by coating manufacturer's instruction or these Specifications.
   4. Conduct spray coating under controlled conditions. Protect adjacent construction and property from coating mist, fumes, or overspray.

M. Drying and recoating:
   1. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.

2. For submerged service, the Contractor shall provide a letter to the Engineer that the lining system is fully cured and ready to be placed into service.
3. Limit drying time to that required by these Specifications or coating manufacturer's instructions.
4. Do not allow excessive drying time or exposure, which may impair bond between coats.
5. Recoat epoxies within time limits recommended by coating manufacturer.
6. When time limits are exceeded, abrasive blast clean and de-gloss clean prior to applying another coat.
7. When limitation on time between abrasive blasting and coating cannot be met before attachment of components to surfaces that cannot be abrasive blasted, coat components before attachment.
8. Ensure primer and intermediate coats of coating are unscarred and completely integral at time of application of each succeeding coat.
9. Touch-up suction spots between coats and apply additional coats where required to produce finished surface of solid, even color, free of defects.
10. Leave no holidays.
11. Sand and feather in to a smooth transition and recoat scratched, contaminated, or otherwise damaged coating surfaces so damages are invisible to the naked eye.

N. Concrete:
1. Apply first coat (primer) only when surface temperature of concrete is decreasing in order to eliminate effects of off-gassing on coating.

3.05 WAX COATING

A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements.

B. Application:
1. Apply in accordance with general application requirements and as follows:
   a. Apply at least 1/32-inch thick coat with 2-inch or shorter bristle brush.
   b. Thoroughly rub coating into metal surface with canvas covered wood block or canvas glove.

3.06 HIGH SOLIDS EPOXY SYSTEM

A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements and as follows:
   a. Abrasive blast ferrous metal surfaces to be submerged at jobsite in accordance with SSPC SP 5 prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP 10.
   b. Abrasive blast non-submerged ferrous metal surfaces at jobsite in accordance with SSPC SP 10, prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP 6.
   c. Abrasive blast clean ductile iron surfaces at jobsite in accordance with SSPC SP 7.

B. Application:
   1. Apply coatings in accordance with general application requirements and as follows:
      a. Apply minimum 2-coat system with minimum total DFT of 12 mils.
      b. Recoat or apply succeeding epoxy coats within time limits recommended by manufacturer. Prepare surfaces for recoating in accordance with manufacturer's instructions.
      c. Coat metal to be submerged before installation when necessary, to obtain acceptable finish, and to prevent damage to other surfaces.
      d. Coat entire surface of support brackets, stem guides, pipe clips, fasteners, and other metal devices bolted to concrete.
      e. Coat surface of items to be exposed and adjacent 1 inch to be concealed when embedded in concrete or masonry.

3.07 HIGH SOLIDS EPOXY AND POLYURETHANE COATING SYSTEM

A. Preparation:
   1. Prepare surfaces in accordance with general preparation requirements and as follows:
      a. Prepare concrete surfaces in accordance with general preparation requirements.
      b. Touch up shop-primed steel and miscellaneous iron.
      c. Abrasive blast ferrous metal surfaces at jobsite prior to coating. Abrasive blast clean rust and discoloration from surfaces.
      d. Degrease or solvent clean, whip abrasive blast, power tool, or hand tool clean galvanized metal surfaces.
      e. Lightly sand (de-gloss) fiberglass and PVC pipe to be coated and wipe clean with dry cloths, or solvent clean in accordance with coating manufacturer's instructions.
      f. Abrasive blast clean ductile iron surfaces.

B. Application:
   1. Apply coatings in accordance with general application requirements and as follows:
      a. Apply a 3-coat system consisting of:
         1) Primer: 4 to 5 mils DFT high solids epoxy.
         2) Intermediate coat: 4 to 5 mils DFT high solids epoxy.
         3) Topcoat: 2.5 to 3.5 mils DFT aliphatic or aliphatic-acrylic polyurethane topcoat.
   2. Recoat or apply succeeding epoxy coats within 30 days or within time limits recommended by manufacturer, whichever is shorter. Prepare surfaces for recoating in accordance with manufacturer's instructions.

3.08 POLYMORPHIC POLYESTER RESIN SYSTEM

A. Preparation:
   1. Prepare surfaces in accordance with general preparation requirements and as follows:
   2. Prepare concrete to obtain clean, open pore with exposed aggregate in accordance with manufacturer's instructions.
   3. Prepare ferrous metal surfaces in accordance with SSPC SP 5, with coating manufacturer's recommended anchor pattern.

4. Complete abrasive blast cleaning within 6 hours of applying prime coat. Dew point shall remain 5 degrees above dew point 8 hours after application of coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP 5.
5. When handling steel, wear gloves to prevent hand printing.
6. Adjust pH of concrete to within 5.5 to 8.0 before applying prime coat.

B. Application:
1. Apply coatings in accordance with general application requirements and as follows:
a. Apply minimum DFT system consisting of primer, tie coat and top coat in accordance with manufacturer's instructions as follows:
1) Steel: 35 mils.
2) Concrete: 45 mils.

3.09 ASPHALT VARNISH

A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements.

B. Application:
1. Apply coatings in accordance with general application requirements and as follows:
a. Apply minimum 2 coats.

3.10 VINYL ESTER

A. Preparation:
1. Prepare surfaces in accordance with coating manufacturer's recommendations and as directed and approved by coating manufacturer's representative.

B. Application:
1. Apply prime coat, as required by coating manufacturer, base coat, glass mat, and topcoat to total dry film thickness of 125 mils minimum:
a. Final topcoat on floors shall include non-skid surface, applied in accordance with manufacturer's instructions.
2. Perform high-voltage holiday detection test in accordance with NACE SP0188, over 100 percent of coated surface areas to ensure pinhole-free finished coating system.
3. All work shall be accomplished in strict accordance with coating manufacturer's instructions and under direction of coating manufacturer's representative.

3.11 ELASTOMERIC POLYURETHANE (100 PERCENT SOLIDS)

A. Preparation:
1. Prepare surfaces in strict accordance with coating manufacturer's instructions and as directed and approved by coating manufacturer's representative.

B. Application:
1. Apply epoxy primer at DFT of 1 to 2 mils, in strict accordance with manufacturer's instructions.

2. Apply polyurethane coating at minimum total DFT as follows:
    a. Steel: 60 mils DFT.
    b. Ductile iron and ductile iron pipe coating and lining: 30 mils DFT.
    c. Concrete: 120 mils DFT.
    d. Or as recommended by the coating manufacturer and accepted by the Engineer.
3. For concrete application, provide saw cutting for coating terminations in strict accordance with manufacturer's instructions.
4. Perform high voltage holiday detection test in accordance with NACE SP0188, over 100 percent of coated surface areas to ensure pinhole free finished coating system.

3.12 CONCRETE FLOOR COATINGS

A. Preparation:
    1. Prepare surfaces in accordance with general application requirements and in strict accordance with coating manufacturer's instructions.

B. Application:
    1. Apply primer if required by coating manufacturer.
    2. Apply 1 or more coats as recommended by coating manufacturer to receive a minimum total DFT of 25 mils; color as selected by the Owner.

C. Final topcoat shall include non-skid surface, applied in strict accordance with coating manufacturer's instructions.

3.13 WATERBORNE ACRYLIC EMULSION

A. Preparation:
    1. Remove all oil, grease, dirt, and other foreign material by solvent cleaning in accordance with SSPC SP 1.
    2. Lightly sand all surfaces and wipe thoroughly with clean cotton cloths before applying coating.

B. Application:
    1. Apply 2 or more coats to obtain a minimum DFT of 5.0 mils.

3.14 FIELD QUALITY CONTROL

A. Each coat will be inspected. Strip and remove defective coats, prepare surfaces, and recoat. When approved, apply next coat.

B. Control and check DFT and integrity of coatings.

C. Measure DFT with calibrated thickness gauge.

D. DFT on ferrous-based substrates may be checked with Elcometer Type 1 Magnetic Pull-Off Gauge or PosiTector® 6000.

E. Verify coat integrity with low-voltage sponge or high-voltage spark holiday detector, in accordance with NACE SP0188. Allow Engineer to use detector for additional checking.

F. Check wet film thickness before coal-tar epoxy coating cures on concrete or nonferrous metal substrates.

G. Arrange for services of coating manufacturer's field representative to provide periodic field consultation and inspection services to ensure proper surface preparation of facilities and items to be coated, and to ensure proper application and curing:
   1. Notify Engineer 24 hours in advance of each visit by coating manufacturer's representative.
   2. Provide Engineer with a written report by coating manufacturer's representative within 48 hours following each visit.

3.15 SCHEDULE OF ITEMS NOT REQUIRING COATING

A. General: Unless specified otherwise, the following items do not require coating:
   1. Items that have received final coat at factory and are not listed to receive coating in field.
   2. Aluminum, brass, bronze, copper, plastic (except PVC pipe), rubber, stainless steel, chrome, Everdur, or lead.
   3. Buried or encased piping or conduit.
   4. Exterior concrete.
   5. Galvanized steel wall framing, galvanized electrical conduits, galvanized pipe trays, galvanized cable trays, and other galvanized items:
      a. Areas on galvanized items or parts where galvanizing has been damaged during handling or construction shall be repaired as follows:
         1) Clean damaged areas by SSPC SP 1, SP 2, SP 3, or SP 7 as required.
         2) Apply 2 coats of a galvanizing zinc compound in strict accordance with manufacturer's instructions.
   6. Grease fittings.
   7. Fiberglass ducting or tanks in concealed locations.
   8. Steel to be encased in concrete or masonry.

3.16 SCHEDULE OF SURFACES TO BE COATED IN THE FIELD

A. In general, apply coatings to steel, iron, galvanized surfaces, and wood surfaces unless specified or otherwise indicated on the Drawings. Coat concrete surfaces and anodized aluminum only when specified or indicated on the Drawings. Color coat all piping as specified in Section 15075 - Equipment Identification.

B. The following schedule is incomplete. Coat unlisted surfaces with same coating system as similar listed surfaces. Verify questionable surfaces.

C. Concrete:
   1. High solids epoxy:
      a. Safety markings.
   2. Vinyl ester:
      a. Secondary containment: All concrete surfaces inside chemical containment areas including inside wall surfaces, top of wall surfaces, sump area, and tank fill area, including equipment pads and tank pads.
      b. Suitable for 72 hours submerged in:
         1) 12-percent to 15-percent sodium hypochlorite.
         2) 39-percent to 47-percent ferric chloride solution.

3) 40-percent active polymer.
4) Concrete floor surfaces in chemical containment areas shall have a

D. Metals:
1. High solids epoxy and polyurethane system: Interior and exterior non immersed ferrous metal surfaces including:
a. Doors, doorframes, ventilators, louvers, grilles, exposed sheet metal, and flashing.
b. Pipe, valves, pipe hangers, supports and saddles, conduit, cable tray hangers, and supports.
c. Motors and motor accessory equipment.
d. Drive gear, drive housing, coupling housings, and miscellaneous gear drive equipment.
e. Valve and gate operators and stands.
f. Structural steel including galvanized structural steel.
1) Exposed metal decking.
g. Crane and hoist rails.
h. Exterior of tanks and other containment vessels.
i. Mechanical equipment supports, drive units, and accessories.
j. Pumps not submerged.
k. Degritters, grit classifiers, frames, supports, and associated equipment.
l. Other miscellaneous metals.
m. Grit separation and washer, frames, supports, and associated equipment.
2. High solids epoxy system:
a. Field priming of ferrous metal surfaces with defective shop-prime coat where no other prime coat is specified; for non-submerged service.
b. Bell rings, underside of manhole covers and frames.
c. Sump pumps and grit pumps, including underside of base plates and submerged suction and discharge piping.
d. Chlorine diffuser supports.
e. Aluminum in contact with concrete.
f. Exterior of submerged piping and valves other than stainless steel or PVC piping.
g. Submerged pipe supports and hangers.
h. Stem guides.
i. Vertical shaft mixers and aerators below supports.
j. Other submerged iron and steel metal unless specified otherwise.
k. Interior surface of suction inlet and volute of submersible influent pumps. Apply coating prior to pump testing.
l. Submerged piping.
m. Exterior of influent pumps and influent pump submerged discharge piping.
3. Asphalt varnish:
a. Underground valve boxes.

E. Fiberglass and PVC pipe surfaces:
1. Waterborne acrylic emulsion.
a. Exterior of fiberglass ducting and fan housings.
b. Fiberglass expose to sunlight.
c. PVC piping exposed to view.
d. ABS piping as determined by Engineer.

END OF SECTION

APPENDIX A
Schedule of Surfaces to be Coated

A. The following schedule is incomplete. Coat unlisted surfaces with same coating system as similar listed surfaces. Contact Engineer for clarification.

EPU-M-1	Well Pumps, High Service Pumps, Ductile Iron Piping
EPX-M-2-PWS	Metals: immersed and in contact with water being treated for domestic use (potable water)- Ground Storage Tank
CTE-M-1	Aluminium in contact with concrete
CTE-C-1	Concrete or steel- Interior or buried moderatley corrosive, immersed or non-immersed
VE-C-1	Chemical Building Trenches
EPU-FRP-1	Exterior of FRP Tanks, Ducts and Pipes
ACR-PVC-1	PVC/CPVC/FRP piping and supports

Notes:

1: Non-immersed ferrous metal surfaces include:

a. Pipe, valves, pipe hangers, supports and saddles, conduit, cable tray hangers, and supports.
b. Motors and motor accessory equipment.
c. Drive gear, drive housing, coupling housings, and miscellaneous gear drive equipment.
d. Valve and gate operators and stands.
e. Structural steel.
f. Crane and hoist rails.
g. Exterior of tanks and other containment vessels.
h. Mechanical equipment supports, drive units, and accessories.
i. Bare electrical equipment: boxes, exposed conduit, and accessories.
j. Pumps not submerged.
k. Other miscellaneous metals.

2: Immersed ferrous metal surfaces include:
a. Interior surfaces of ferrous metal tanks.
b. Field priming of ferrous metal surfaces with defective shop-prime coat; including non-submerged service.
c. Bell rings, underside of manhole covers and frames.
d. Sump pumps, including underside of base plates and submerged suction and discharge piping.
e. Exterior of submerged piping and valves other than stainless steel or PVC piping.
f. Submerged pipe supports and hangers.
g. Stem guides.
h. Other submerged iron and steel metal unless specified otherwise.

Appendix B			
Coating Detail Sheet			
Coating System	EPU-M-1		
Coating Material	Two coats epoxy with polyurethane finish coat		
Substrate	Metal		
Products	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	Carboguard 890	Carbothane 134 VOC
International Paint	Devran 224V	Devran 224V	Devthane 379
PPG	Amercoat 385	Amercoat 385	Amercoat 450H
Sherwin Williams	Macropoxy 646	Macropoxy 646	Hi Solids Polyurethane
Tnemec	Series 66HS	Series 66HS	Series 1095
Service Condition	Interior or Exterior, subject to direct sunlight. Non-immersion.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP10, Near-White Blast Cleaning. Shop primed surfaces: SSPC-SP2, Hand Tool Cleaning or SSPC-SP3, Power Tool Cleaning. Damaged primer or rust: SSPC-SP10, Near White Blast Cleaning and spot prime.		
Nonferrous Metal	SSPC-SP16, Brush Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush Blast Cleaning. Test for surface contaminants.		
Surface profile			
Ferrous Metal	2.5 to 3.0 mils		
Nonferrous Metal	1.5 to 2.0 mils		
Galvanized Metal	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	10 to 13 mils		
Primer	4 to 5 mils		
Intermediate Coat	4 to 5 mils		
Finish Coat	2 to 3 mils		
Application			
Special CTR Training	Not required.		

Appendix B			
Coating Detail Sheet			
Coating System	EPX-M-2-PWS		
Coating Material	Ultra-high Solids Epoxy		
Substrate	Metal		
Products	Primer	Intermediate Coat	Finish Coat
Carboline	Plasite 4500	None Applied	Plasite 4500
International Paint	No product specified	No product specified	No product specified
PPG	No product specified	No product specified	No product specified
Sherwin Williams	Sher-Plate	None Applied	Sher-Plate
Tnemec	Series 22	None Applied	Series 22
Service Condition	Immersed, moderately corrosive environment in contact with Potable Water.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP5, White Metal Blast Cleaning. Shop primed surfaces: SSPC-SP7, Brush-Off Blast Cleaning. Damaged primer or rust: SSPC-SP5, White Metal Blast Cleaning and spot prime.		
Surface profile			
Ferrous Metal	2.0 to 2.5 mils		
Primed surfaces	1.0 to 1.5 mils on the intact primer.		
System Thickness (Dry Film)			
Total	16 to 25 mils		
Application			
Special CTR Training	Required.		

Appendix B			
Coating Detail Sheet			
Coating System	CTE-M-1		
Coating Material	Coal Tar Epoxy		
Substrate	Metal		
Products	Primer	Intermediate Coat	Finish Coat
Carboline	CSM recommended	300M	300M
International Paint	CSM recommended	Devtar 5A-HS	Devtar 5A-HS
PPG	None applied	Amercoat 78 HB	Amercoat 78 HB
Sherwin Williams	CSM recommended	TarGuard	TarGuard
Tnemec	None applied	Series 46H-413	Series 46H-413
Service Condition	Immersed, non-potable; non-immersed, moderately corrosive or buried.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Immersed: SSPC-SP5, White Metal Blast Cleaning. Non-immersion: SSPC-SP10, Near White Blast Cleaning. Shop primed: Clean to bare metal.		
Nonferrous Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Galvanized Metal	Not recommended.		
Surface profile			
Ferrous Metal	2.5 to 3.5 mils		
Nonferrous Metal	1.0 to 1.5 mils		
System Thickness (Dry Film)			
Total	16 to 20 mils		
Primer	2 to 4 mils		
Intermediate Coat	0 to 10 mils		
Finish Coat	8 to 20 mils		
Application			
Special CTR Training	Not Required.		

Appendix B			
Coating Detail Sheet			
Coating System	CTE-C-1		
Coating Material	Coal Tar Epoxy		
Substrate	Concrete		
Products	Primer	Intermediate Coat	Finish Coat
Carboline	None applied	300M	300M
International Paint	None applied	Devtar 5A-HS	Devtar 5A-HS
PPG	None applied	Amercoat 78 HB	Amercoat 78 HB
Sherwin Williams	None applied	TarGuard	TarGuard
Tnemec	None applied	Series 46H-413	Series 46H-413
Service Condition	Below grade in contact with soil.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Surface profile			
Concrete	ICRI CSP 3.		
Existing Coated Concrete	ICRI CSP 3.		
System Thickness (Dry Film)			
Total	16 mils		
Primer	4 to 6 mils		
Intermediate Coat	4 to 6 mils		
Finish Coat	4 to 6 mils		
Application			
General	Fill all bugholes with a filler/surfacer compatible with the coating.		
Special CTR Training	Not Required.		

Appendix B			
Coating Detail Sheet			
Coating System	VE-C-1		
Coating Material	Vinyl Ester		
Substrate	Concrete		
Products	Primer	Intermediate Coat	Finish Coat
Carboline			Plasite 4300
International Paint			Ceilcote Flakeline 232.
PPG			Nova Rez 370
Sherwin Williams			CorCote VEN
Tnemec			Series 120-5001 Vinester
Service Condition	Immersed, non-immersed, very corrosive environment, color not required, new or existing construction. Primary or secondary containment indoors or exterior.		
General	Prepare surfaces as specified in this Section and as follows.		
Concrete	Apply complete parge coat over all concrete surfaces after surface preparation is accepted. Completely fill all bugholes with the same material. Brush blast clean, if parge coat is non-polymer modified, after adequate cure per CSM's instructions to produce a uniform anchor pattern. Let concrete substrate cure under warm conditions (minimum of 75 degrees F) for at least 5 days before coating application if using wet abrasive or water jet surface preparation. Sawcut 1/4" minimum deep groove and provide coating termination and transition details as shown on the drawings and in accordance with CSM's standard details including terminations, transitions at corners, cracks, pipe penetrations, terminations at metal embedments, and other details. Vacuum all surfaces to be coated after surface preparation and curing to remove all loose dirt, dust, or other loose materials.		
Existing Coated Concrete	Prepare as for new concrete. Apply a skim coat of a surfacer or filler material to restore the substrate to a coatable condition.		
Surface profile			
Concrete	ICRI CSP 5.		
Existing Coated Concrete	ICRI CSP 5.		
System Thickness (Dry Film)			
Parge coat	Completely cover the substrate above filled voids by 1/8 inch (125 mils) of thickness.		
Total	60 to 65 mils in addition to the parge coat.		
Primer	Per CSM's recommendations.		
Intermediate Coat			
Finish Coat			
Application			
General	Trowel-apply surfacers or filler materials CSM's recommendations. Work surfacer/filler into all voids to displace air and fill bugholes.		
Special CTR Training	Required.		

Appendix B			
Coating Detail Sheet			
Coating System	EPU-FRP-1		
Coating Material	Polyurethane		
Substrate	FRP		
Products	Primer	Intermediate Coat	Finish Coat
Carboline	Carbocrylic 120	None Applied	Carbothane 134 VOC
International Paint	Devran 210H/224V	None Applied	Devthane 378H
PPG	Amerlock 2/400 Series	None Applied	Amercoat 450 HS
Sherwin Williams	Macropoxy 646	None Applied	Hi Solids Polyurethane
Tnemec	Series 66HS	None Applied	Series 1095
Service Condition	Exterior, exposed to direct sunlight, non-immersed.		
Surface Preparation	Prepare surfaces as specified in this Section and as follows.		
General	Clean to remove loose dirt, dust, or other contaminants. Sand surfaces to achieve a uniform, roughened surface profile. Solvent clean and vacuum to remove loose debris.		
Surface profile	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	4 to 7 mils		
Primer	2 to 4 mils		
Finish Coat	2 to 4 mils		
Application			
Special CTR Training	Not Required.		

Appendix B			
Coating Detail Sheet			
Coating System	ACR-PVC-1		
Coating Material	Acrylic		
Substrate	PVC and CPVC pipe		
Products	Primer	Intermediate Coat	Finish Coat
Carboline	Carbocrylic 120	None Applied	Carbocrylic 3359
International Paint	Devcryl 1440	None Applied	Devcryl 1448
PPG	Pitt Tech Primer	None Applied	Pitt Tech
Sherwin Williams	Sher Cryl HPA	None Applied	Sher Cryl HPA
Tnemec	Series 1028 or 1029	None Applied	Series 1028 or 1029
Service Condition	Exterior, exposed to direct sunlight, non-immersed.		
Surface Preparation	Prepare surfaces as specified in this Section and as follows.		
General	Clean to remove loose dirt, dust, or other contaminants. Sand surfaces to achieve a uniform, roughened surface profile. Solvent clean and vacuum to remove loose debris.		
Surface profile	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	3 mils		
Primer	2 to 4 mils		
Finish Coat	2 to 4 mils		
Application			
Special CTR Training	Not Required.		

SECTION 10280

TOILET ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Accessories for restrooms.

B. Glass mirrors.

C. Grab bars.

1.02 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; current edition; (ADA Standards for Accessible Design).

B. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.

C. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008.

D. GANA (TIPS) - Mirrors Handle with Extreme Care: Tips For the Professional on the Care and Handling of Mirrors; National Association of Mirror Manufacturers; 2004 (http://www.mirrorlink.org/members/technical).

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.04 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

B. Product data: Provide data on accessories describing size, finish, details of function, attachment methods.

C. Manufacturer's installation instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Toilet accessories:
   1. Bobrick: www.bobrick.com.
   2. Bradley Corporation: www.bradleycorp.com.

3. American Specialties, Inc: www.americanspecialties.com.
4. Substitutions: Section 01600 - Product Requirements.
5. All items of each type to be made by the same manufacturer.

2.02 MATERIALS

A. Accessories - general: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Mirror glass: Float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

C. Adhesive: 2-component epoxy type, waterproof.

D. Fasteners, screws, and bolts: Hot dip galvanized, tamper-proof, security type.

2.03 FINISHES

A. Stainless steel: No. 4 satin brushed finish, unless otherwise noted.

B. Chrome/nickel plating: ASTM B456, satin finish, unless otherwise noted.

2.04 TOILET ROOM ACCESSORIES

A. Grab bars: Stainless steel, 1-1/4 inches (32 millimeters) outside diameter, minimum 0.05 inch (1.3 millimeters) wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches (38 millimeters) clearance between wall and inside of grab bar.
   1. Length and configuration: As indicated on drawings.

B. Shower curtain rod: Stainless steel tube, 1-inch diameter, satin finish.

C. Towel bar: Stainless steel 3/4-inch square tubular bar, with rectangular wall brackets.

D. Robe hooks: Steel double hook, surface mounted to bathroom door, satin finish.

E. Toilet paper dispenser: Single roll, surface mounted, brushed nickel finish.

2.05 MIRRORS

A. Mirror glass - general: Select materials and/or provide supports as required to limit mirrored glass deflection to 1/200 or flexure limit of glass with full recovery of glazing materials, whichever is less.

B. Mirror glass: Clear float type with copper and silver coating, organic overcoating, arrised edges, 1/4-inch thick minimum.

C. Sizes noted on Drawings.

D. Mirror attachment accessories: Stainless steel clips.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions.

B. Install blocking, reinforcing plates, and concealed anchors in walls and ceiling as required.

C. Install plumb and level, securely and rigidly anchored to substrate.

D. Mounting heights and locations: As required by accessibility regulations and as indicated on drawings.

E. Install mirrors in accordance with GANA recommendations.

F. Set mirrors plumb and level, free of optical distortion.

G. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

H. Frameless mirrors: Set mirrors with clips. Anchor rigidly to wall construction.

END OF SECTION

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SECTION 10800

MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Provide miscellaneous specialties, complete:
   1. Fire extinguisher and mounting brackets.
   2. Interior building signage.
   3. Exterior vinyl building address lettering.

1.02 SUBMITTALS

A. None required unless submitting for approved equals.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers that have been in satisfactory use in similar service for 3 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Standards: UL and FM listed products, NFPA 10.

C. Regulations: Americans with Disabilities Act Accessibility Guidelines (ADAAG).

PART 2 PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Manufacturers: Ansul Sentry specified; equivalent by J.L. Industries, Larsen's Manufacturing, Potter-Roemer, or approved equal.

B. Fire extinguishers:
   1. Model: # SY-1014.
   2. Type: Multipurpose dry chemical type.
   3. Rating: UL listed ABC.
   4. Capacity: 10-pound heavy duty steel extinguisher.
   5. Surface mounting: Manufacturer's standard metal brackets and fasteners as recommended by manufacturer for substrate attached.

2.02 INTERIOR SIGNS

A. Manufacturers: Seton specified; equivalent by ASI, APCO, Best, Kroy, Kaltech, Mohawk, National Signage, or approved equal.

B. Interior Signs:
   1. Model: Refer drawing toilet accessories schedule.
   2. Type: Raised or engraved acrylic or plastic.
   3. Size: 8 inch by 8 inch.
   4. Color: Manufacturers standard colors contrasting from background and as indicated on drawings or selected by Architect.
   5. Copy: Helvetica Medium 5/8-inch height lettering, Braille, and accessibility graphics meeting requirements of ADA and CABO/ANSI A117.1 specifications.
   6. Fasteners, tape, and adhesive: As recommended by sign manufacturer for substrate attached.

2.03 EXTERIOR VINYL BUILDING ADDRESS LETTERING

A. Vinyl lettering indicating building address number, white, Helvetica medium 6-inch high copy. Attached to glazing per lettering manufacturer's recommendations with non-staining or non-yellowing adhesive.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

B. Install fire extinguishers with wall-hung brackets at locations and heights indicated and acceptable to authorities having jurisdiction.

C. Install interior signs at locations and height indicated and acceptable to authorities having jurisdiction. Comply with ADA and CABO/ANSI A117.1 specifications.

D. Install exterior vinyl lettering per manufacturer's recommendations. Ensure attachment to withstand local wind load requirements.

E. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 11242

PACKAGED CHEMICAL FEED SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes materials, testing, and installation of packaged, skid-mounted chemical feed systems for sodium hypochlorite. Components include:
   1. Metering pumps to pump the chemical from the storage tanks to the point of application.
   2. Interconnecting piping on the skid.
   3. Isolation, control, and relief valves within the piping.
   4. Controls for the above components.
   5. Water piping connections for connecting to external sources for flushing.
   6. AC variable speed drives as specified herein.
   7. Electrical power and control wiring and conduit between the above components.
   8. A control panel for local control of the feed system and for sending and receiving alarms and control signals to or from an external plant wide control system.
   9. Pressure gauges as specified herein
   10. Other ancillary equipment as specified herein.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions and Section 01330 - Submittal Procedures.

B. Submit structural drawings showing the design of the fabricated skid. Show support systems for pumps and panels. Show materials of construction by ASTM reference and grade. Show sizes of members. Show welding, bolting, or other assembly arrangements.

C. Submit installation and arrangement drawings showing dimensions and locations of equipment on the fabricated skid. Show locations of equipment on the fabricated skid. Show locations of pumps, variable speed drives, piping, electrical equipment, pipe and valve supports, and control panels.

D. Submit electrical wiring drawings showing wiring and conduit, controls, interlocks, terminals, and power disconnects. Show number and sizes of power and control wiring. Label each terminal showing which control or electrical power wire connects to each terminal.

E. Submit operations and maintenance manuals in accordance with Section 01330 - Submittal Procedures and the following:
   1. Operating and maintenance manuals prepared specifically for this project shall be provided. Manuals shall include all procedures, drawings, parts lists, etc. required to instruct personnel unfamiliar with such equipment. Operation and maintenance manuals shall be prepared in accordance with all specifications of this project.
   2. Complete operating and maintenance manuals shall be provided in PDF electronic format with bookmarks and index for easy navigation.
   3. Operating and maintenance manuals shall include a copy of in-house testing certificate.
   4. A detailed database shall be maintained by the manufacturer containing production data for each chemical metering system. The database shall include serial numbers for all serialized components, production drawings, test data, ship dates, start-up dates and all relevant information.

F. Submit manufacturer's catalog data and detail drawings showing metering pumps and associated speed reducer parts and describe by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show stroke speed at the specified flow for diaphragm metering pumps. Submit data on pump tubing and tubing elements. Show linings and coatings. Identify each metering pump by tag number to which the catalog data and detail sheets pertain.

G. Submit hydraulic diaphragm metering pump operating capacity and discharge pressure limits (both minimum and maximum flow and pressure limits). Submit materials of construction for all metering pump components. Provide chemical compatibility charts for materials of wetted components to substantiate material selection for the associated chemical.

H. Submit data as a single complete package for pumps and motors, piping, structural skid or base design, valves and actuators, instrument components, power and instrumentation wiring and other items.

I. Submit calculations supporting the selection of the pulsation dampener sizes for each application.

J. Submit chemical compatibility charts for materials of wetted components including piping, fittings, valve bodies, gaskets, rings, and seals to substantiate material selection for the associated chemical.

K. Submit pipe and fitting materials list showing materials of construction by reference and grade. Submit manufacturer's certification of compliance with referenced standards. Show wall thickness of pipe and fittings. Show fitting dimensions. Submit data sheets for solvent cement demonstrating compliance with ASTM F493 for PVC and CPVC applications. Submit manufacturer's installation procedures for pipe and fittings included.

L. As part of the shop drawing submittal package for the chemical feed systems, submit proposed format for reporting the results of the factory testing. Describe how control system will be tested and the results tabulated. As a minimum, the report format shall present the results of testing for each input signal and each output and alarm signal (including correcting defective input and output and alarm signals). Describe procedure for performing the pressure testing of the skid piping and how

results (including correcting defective piping components) will be tabulated or reported. Include the format for reporting the results of factory testing for individual system components and pieces of equipment, as described in the specifications for those components or pieces of equipment.

M. At least thirty days prior to factory testing, provide the Owner with written notification stating the schedule of the factory test so that the Owner can plan in advance to witness the testing.

N. Submit report on results of factory testing. Do not ship systems until the Engineer has reviewed the report.

O. Submit shop drawings for the individual pieces of equipment per those equipment specifications.

P. Submit a list of successful installations of similar chemical feed systems. Submit name and references for at least five project sites for similar chemical feed systems in the State of Florida. At least three of these sites shall include sodium hypochlorite metering pump applications.

Q. As part of the shop drawing submittal package for the chemical feed systems, submit proposed format for reporting the results of the factory testing. Describe how control system will be tested and the results tabulated. As a minimum, the report format shall present the results of testing for each input signal and each output and alarm signal (including correcting defective input and output and alarm signals). Describe procedure for performing the pressure testing of the skid piping and how results (including correcting defective piping components) will be tabulated or reported. Include the format for reporting the results of factory testing for individual system components and pieces of equipment, as described in the specifications for those components or pieces of equipment.

R. At least 30 days prior to factory testing, provide the Owner with written notification stating the schedule of the factory test so that the Owner can plan in advance to witness the testing.

S. Submit report on results of factory testing. Do not ship systems until the Owner's Representative has reviewed the report.

1.03 MANUFACTURER AND SYSTEM RESPONSIBILITY

A. The Contractor shall assign the design and fabrication of the chemical feed system to a single system manufacturer.

B. The packaged Chemical Feed System manufacturer shall assemble the complete system on a single fabricated skid or base and shall factory-test each skid as a complete system, including pumps, piping, valves, variable speed drives, controls, and motor starters.

C. The packaged chemical system manufacturer shall determine and verify quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and the packaged chemical system manufacturer shall review and coordinate each submittal with the requirements of the contract documents.

1.04 WARRANTIES

A. The system manufacturer shall provide a warranty for the metering pumps, skid material construction, and skid-mounted equipment, piping and valves. This warranty shall be in addition to and not in lieu of any warranties provided by the manufacturer of the equipment itself.

1.05 MANUFACTURER'S SERVICES

A. Provide manufacturer's services as follows:
   1. Four (4) labor days to check the installation and advise during start-up, testing, and adjustment of each system.
   2. Two (2) labor days to instruct the Owner's personnel in the operation and maintenance of the systems.

PART 2 MATERIALS

2.01 MANUFACTURERS

A. Blue Planet Environmental Systems, Inc., Melbourne, FL, per Polk County USSM.

2.02 FABRICATED SKID OR BASE--GENERAL REQUIREMENTS

A. Design skid or base to fit within the designated area shown on the drawings for each application.

B. Provide the skid or base with four lifting lugs, one at each corner, designed to lift the weight of the complete skid or base with all equipment attached to it.

C. Provide a design such that each pump is individually bolted to a baseplate. A single common baseplate, or individual pump baseplates, may be provided, but each pump shall be individually bolted so that it is removable.

D. Each pump shall be removable by disconnecting only the piping connected to its inlet and outlet connections. It shall not be necessary to disconnect or remove any adjacent piping or electrical conduit or wiring in order to remove or replace any pump.

E. The skid and system components shall be designed with components designed to provide long life in the intended service and to withstand corrosive atmospheres in either intermittent or continuous duty.

F. Components that require initial or periodic adjustment shall be easily accessible on the feed systems.

2.03 FABRICATED PLASTIC SKID AND BASE

A. The chemical metering skids shall be constructed from PVC sheet with a minimum trade thickness of 1/2-inch. The design of the skid shall include gussets and supports as required for all components and shall be self-supporting. All components of the chemical metering system shall be contained within the skid. Each base shall provide a minimum of 1 foot of width for each pump with appurtenances. The skid shall incorporate spill containment capability and feature dual 1/2-inch FTP connections for containment drain piping. The skids shall be manufactured using continuous welding technology; bolted construction is not acceptable. Pedestals shall be provided to elevate the metering pumps above the skid base. The pedestals shall be bolted to the skid base with non-metallic bolts to allow for future pump/piping modifications.

B. The piping shall be attached to the chemical metering skid with a non-metallic corrosion resistant support system. All support channels shall be bolted to the skid with non-metallic, corrosion resistant fasteners. Tapped holes shall be provided for the support fasteners (no nuts shall be required), the tapped holes shall not penetrate the skid base in order to maintain containment integrity. The straps shall be removable and reusable to allow for servicing of the system. All inlet/outlet connections, valves, and pump accessories shall be clearly labeled on the skid for easy identification.

C. Fasteners for skids in sodium hypochlorite service shall be non-metallic or titanium. Titanium bolts shall be in accordance with ASTM F468, Grade Ti1, Ti2, or Ti7. Nuts shall conform to ASTM F467, same materials as the bolts.

2.04 PACKAGED CHEMICAL FEED SYSTEM COMPONENTS

A. For each chemical metering pump the piping system shall include (1) pressure relief valve; (1) pulsation dampener; (1) diaphragm protected pressure gauge; (1) back-pressure/anti-siphon valve; (1) flushing inlet; (1) flushing outlet and all required piping, valves and supports. Piping shall include isolation valves and unions for all serviceable components. The chemical supply piping shall feature a y-strainer and a calibration column shall be provided and designed for use with any of the metering pumps. The discharge piping shall provide outlets as indicated on the P&IDs in the drawings. A reasonable amount of free pipe space on the suction and discharge piping sub-assemblies shall be provided to allow for future pump/piping modifications.

2.05 HYDRAULIC DIAPHRAGM METERING PUMPS (TAG NUMBERS PMP-80-1, PMP-80-2, PMP-80-3 AND PMP-80-4)

A. Diaphragm metering pumps shall be ProMinent Sigma 1 or equal diaphragm metering pump, per Polk County USSM.

B. General:
   1. Chemical metering pumps shall be of the positive displacement, hydraulic diaphragm type.
   2. A steel and nodular iron non-loss-motion stroke adjust mechanism, driven by a direct coupled, variable speed DC motor, shall actuate a flat, Teflon-faced composite diaphragm.

3. Solenoid-driven pumps, lost-motion mechanically actuated diaphragm pumps and hydraulically actuated diaphragm pumps shall not be accepted.
4. The liquid ends shall provide for easy maintenance (and integral sight flow indication) via clear PVC cartridge-type check valves.
5. Conventional threaded (and integral sight flow indicator) will not be allowed.

C. Drive:
1. A steel and nodular iron-loss-motion stroke adjust mechanism shall be housed in a corrosion resistant, epoxy painted, cast iron gearbox.
2. All drive bearings shall be tapered rollers; all fasteners shall be 316 SS.
3. The gearbox shall be oil-bath lubricated.
4. Stroke length shall be controlled manually via a 10-turn micrometer-type adjuster.
5. A percent scale and vernier shall indicate stroke length in 0.25 percent increments. Each revolution of the knob shall change stroke length by 10 percent.
6. The motor shall be coupled to the gearbox via a field retrofittable, 4-step pulley and belt driven mechanism.
    a. This mechanism shall provide four individual capacity ranges at 100 percent motor speed.
    b. Each range shall have 10:1 turndown adjustment, thereby extending the total operation turndown to 40:1 with a standard induction motor, 800:1 with a variable speed DC motor.

D. Liquid end:
1. The process diaphragm shall be Teflon-faced, fabric reinforced and bonded to pre-formed elastomeric support.
2. It shall incorporate convolutions, for unconstrained rolling action and a steel backing plate for volumetric accuracy.
3. An O-ring groove in the head's diaphragm cavity will provide for a complete leak-free seal.
4. Positive flow shall be ensured via single ball cartridge-type check valves.
5. The valve retainers shall be clear PVC, for integral sight flow indication, and shall compression seal to the pump head and pipe connectors via o-rings.
6. Valve service or removal shall not require any disturbances to the pump head pipe works.
7. A secondary diaphragm shall completely seal and separate the pump head from the drive unit, to eliminate any risk of cross-contaminating gearbox lubricant and process fluid.
8. For sodium hypochlorite service the liquid end shall incorporate an automatic de-gassing feature for removal of any entrained vapors.

E. Configuration:
1. The design shall be capable of multiplexing two gearboxes, each with independent capacity control.

F. Stroke length control:
1. Feed rate shall be controlled manually, via a 10-turn micrometer-type stroke length adjuster.
2. A percent scale and vernier shall indicate stroke length in 0.25 percent increments.
3. Each revolution of the knob shall change stroke length by 10 percent.

4. Feed rate shall be infinitely adjustable from 0 through 100 percent.
5. Stroke length shall be adjustable over a 10:1 operating range.
6. Repeatable metering accuracy shall be ±2 percent of full scale, at constant hydraulic conditions, over the operating range.

G. Diaphragm leak detection:
1. The metering pumps shall be fitted with a diaphragm leak detection system for each pump head, to detect the early stages of diaphragm failure.
2. The system shall consist of a solid-state electro-optic sensor that mounts to the liquid end and a NEMA 4X control box.
3. Each control box shall be capable of monitoring two liquid ends and shall provide both local and remote indication of failure via LEDs and a relay.

2.06 SPARE PARTS

A. Provide the following spare parts to the Owner for the chemical metering skid upon delivery of the pump skid. Spare parts shall include all parts required for (2) years of normal maintenance of all components of the chemical metering system. All parts shall be in one box labeled with the Skid ID Information:
1. (1) Maintenance kits for each chemical metering pump. Maintenance kits shall include but not be limited to diaphragm, check valve seats, gaskets and O-rings.
2. (1) Maintenance kits for each pressure relief valve for each pump skid.
3. (1) Maintenance kit for each back-pressure valve for each pump skid.
4. (1) Spare bladder for each pulsation dampener for each pump skid.
5. (1) Spare valve of each size for each pump skid.
6. (1) Parts list for all serviceable components.

B. Pack spare parts in a wooden box; label with the job location, pump type and model, manufacturer's name and local representative's name, address, and telephone number and attach list of materials contained within.

2.07 PIPING ON THE SKID

A. Rigid piping on the skid shall be Schedule 80 PVC for process 80 metering pumps per Section 15249 - Polyvinyl Chloride (PVC) Pipe: Schedule Type and as specified herein.

B. Workmanship shall be in accordance with good commercial practice. Fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The fittings shall be commercially uniform in color, opacity, density and other physical properties.

C. Assembly shall be performed in a controlled shop environment by the skid manufacturer. All pipe shall be squarely cut on precision equipment with the ends chamfered and deburred. All socket welded connections shall follow the guidelines set by the pipe/fitting manufacturer for proper cleaning, priming, and gluing procedures. A heavy bodied solvent suitable for use with all chemicals as listed under section Part 2.U. Service Conditions shall be used. All threaded connections will utilize Teflon tape, a suitable thread sealant, or a combination of both.

2.08 ISOLATION VALVES WITHIN THE SKID OR BASE

A. Isolation valves shall be as specified in Section 15111 - Ball Valves.

B. Provide an isolation valve on the suction and discharge piping of each pump.

2.09 QUICK CONNECT COUPLINGS FOR FLUSH AND DRAIN HOSE CONNECTIONS

A. Drain/flush quick connect couplings:
   1. Provide 3/4-inch diameter quick connect couplings on the pump skid suction and discharge piping for flushing and draining the pump skid piping. Provide pipe reducers or transition bushings to transition pipe diameter to 3/4-inch diameter at the quick connect couplings if pump suction or discharge pipe is a size other than 3/4-inch diameter.
   2. The quick connect couplings on skids with thermoplastic pipe shall be polypropylene. Quick connect coupling on the skid shall be male end coupling. Provide a locking female end cap for each male coupling on the skid. Thermoplastic couplings shall be Evertite Part A, or equal.
   3. Coordinate quick connect couplings with the following paragraph.

B. Chemical resistant hose and quick connect couplings on hose ends:
   1. Provide two 50-foot lengths of 3/4-inch diameter PVC hose for the metering pump station). PVC hose shall be clear PVC inner tube with synthetic yard reinforcing and a white or grey PVC cover. Hose shall be Ryan Herco High Purity PVC Water Hose or equal.
   2. Provide a female end quick connect coupling on one end of each hose (as described above) for connection to the flush and drain quick-connect couplings on the skids as described above. The female coupling shall be the match of the male end couplings on the skids specified above. Provide polypropylene female end couplings Evertite Part C, or equal.
   3. Provide a 3/4-inch diameter female end hose bibb connector on the other end of one of the hoses in each chemical room for connection to a standard 3/4-inch hose bibb. On the other hose, leave one end open for draining chemical from the skids.

2.10 PRESSURE RELIEF VALVES

A. Provide one external pressure safety relief valve located in the discharge piping for each chemical metering pump.

B. Sizing shall allow maximum capacity requirements per service to pass through at a set pressure of 140 pounds per square inch gauge.

C. Inlet and Outlet connections shall be a minimum of 1/2-inch NPT.

D. Materials of construction shall be as shown under the subsection Service Conditions Part 2.U and Part 3.F.

E. Pressure relief valves shall be manufactured by Griffco or equal.

2.11 PRESSURE SUSTAINING (BACKPRESSURE) VALVES

A. Provide one pressure sustaining (backpressure) valve for each hydraulic diaphragm chemical metering pump.

B. Sizing shall allow maximum capacity requirements per service to pass through at a set pressure of 35 pounds per square inch gauge above maximum suction pressure.

C. Inlet and Outlet connections shall be a minimum of 1/2-inch NPT.

D. Design shall use a Teflon diaphragm to isolate an externally adjustable spring. Adjustment range shall be from 20 to 50 pounds per square inch gauge minimum. Designs utilizing springs within the fluid pumped are not acceptable. Valves shall be designed for at least 150 pounds per square inch gauge working pressure.

E. Materials of construction shall be as shown under the subsection Service Conditions Part 2.U and Part 3.F.

F. Pressure sustaining valves shall be manufactured by Griffco or equal.

2.12 PULSATION DAMPENERS

A. Sizing shall result in no more than plus or minus 5 percent variation in average pressure in the discharge line and no more than plus or minus 2 percent variation in average pressure in the suction line. Variation shall be checked and confirmed on pressure gauge installed upstream of discharge dampener. System supplier shall provide sizing calculations that must be included in submittals.

B. Design shall incorporate an elastomeric diaphragm constructed of a material that is resistant to fluid pumped. Submittal data shall include chemical compatibility charts confirming elastomer suitability with each fluid pumped. Rating must be highest available representing recommended for use.

C. A gas charging valve and liquid filled pressure gauge shall be mounted on each dampener.

D. The dampeners shall be installed in the discharge piping of each metering pump, as close to the metering pump discharge check valve as possible. Pulsation dampeners larger than 10 cubic inches shall attach to the piping by ANSI 150# flanges with titanium bolts. Threaded connections are not acceptable.

E. Materials of construction of pulsation dampener wetted parts shall be as listed under the subsection Service Conditions Part 2.U and Part 3.F.

F. Pulsation dampeners shall be Greer Bladder Accumulator, Blacoh, or equal.

2.13 CALIBRATION TUBE

A. A clear calibration column shall be provided in the chemical supply piping of each system. The piping shall be designed for the calibration column to be used with any of the metering pumps. The calibration column shall be self-filling so that the discharge manifold will allow for filling of the calibration column in the event of non-flooded suction conditions. The top of the calibration column shall allow for connection to rigid piping for "vent." Calibration columns may also be used as de-gassing chambers. All materials shall be compatible with chemicals as listed under section Service Conditions Part 2.U and Part 3.F.

B. Provide a clear Pyrex or clear PVC calibration tube having engraved graduations and a minimum volume as follows:

Chemical	Minimum Volume	Engraved Graduations (Units)
Sodium Hypochlorite	200 mL	2 mL

C. Calibration tube shall be located in the piping between the metering pumps and the day tank. Provide isolation valve between the tube and the piping. Calibration tube shall be Griffco, or equal.

2.14 DE-GASSING RISER (DEGAS)

A. A de-gassing riser pipe shall be provided in the suction header of each skid. The de-gassing riser shall be prior to any metering pump inlets. The de-gassing riser shall include an isolation ball valve and shall be piped in SCH-80 clear PVC to allow for visual inspection and shall terminate at the top of the chemical storage tank. An FPT connection shall be provided for connection to rigid piping for "vent" piping.

2.15 PRESSURE GAUGES WITH DIAPHRAGM SEALS AND ACRYLIC SHIELDS

A. Pressure gauges shall be stainless steel casing, 2-inch face with white background and black lettering.

B. Gauges shall be glycerin filled.

C. Provide a diaphragm seal with each gauge. Diaphragm seals shall have PVC bodies with PTFE or encapsulated PTFE diaphragms. Diaphragm seals shall be glycerin filled. Diaphragm seals shall be Plastico, Plast-O-Matic, Blacoh, Marquest, or equal.

D. Provide a clear acrylic shield with each pressure gauge to protect gauge from external corrosion. Acrylic shields shall mount on top of diaphragm seal. Acrylic shields shall be Plast-O-Matic, or equal.

E. Size each pressure gauge for the service conditions such that the pressure reads in the middle range of the gauge under normal operating conditions.

F. A fabricated PVC bracket shall be provided for each pressure gauge to secure the isolator and prevent lateral movement of the pressure gauge.

G. Pressure gauges shall be Ashcroft, Meriam Instruments in Cleveland, OH, or equal.

2.16 WIRING AND CONDUIT WITHIN THE SKID OR BASE

A. Power wiring and conduits for 480-volt circuits shall be sized per the NEC.

B. Power wiring for 120-volt circuits shall be No. 12 AWG with No. 12 AWG ground. Wiring for control circuits shall be No. 14 AWG. Install wiring per the NEC.

C. Color-code control wiring in switching and control assemblies per ICEA Method 1, NEC applications, Option A. Jacket shall be black PVC. Lay out conductors neatly so they may be followed by eye form one terminal to another. Wiring shall be vertical or horizontal. Color-coding shall be such that electrically common interconnections of devices are the same color. The colors may be used more than once but not in the same circuit or cable grouping.

D. Power and control cable shall be copper, insulated for 600 volts, 75 degrees Celsius wet and 90 degrees Celsius dry locations, UL Type THWN or XHHW. Insulation jacket shall be nylon. Install bare or green insulated copper conductors in power circuits for grounding connections. The cable shall meet the requirements of UL 83.

2.17 VARIABLE SPEED DRIVE UNITS FOR HYDRAULIC DIAPHRAGM METERING PUMPS

A. Each chemical metering pump shall be provided with a local NEMA 4X drive for local and remote operation as specified with required I/O as indicated on P&ID drawings and herein. The drive shall be capable of encoderless vector operation with a 90:1 turndown.

B. Drive shall be rated for wash down environment.

C. All operating parameters shall be made at the drive via the built-in display. The controller shall feature an intuitive menu system and shall not require additional hardware or software for programming.

D. In the local mode the drive shall respond to local pushbuttons, which shall provide control from 0 to 100 percent as indicated on the display.

E. In remote the drive shall respond to an external "RUN" command to start the pump and a 4-20 mA reference signal for 0 to 100 percent speed control.

F. The drive shall provide the following status signals for remote monitoring:
   1. DO = RUN.
   2. DO = FAULT.
   3. AO = SPEED FEEDBACK.

G. The drive shall operate using a sinewave carrier input with microprocessor controlled PWM encoderless vector output adjustable from 1 to 5 kHz standard and 5 to 16 kHz in quiet mode.

H. The drive shall feature internal protection for over voltage, over current, under voltage, external trip, motor overload, over temperature, output shorted or ground. An LED indicator shall indicate a trip condition and a separate message and trace log shall be provided with the last 10 trips stored in memory.

I. The display shall be a backlit graphical LCD 128 by 64 with 14 key membrane keypad with tactile response. The display shall provide all parameter values for setup and review. The display shall indicate output frequency, set frequency, output current (%), voltage, motor RPM, custom units power or energy consumed as selected by the operator.

J. The drives for each pump shall be designed for 120 VAC, 1 PH power supply.

K. Drive shall be as specified by Polk County USSM.

2.18 PUMP, MOTOR, DRIVE AND COMPONENT INTEGRATION

A. The chemical feed system manufacturer shall select compatible pump, motor and drive units and shall be responsible for integrating the components to provide a complete working system using the following input power supply:
   1. A 120-volt AC, 1-phase skid for Process 80.

2.19 FACTORY TESTING

A. Test each package system by using water. Fill each chemical storage tank and operate the control system by simulating the external control signals. Verify that the control system automatically controls the packaged system in response to the specified external control signals. Verify that metering pumps respond to the external flow-pacing signal.

B. Verify that the various specified alarm signals are generated and transmitted from the system control panel. Simulate metering pump running, tank low alarm shutdown and high- and low-pressure alarms.

C. Pressure test skid piping (except for overflow and vent piping) to a pressure of 150 psi for duration of three hours. There shall no leakage at any pipe joint or connection to any valve or piece of equipment. Repair or replace any defective pipe joint or connection and retest.

2.20 SERVICE CONDITIONS

A. The sodium hypochlorite solution has the following characteristics:

Liquid Pumped	12.5% trade wt. Sodium Hypochlorite Solution
Liquid Specific Gravity:	1.16
Viscosity:	1.75 to 2.50 centipoise
Operating Temperature:	25 to 100˚F

B. Sodium Hypochlorite Metering System Skid (Process 80):
   1. Provide the following pumping system for disinfection. The sodium hypochlorite metering system should be pre-plumbed, pre-wired, pre-preprogrammed complete with variable speed drives, pressure sustaining and relief valves, pump isolation valves and mounted control package.
   2. Sodium Hypochlorite Metering System Design:
      a. Metering a 12.5 percent sodium hypochlorite solution to injection points to the Ground Storage Tank Fill and pump discharge piping.
   3. The following table provides system design criteria for the Sodium Hypochlorite Metering Skid:

Pump Tag No.	Pump Operating Point	Liquid End or Tubing Material	Elastomer Material	Valve/Piping and Accessory Material	Motor hp	Pump Manufacturer (per USSM)
PMP-80- 1	15.9 gph @37' TDH	PVDF	PTFE	PVC	1/2	ProMinent Sigma 1 or Equal
PMP-80-2	15.9 gph @37' TDH	PVDF	PTFE	PVC	1/2	ProMinent Sigma 1 or Equal
PMP80-3	6.8 gph @36' TDH	PVDF	PTFE	PVC	1/2	ProMinent Sigma 1 or Equal
PMP-80-4	6.8 gph @36' TDH	PVDF	PTFE	PVC	1/2	ProMinent Sigma 1 or Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the chemical metering skid as indicated on the Drawings and specified and in compliance with the manufacturer's instructions.

B. Upon completion of installation, a full operating test shall be performed in the presence of the Engineer and a qualified direct company employed manufacturer's representative. The Contractor shall furnish all labor, materials and equipment required for such test and shall correct any deficiencies noted.

3.02 ASSEMBLING SKID OR BASE

A. Assemble and mount components on the fabricated skid or base at the factory. Provide the following minimum clearances around equipment:
   1. 12 inches between adjacent pumps.
   2. 6 inches between parallel pipes.

B. Design skid to provide access to the manual stroke control knobs located with the metering pumps.

C. Provide separate supports for pulsation dampener and calibration tube. Do not mount unsupported devices directly on the piping.

D. Provide fiberglass supports with fiberglass or titanium fasteners and hardware for the piping. Provide a support for each pipe at its termination point at the edge of the skid, within 3 inches of any isolation valve.

E. Route electrical conduit around the ends and sides of the skid or base. Do not install conduit overhead. Install wiring on the skid or base in PVC conduit with a minimum size of 3/4 inch. Install power and control wiring in separate conduits. Terminate conduits at the control panel.

F. Provide at least one side (preferably the front) of the skid clear of any piping or conduits to allow for maintenance access to the skid components. This clear access side shall not include any side that is within 3 feet of a wall.

3.03 ISOLATION VALVE LOCATIONS

A. Provide isolation valves at the following points:
   1. Inlet connection to each pump.
   2. Outlet connection from each pump.
   3. Connection to water supply quick connect coupling.
   4. Connection to drain quick connect coupling.
   5. As shown on the drawings.
   6. Outlet connection from each tank. Do not provide valves on overflow pipe connections or vent pipe connections.

3.04 PRESSURE-RELIEF VALVE LOCATIONS

A. Provide pressure-relief valve on the discharge piping of the metering pump discharge header. Size valve to match the associated metering pump capacity. Combine the pressure-relief piping from the metering pumps into a single pipe running back and connected to the suction standpipe/vent.

3.05 PRESSURE SUSTAINING VALVE

A. Provide pressure sustaining valve on the discharge piping of the hydraulic diaphragm metering pump. Size to match the associated metering pump capacity.

3.06 SERVICE CONDITIONS

Skid	Sodium Hypochlorite Metering System
Location	Outdoors with covered with Metal Canopy
Chemical Pumped	12.5% sodium hypochlorite
Number of Pump skids	2
Pump Tag Numbers	PMP-80-1 through PMP-80-4
Pump Type	Solenoid-driven mechanically actuated diaphragm with built-in microprocessor controls
Liquid End	PVC/Cer/PTFE
Maximum Stroke Rate	36 SPM
Motor Horsepower	0.5
Voltage	120 Volt, 1 Phase

Stroke Rate Control	4-20 mA with manual adjustment knob
Pump Capacity (80-P-01 and 80-P-02)	15.9 gph
Pump Maximum Pressure (80-P-01 and 80-P-02)	16 psi
Pump Capacity (80-P-03 and 80-P-04)	6.8 gph
Pump Maximum Pressure (80-P-03 and 80-P-04)	16 psi
Piping Material	Sch 80 PVC
Valve Types	Type 21-Vented
Options	Leak Detection, Degassing Riser

3.07 FIELD TESTING

A. Test each package system by using the water for the system. The Owner will provide sufficient chemical for a test period of 24 hours. Fill each tank and operate the control system. Verify that the control system automatically controls the packaged system in response to the specified external control signals. Verify that each metering pump responds to the selected external flow-pacing signal.

B. Verify that the various specified alarm signals are generated and transmitted from the system control panel. Verify each metering pump running and fail signals are sent and that local indicators operate correctly.

3.08 LABELING AND MARKING

A. Provide a tag for each unit, valve, or appurtenance bearing the tag number (Section 15075 - Equipment Identification). Piping shall be labeled according to Section 15076 - Pipe Identification.

3.09 WARRANTIES

A. The system manufacturer shall provide a 2-year warranty for the metering pumps, skid material/construction, and skid-mounted equipment, piping and valves. This warranty shall be in addition to and not in lieu of any warranties provided by the manufacturer of the equipment itself.

B. The system manufacturer shall pass through any warranties from the equipment suppliers for the pumps, controllers, and other system components manufactured by others.

3.10 CERTIFICATION

A. Provide a written certification from the equipment manufacturer that each packaged chemical feed system has been properly installed according to the drawings, specifications and manufacturer's specifications, and that the equipment is operating normally. Make all necessary corrections and adjustments including but not limited to labor, parts or freight at no additional cost to the Owner.

END OF SECTION

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SECTION 11312H

AXIALLY-SPLIT CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Split-case centrifugal pumps with drivers and components.

B. Tag numbers: As specified in Pump Schedule.

1.02 REFERENCES

A. American Bearing Manufacturers' Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.

C. ASTM International (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings.
   2. A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   3. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   4. A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   5. A582 - Standard Specification for Free-Machining Stainless Steel Bars.
   6. B505 - Standard Specification for Copper Alloy Continuous Castings.
   7. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
   8. E10 - Standard Test Method for Brinell Hardness of Metallic Materials.

D. Hydraulic Institute (HI):
   1. 1.1-1.2 - Rotodynamic (Centrifugal) Pumps for Nomenclature and Definitions.
   2. 1.3 - Rotodynamic (Centrifugal) Pumps for Design and Application.
   3. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application, Sound Measurement and Decontamination.
   4. 9.6.4 - Rotodynamic Pumps for Vibration Measurement and Allowable Values.
   5. 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

E. NSF International (NSF):
   1. Standard 61 - Drinking Water System Components - Health Effects.
   2. Standard 372 - Drinking Water System Components - Lead Content.

1.03 DEFINITIONS

A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net-positive suction head available (NPSHa), and net-positive suction head required (NPSHr): As defined in HI 1.1-1.2, 1.3, 9.1-9.5, 9.6.4, and 14.6 and as modified in the Specifications.

B. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; average when using multiple suction pressure taps, regardless of variation in individual taps.

C. Allowable Operating Region (AOR): The region over which the service life of the pump is not seriously compromised by hydraulic loads, vibration, or flow separation where the pump's vibration, noise, and cavitation are within acceptable limits.

D. Preferred Operating Region (POR): The region over which the service life of the pump will not be significantly affected by hydraulic loads, vibration, or flow separation where the pump's vibration, noise, and cavitation are within acceptable limits.

1.04 SYSTEM DESCRIPTION

A. Split-case centrifugal pumps with components: Pump, driver, motors, and drive arrangements as scheduled with seals or packing, couplings, base plates, guards, supports, anchor bolts, necessary valves, gauges, taps, lifting eyes, stands, and other items as specified and as required for a complete and operational system.

B. Pumps suitable for intermittent or continuous service with up to 10 milligrams per liter residual chlorine concentration.

C. Design requirements:
   1. Pump performance characteristics:
      a. As specified in the Pump Schedule.
      b. Performance tolerances shall be the same as the test tolerances specified in Section 15958 - Mechanical Equipment Testing. Test Acceptance per ANSI/HI 14.6 Grade 1U.
   2. All required conditions (flow/head) shall be within the pump manufacturer's Allowable Operating Range (AOR).
   3. Motor characteristics: As specified in the Pump Schedule.

D. Product requirements as specified in Section 01600 - Product Requirements and Section 15050 - Common Work Results for Mechanical Equipment.

1.05 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. For each item of equipment:
      a. Design features.
      b. Load capacities.
      c. Efficiency ratings.

d. Material designations by UNS alloy number or ASTM Specification and Grade.
e. Data needed to verify compliance with the Specifications.
f. Catalog data.
g. Nameplate data.
h. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.

2. Gear reduction units:
a. Engineering information in accordance with applicable AGMA standards.
b. Gear mesh frequencies.

3. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372.
a. Certification by an independent ANSI accredited third party, including, but not limited to, NSF International, as being lead free.

C. Shop drawings: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

D. Calculations: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

E. Vendor operation and maintenance manuals: As specified in Section 01782 - Operation and Maintenance Data.

F. Commissioning submittals:
1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756 - Commissioning.
2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050 - Common Work Results for Mechanical Equipment.

B. Provide pumps in this Section from same manufacturer.

C. Manufacturer qualifications:
1. Experience: Demonstrate minimum 5 years' experience in manufacture of split-case centrifugal pumps which have been successfully utilized in municipal water/wastewater applications.
2. References: Provide reference list of at least 5 different installations in municipal water/wastewater applications in the continental United States, where manufacturer has supplied equipment substantially similar in design and characteristics to that proposed here. The installations must:
a. Have been designed and fabricated by the manufacturer.
b. Be at least equal in horsepower to that of the largest unit specified.
c. Have been in continuous operation for last 5 years.
d. Include in the list the name, address, and telephone number of the Owner, horsepower, and time in operation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050 - Common Work Results for Mechanical Equipment.

1.08 PROJECT CONDITIONS

A. All equipment and materials for the project are to be suitable for performance in pump station environment and under following conditions:
   1. Design temperatures are:
      a. Outdoor temperatures: 18 to 35 degrees Celsius.
   2. Seasonal high groundwater table: 129 feet.
   3. Moisture conditions: Defined in individual equipment sections.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with Commissioning and Start-up as specified in Section 01756 - Commissioning.

1.10 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pump: One of the following or equal (per the PCU USSM):
   1. Aurora Pumps.
   2. FlowServe Corporation.
   3. Goulds Pumps.
   4. Peerless. (Added by PCU).

2.02 MATERIALS

A. General:
   1. Materials in the Pump Schedule shall be the type and grade as specified in this Section.

B. Cast iron: In accordance with ASTM A48, Class 30 minimum.

C. Low Lead Bronze: As required for Drinking Water service meeting the requirements of Section 15050 - Common Work Results for Mechanical Equipment.

D. Bronze: In accordance with ASTM B584, UNS Alloy C83600.

E. Zincless bronze: In accordance with ASTM B584, UNS Alloy C93700.

F. Stainless steel:
   1. In accordance with ASTM A276, Type 316 stainless steel.
   2. Impellers and casing: ASTM A276, CF8M stainless steel.
   3. In accordance with ASTM A582, Type 416 stainless steel.

G. Steel: ASTM A108, Grade as scheduled.

2.03 PUMP CASINGS

A. Type: Axially split case; allow removal of rotating element without disturbing piping connections or alignment; mounted horizontally or vertically as scheduled.

B. Material: As scheduled.

C. Construction: Of sufficient strength, weight, and thickness to provide accurate alignment and prevent excessive deflection.

D. Design working pressure: Minimum 1.10 times maximum shutoff total dynamic head with maximum installable impeller diameter at maximum operating speed plus maximum suction static head.

E. Hydrostatic test: 5-minute hydrostatic test for casing and covers for minimum 1.5 times design working pressure corresponding to 40 degrees Celsius for the material of construction used, or twice the shutoff head, whichever is higher.

F. Casing assembly: The upper and lower casing halves shall be flanged, bolted, and doweled together. The internal wall of the casing halves shall match with not more than 1/16-inch overhang or underhang between the two casing halves. Provide machined surfaces where the upper casing mates with the lower casing. Provide lifting lugs on the upper casing. Support the casing by feet beneath the casing or by supports between the casing and baseplate. Provide internal bypass between casing and stuffing box or provide a Plan 11 recirculation piping arrangement per API 682.

G. Suction and discharge: Single or dual suction as scheduled; piping connections in lower half of casing with side entry and exit.

H. Suction and discharge piping connections: Flanged, meeting ASME B16.1, Class 125, or ASME B16.5, Class 150, or higher pressure class as required to meet design working pressure.

I. Vent and taps:
   1. Provide casings with bolt 3/4-inch threaded high-point and low-point drain taps (ASME B1.20.1).
   2. Provide 1/2-inch threaded tap with valve and pressure gauge on the suction and discharge flanges (ASME B1.20.1).

2.04 IMPELLERS

A. Impellers and sleeves shall be in accordance with API 610 (9th edition), Section 5, paragraphs 5.6.3, 5.6.5, and 5.6.7.

B. Type: As scheduled. Jockey pump impellers shall be of the enclosed double-suction type.

C. Material: As scheduled.

D. Water passages: Smooth, machined to reduce turbulence.

E. Method of securing to shafts: Keyed and axially secured by bronze sleeves with nuts.

F. Rotation: Clockwise looking from driver.

G. Balance: As specified in Section 15050 - Common Work Results for Mechanical Equipment to meet the vibration criteria as specified in Section 15958 - Mechanical Equipment Testing.

H. Provide shaft and sleeve design such that the sleeves tighten with the rotation of the shaft. Provide Teflon or neoprene gaskets or encapsulated O-rings between impeller hub and shaft sleeves.

2.05 WEAR RINGS

A. Impeller wear-ring material:
   1. When low lead bronze impeller is scheduled, provide bronze alloy meeting the requirements of NSF 61 and 372.
   2. When bronze impeller is scheduled, provide UNS Alloy C93200 wear ring.
   3. When zincless-bronze impeller is scheduled, provide UNS Alloy C93700 wear ring.
   4. When cast-iron impeller is scheduled, provide ASTM A48, Class 30 cast-iron wear ring.
   5. When stainless steel impeller is schedule, provide Stainless Steel ASTM A276 CD4MCU wear ring.
   6. Impeller wear ring shall have a Brinell Hardness Number at least 50 less than the casing wear ring Brinell Hardness Number when tested in accordance with ASTM E10.

B. Casing wear-ring material: Same material as impeller wear ring.

C. Features:
   1. Able to allow compensation for minimum 1/8-inch wear.
   2. Removable.
   3. Fastened with recessed screws or keyed to casing to prevent relative rotation.

D. Wear rings and running clearances shall not exceed 0.002-inch clearance per inch of diameter.

E. Case wear ring shall be register fitted. Designs using a press fit with locking pins or screws may be used providing the design and construction comply with API 610 (9th edition), paragraph 5.7.3.

F. The case wear ring and impeller wear ring shall mate together to provide a smooth, rounded approach for the fluid entering the volute. The case wear ring shall be of a "bull-nose" design, which provides a smooth radius transition from the casing into the impeller. There shall be no abrupt angles to induce vortexing of the fluid at the entry to the impeller or to induce metal erosion in the area where the case wear ring attaches to the casing.

2.06 PUMP SHAFTS

A. Material:
   1. When low lead bronze impeller is scheduled, provide bronze alloy meeting the requirements of NSF 61 and 372.
   2. When bronze impeller scheduled, provide ASTM A582, Type 416 stainless steel shaft.
   3. When zincless-bronze impeller scheduled, provide ASTM A276, Type 316 stainless steel shaft.
   4. When cast-iron impeller scheduled, provide ASTM A108, Grade 1141 steel shaft.
   5. When stainless steel impeller is schedule, provide Stainless Steel ASTM A276 Type 316 stainless steel shaft.

B. Strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.

C. Resonant frequency: As specified in Sections 15050 - Common Work Results for Mechanical Equipment and 15958 - Mechanical Equipment Testing.

D. Deflection: Tolerance on the shaft diameter, with shaft rotated on centers, shall not exceed 0.001-inch TIR. Shaft runout on the stuffing box or seal chamber face and at the impeller shall not exceed 0.002-inch full indication movement. The shaft stiffness shall limit the total deflection under the most severe dynamic conditions over the allowable operating range of the pump, with the maximum impeller diameter installed, to 0.002 inch at the primary seal faces or at the stuffing box faces.

E. The first lateral critical speed of the rotating assembly shall be at least 120 percent of the maximum pump operating speed.

F. Shafts and sleeves shall be machined and finished so that the surface finish of the shafts or sleeves through the stuffing box and at the rubbing contact-bearing housing seals shall not exceed a roughness of 32-microinch TIR.

G. Shaft sleeve:
   1. When low lead bronze impeller is scheduled, provide bronze alloy meeting the requirements of NSF 61 and 372.
   2. When bronze impeller scheduled, provide ASTM B505, UNS Alloy C93200 shaft sleeve.
   3. When zincless-bronze impeller scheduled, provide ASTM A276, Type 316 stainless-steel shaft sleeve.
   4. When cast-iron impeller scheduled, provide ASTM A582, Type 416 stainless-steel shaft sleeve.
   5. When stainless steel impeller is schedule, provide Stainless Steel ASTM A276 Type 316 stainless steel shaft.
   6. Renewable, key locked or set screws in stuffing box, gland area, and bearings; able to protect shaft from pumped liquid and wear.

2.07 BEARINGS AND BEARING FRAME

A. Bearing type: Anti-friction, grease- or oil-lubricated as scheduled, meeting ABMA standards; self-aligning spherical-roller-type radial bearings; angular-contact ball type or tapered roller for thrust bearings.

B. Bearing lubrication:
   1. When grease lubrication is scheduled, provide:
      a. External grease fittings with grease-relief pipe.
      b. Lip-type grease seals and labyrinth-type grease deflectors at both ends of bearing housings, able to prevent entrance of contaminants.
   2. When oil lubrication is scheduled, provide:
      a. Internal oil reservoir with separate constant-level external oil makeup reservoir type system.
      b. External level indication.
   3. Lubrication system sized sufficiently to safely absorb heat energy normally generated in bearing under maximum ambient temperature of 140 degrees Fahrenheit.

C. Bearing life: Minimum L10 life of 100,000 hours at rated design point but not less than 24,000 hours in accordance with ABMA 9 or 11 at bearing design load imposed by pump shutoff with maximum-sized impeller at rated speed, whichever provides longest bearing life in intended service.

D. Pump bearing frames:
   1. 1-piece rigid construction with bearing housing at outboard (pump) end and at inboard (driver) end.
   2. Materials:
      a. Pump bearing frame: ASTM A48, Class 30 minimum, cast iron.
      b. Bearing housing and end cover: ASTM A48, Class 30 minimum, cast iron.

E. Bearing frame drain hole: Tapped, located as low as possible to drain leakage when adjacent to packing or seal.

F. Bearing Housing: Bearing housings shall have register fits and shall be cast iron, bolted and doweled to the lower half of the casing. Provide housings with cast-iron caps, bolted in place. The bearings and caps shall be bored to receive the bearings. For pumps having shaft diameters 2-1/2 inches and larger, provide the caps with openings (minimum 1-inch size) for inspection of the oil rings or bearings; provide threaded plugs in the openings.

G. Oil Well: Brackets for oil-lubricated bearings shall have cast partitions that shall form oil wells on one side and drip pockets beneath the packing boxes or seal chambers on the other. Provide brass plugs in the oil wells at the lowest portion. Provide oil level indicators with brass enclosing shells surrounding the glass tubes. Provide oil level markers on the shells indicating the normal oil level.

2.08 SHAFT STUFFING BOX

A. Provide stuffing box suitable for shaft-seal type scheduled and as specified in Section 15050 - Common Work Results for Mechanical Equipment.

~~B.~~ Seal flushing: Use pumped fluid; pipes and passages by pump manufacturer.

2.09 SUPPORTS, PEDESTALS, AND BASEPLATES

A. Type: As specified below and in Section 15050 - Common Work Results for Mechanical Equipment.

B. Materials: ASTM A283 steel, hot-dip galvanized after fabrication and coated as specified in Section 09960 - High-Performance Coatings or ASTM A240 or A666 316 stainless steel.

C. Pump and driver support strength: Able to withstand minimum 1.5 times maximum imposed operating loads or imposed seismic loads, whichever is greater.

D. Configuration: Allow easy access to stuffing boxes, bearing frames, and couplings.

E. Vertical mounted: When scheduled, structural base plate and support for vertically mounted pump and driver able to resist torsional and seismic loads and meet vibration criteria as specified in Section 15958 - Mechanical Equipment Testing.

F. Anchor bolts: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.10 COUPLINGS

A. Types: Flexible coupling as recommended by the manufacturer and as specified in Section 15050 - Common Work Results for Mechanical Equipment.

B. Flexible coupling life: Infinite at up to 0.30-degree misalignment angle total or per disk for disk type at maximum operating loads.

C. Design coupling to withstand a minimum of 1.5 times the maximum operating torque and other imposed loads.

2.11 EQUIPMENT GUARDS

A. Provide equipment safety guards as specified in Section 15050 - Common Work Results for Mechanical Equipment.

2.12 DRIVERS

A. Horsepower:
   1. As scheduled.
   2. Listed driver horsepower is the minimum to be supplied.
      a. Increase driver horsepower, if required, to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
      b. When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.
      c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.

B. Motors: Provide motors as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower and as specified in this Section:
   1. Revolutions per minute: As scheduled.

2. Enclosure: As scheduled.
3. Electrical characteristics: As scheduled.
4. Efficiency, service factor, insulation, and other motor characteristics: As specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.
5. Motor accessories: As specified in Section 16222 - Low Voltage Motors up to 500 Horsepower and in this Section.
6. Coordinate motors with the variable frequency drive manufacturer to ensure compatibility between the motor and variable frequency drive.

C. Other drivers: As scheduled and as specified in sections listed in the Pump Schedule.

2.13 FINISHES

A. Line all water passages with a high-solids epoxy system as specified in Section 09960 - High-Performance Coatings. This lining shall meet the requirements of NSF 61.

B. Coat pump and frame and motor and baseplate the same as the connecting piping. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in field. Color of finish coat shall match the color of the connecting piping.

C. Do not coat bronze impellers. Do not coat wear rings. Apply coating in factory.

2.14 SPARE PARTS AND SPECIAL TOOLS

A. Special tools: Deliver 1 set for each furnished pump type and size needed to assemble and disassemble pump system.

B. Pack spare parts in a wooden box; label with the manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained within.

C. Spare parts: Deliver the following as specified in Section 01600 - Product Requirements:
1. One spare rotating assembly.
2. One spare repair kit for each type and size.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with written instructions of the manufacturer, and as specified in Section 15050 - Common Work Results for Mechanical Equipment.

B. Provide the manufacturer's recommended lubricants in the pumps, bearings, and other mechanical equipment.

C. Prepare foundation, mount driver, level the base, align pumps, and install couplings per ANSI/HI 1.4. Install baseplates with epoxy grout in accordance with API 686, Chapter 5.

D. Pump drainpipes:
   1. Connect pipe drains from drip pockets to point indicated on the Drawings or as directed by the Engineer.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer's Certificate of Source Testing.
      b. Manufacturer's Certificate of Installation and Functionality Compliance.
   2. Manufacturer's Representative onsite requirements:
      a. Installation: 1 trip, 2 day minimum.
      b. Functional Testing: 1 trip, 1 day minimum each.
   3. Training:
      a. Maintenance: 4 hours per session, 1 session.
      b. Operation: 2 hours per session, 1 session.
   4. Process operational period:
      a. As required by Owner or Contractor.

C. Source testing:
   1. Pump:
      a. Non-witnessed testing: As scheduled and as specified in Section 01756 - Commissioning.
      b. Performance test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
      c. Vibration test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
      d. Noise test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
   2. Pump casing: Hydrostatic pressure tests if specified in this Section.
   3. Motor: Test as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.

D. Functional testing:
   1. Pump assembly:
      a. Performance test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
      b. Vibration test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
      c. Noise test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
   2. Motor: Test as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.

3.03 PUMP SCHEDULE

Tag Numbers	PMP-54-1, PMP-54-2, PMP-54-3,	PMP-52-1, PMP-52-2
General Characteristics:		
Application	Drinking Water	Drinking Water
Quantity	3	2
Maximum Noise, dBA at 3 feet	85	85
Torsional Analysis	Not Required	Not Required
Minimum Pumped Fluid Temperature, degrees Fahrenheit	50	50
Normal Pumped Fluid Temperature, degrees Fahrenheit	60	60
Maximum Pumped Fluid Temperature, degrees Fahrenheit	80	80
Pump Characteristics:		
Pump and Driver Mounting	Horizontal	Horizontal
Suction Configuration	Double	Double
Impeller Type	Double Entry	Double Entry
Bearing Lubrication	Grease	Grease
Shaft Seal Type	Single Mechanical, Balanced	Single Mechanical, Balanced
Speed Control	Variable Frequency Drive	Variable Frequency Drive
Maximum Pump rpm	1800	1800
Rated Design Point (At Maximum Revolutions per Minute):		
Flow, gpm	2100	900
Head, Feet	199	199
Minimum Efficiency, Percent	75%	70%
Required Condition 2 (At Maximum Revolutions per Minute):		
Flow, gpm	1000	500
Head Range, Feet	230	220
Minimum Efficiency, Percent	60%	60%
Required Condition 3 (At Maximum Revolutions per Minute):		
Flow Range, gpm	2500	1200
Head, Feet	175	180
Minimum Efficiency, Percent	80%	70%
Required Condition 4 (At Reduced Revolutions per Minute):		
Flow, gpm	800	200
Head, Feet	199	199
Minimum Efficiency, Percent	60%	35%

Tag Numbers	PMP-54-1, PMP-54-2, PMP-54-3,	PMP-52-1, PMP-52-2
Other Conditions:		
Shutoff Head, Feet	230	230
Maximum NPSHr at Every Specified Flow, Feet	15	10
Minimum NPSHa at Every Specified Flow, Feet	34	34
Maximum Suction Static Head, Feet	26.33	26.33
Minimum Suction Static Head, Feet	4.33	4.33
Pump Materials:		
Pump Casing	Cast Iron	Cast Iron
Impeller	316 Stainless Steel	316 Stainless Steel
Driver Characteristics:		
Driver Type	Motor	Motor
Drive Arrangement	Horizontal, Flexibly Coupled	Horizontal, Flexibly Coupled
Minimum Horsepower	150	100
Maximum Speed, rpm	1800	1800
Motor Characteristics (when motor is driver type):		
Inverter Duty Rated	Yes	Yes
Motor Voltage/Phases/Hertz	460/3/60	460/3/60
Enclosure Type	TEFC	TEFC
Source Testing:		
Test Witnessing	Not Witnessed	Not Witnessed
Performance Test Level	2	2
Vibration Test Level	2	2
Noise Test Level	2	2
Functional Testing:		
Performance Test Level	3	3
Vibration Test Level	3	3
Noise Test Level	3	3

END OF SECTION

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SECTION 11313L

VERTICAL TURBINE DEEP WELL CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Vertical line shaft well pump with features as scheduled in the Pump Schedule.

B. Tag numbers: As specified in Pump Schedule.

1.02 REFERENCES

A. American Bearing Manufacturers' Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.

C. American Water Works Association (AWWA):
   1. C654 - Disinfection of Wells.

D. ASTM International (ASTM):
   1. A36 - Standard Specification for Carbon Structural Steel.
   2. A48 - Standard Specification for Gray Iron Castings.
   3. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   4. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   5. A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   6. A516 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
   7. A536 - Standard Specification for Ductile Iron Castings.
   8. A582 - Standard Specification for Free-Machining Stainless Steel Bars.
   9. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
   10. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   11. F594 - Standard Specification for Stainless Steel Nuts.

E. The Hydraulic Institute (HI):
   1. 2.1-2.2 - Rotodynamic (Vertical) Pumps for Nomenclature and Definitions.
   2. 2.3 - Rotodynamic (Vertical) Pumps for Design and Applications.
   3. 2.4 - Rotodynamic (Vertical) Pumps for Manual Describing Installation, Operations, and Maintenance.

4. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application, Sound Measurement and Decontamination.
5. 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

F. National Electrical Manufacturers Association (NEMA).

G. NSF International (NSF):
1. Standard 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 2.1-2.2, 2.3, 2.4, 9.1-9.5, and 14.6 and as modified in the Specifications. The pump head and efficiency are evaluated at the outlet of the discharge head and include the net losses in the pump column and discharge.

B. Flow, head, efficiency, and motor horsepower specified in this Section are minimums unless stated otherwise.

C. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric.

D. Tolerances: This Section contain tolerances that may be more stringent than Hydraulic Institute Standard tolerances. Where tolerances are not mentioned, HI 2.1-2.2, 2.3, 2.4, and 9.1-9.5 shall apply. Testing acceptance per ANSI/HI 14.6 Grade 1U.

1.04 SYSTEM DESCRIPTION

A. Components: Pump, driver, motors, and drive arrangements as specified or as scheduled with shafts, columns, intermediate bearings, seals or packing, couplings, base plates, guards, supports, anchor bolts, necessary valves, gauges, taps, lifting eyes, stands, and other items as required for a complete and operational system.

B. Design requirements:
1. Pump performance characteristics:
a. As specified in the Pump Schedule.
b. Performance tolerances shall be the same as the test tolerances specified in Section 15958 - Mechanical Equipment Testing.
c. Pump curve shall be continuously rising throughout the design conditions listed in the pump schedule.
2. Motor characteristics: As specified in the Pump Schedule.

C. Product requirements.

1.05 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15050 - Common Work Results for Mechanical Equipment:
   1. For pumps in contact with Drinking Water application submit one of the following:
      a. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372.
         1) Certification by an independent ANSI accredited third party, including, but not limited to, NSF International, as being lead free.

C. Shop drawings: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

D. Calculations: As specified in Section 15050 - Common Work Results for Mechanical Equipment:
   1. Torsional analysis: Submit as specified in Section 15050 - Common Work Results for Mechanical Equipment when scheduled.

E. Vendor operation and maintenance manuals: As specified in Section 01782 - Operation and Maintenance Data.

F. Commissioning submittals:
   1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756 - Commissioning.
   2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.06 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following per County USSM:
   1. Flowserve.
   2. Goulds Pumps.
   3. National Pump Co.
   4. Peerless (Added by PCU).

2.02 MATERIALS

A. General:
   1. Materials in the Pump Schedule shall be the type and grade as specified in this Section.

B. Drinking water pumps: Provide materials in conformance with Section 15050 - Common Work Results for Mechanical Equipment.

C. Cast iron: In accordance with ASTM A48, Class 30 minimum.

D. Ductile iron: In accordance with ASTM A536, 65-45-12.

E. Tin bronze: In accordance with ASTM B584, Alloy C90300.

F. Silicon bronze: In accordance with ASTM B584, Alloy C87600.

G. Red bronze: In accordance with ASTM B584, Alloy C83600.

H. Type 416 Stainless Steel: In accordance with ASTM A582.

I. Type 304 Stainless Steel: In accordance with ASTM A276.

J. HDPE: Polyethylene.

K. Steel: In accordance with ASTM A283, Grade D or ASTM A516 Grade. 70.

L. Steel pipe: In accordance with ASTM A53, Grade B.

2.03 GENERAL PUMP CONSTRUCTION

A. Type: Industrial, heavy duty, vertical turbine, centrifugal type pumps meeting performance requirements and features as scheduled and as specified.

B. Discharge flange: ASME B16.1 or B16.5 drilled; rated for 1.2 times the pump shutoff head at 150 degrees Fahrenheit.

C. Discharge nozzles: Provide 1/2-inch NPT taps for pressure gauges; install nipple and gauge with block valve.

D. Bearings:
   1. Column shaft bearings to have 3, 1/4-inch squared, vertical, machined grooves on the inside of the bearing wall, spaced 120 degrees apart, which will allow water to flow through them (water flush lubrication system). Bearings shall be approved by Engineer prior to pump installation.
   2. Design driver/motor bearings to support the line shaft assembly and rated for ABMA L10 life of 40,000 hours at Design Rated Point flow and head in accordance with ABMA 9 or ABMA 11.
   3. Design motor to withstand continuous duty full load thrust and momentary upthrust that may occur during pump on/off or other operations.

E. Fasteners: Provide Type 316 stainless steel fasteners in accordance with ASTM F593 or ASTM F594.

2.04 PUMP SUCTION ASSEMBLY

A. Suction case shall be taper threaded to accept an inlet strainer.

B. A sand collar shall be pressed on or set screwed to the bowl shaft, immediately above the housing.

C. Materials:
   1. Suction case: ASTM A48 class 30 cast iron.
   2. Suction bearing: Bronze with Buna-N A40 rubber (combination type) or Buna-N A40 rubber (marine).
   3. Sand collar: Low density polyethylene.

4. Suction plug: Cast iron.
5. Suction strainer: per Pump Schedule.

2.05 IMPELLER BOWL ASSEMBLIES

A. Pump impeller assembly:
   1. Type: As scheduled in the Pump Schedule.
   2. Number of stages: As scheduled in the Pump Schedule.
   3. Material: Silicon Bronze.
   4. Required balance: As specified in Section 15050 - Common Work Results for Mechanical Equipment to meet vibration criteria as specified in Section 15958 - Mechanical Equipment Testing.
   5. Method of securing impellers to shafts: Tapered collets or locked by other methods acceptable to the Engineer.

B. Provisions for adjustment of axial clearance: Make such adjustment through use of motor adjusting nut or adjustable coupling.

C. Shafts:
   1. Material: Type 416 stainless steel.
   2. Turned, ground and polished.

D. Intermediate and discharge impeller cases:
   1. Material: As scheduled.
   2. Attached with bolting.

E. Pump impeller bowl bearings:
   1. Provide bearing for each impeller.
   2. Materials: Bronze.

F. Discharge and suction bowl bearing:
   1. Provide bronze bearings with self-contained lubrication system filled with graphite type non-soluble grease when grease lubrication scheduled; provide bearing with sand cap.
   2. When service is potable water, provide non-toxic grease approved by the Food and Drug Administration for use in potable water.

G. Design with smooth water passages to reduce clogging by stringy or fibrous materials on impellers or shafting.

2.06 SUCTION ADAPTOR

A. Material: Cast iron.

B. Provide a Type 316 stainless steel strainer.

C. Designed to prevent entrance of abrasive material into the top end of the motor.

2.07 LINE SHAFTS

A. Provide line shaft type and lubrication type as scheduled and as specified in this Section.

B. Strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.

C. Resonant frequency: As specified in Sections 15050 - Common Work Results for Mechanical Equipment and 15958 - Mechanical Equipment Testing.

D. Design pump line shafting in interchangeable lengths as scheduled, but not to exceed 20 feet; shaft lengths to match scheduled pump column lengths.

E. Coupling strength: Design driver to pump line shaft coupling of sufficient length and strength to maintain line shaft alignment.

F. Adjustment:
   1. Design a means to adjust shaft position to adjust impeller position.
   2. For motor driven units with hollow shafts, an adjusting nut may be provided at the top of the motor shaft.

G. Spacer coupling: When mechanical seals are scheduled, provide an adjustable spacer coupling to allow removal of the seal without driver removal.

2.08 COLUMN PIPE

A. Material: ASTM A53 grade B Taper Threaded, T&C.

B. Size: As scheduled in the Pump Schedule.

C. Head connection: Design with and flange bolted connection to discharge head and flange bolted connection to impeller assembly to permit removal of impeller bowl assembly without disturbing the column or discharge connections.

D. Design working pressure: Design to withstand a design working pressure not less than 1.20 times the maximum shutoff total dynamic head with the maximum diameter impeller at the maximum operating speed plus the maximum suction static head.

E. Pressure test: Design to withstand a 5-minute hydrostatic test pressure not less than 1.5 times the design working pressure; perform test at source.

F. Lengths and connections: Design with maximum 20-foot length, or less if scheduled, interchangeable column sections with threaded with registered fit screwed connections as scheduled.

2.09 PUMP DISCHARGE HEAD ASSEMBLY

A. Design the discharge head for above or base discharge as scheduled.

B. Design the discharge vertical to horizontal flow transition as a smooth pipe elbow or from a minimum of 3 pipe pieces mitered to form the elbow.

C. Design discharge head to mate with the driver as scheduled.

D. Head and base plate construction: Sufficient strength, weight, and thickness to provide accurate alignment, prevent excessive deflection and support the drive motor.

E. Mechanical seal:
   1. Design the discharge head to accommodate mechanical seal as scheduled.
   2. Mechanical seal: When scheduled, provide stuffing box suitable for the specified seal.
   3. Refer to Section 15050 - Common Work Results for Mechanical Equipment for mechanical seals.

F. Steady bushing: Bronze.

G. Discharge vent: Provide 3/4-inch NPT threaded high point vent on discharge; install pipe nipple with threaded gate valves in vent.

H. Materials: As scheduled; when not scheduled, provide:
   1. Pump discharge head/driver stand: Steel, ASTM A283, Grade B and/or ASTM A53, Grade B; or Cast iron, ASTM A48, Class 30 minimum.
   2. Pump discharge head sleeve bearing: ASTM B584, Alloy C93800, high lead tin bronze.
   3. Mechanical seal: Container and gland, Cast iron, ASTM A48, Class 30 minimum; Neoprene top shaft seal.

2.10 SOLEPLATE AND ANCHOR BOLTS

A. The Contractor shall assign the design and construction of the pump (including bowls, column, and discharge head), motor and supporting stand, and baseplate and soleplate system to the pump manufacturer. The pump manufacturer shall design and construct an integrated system to comply with the specified restraint, deflection, vibration, and critical speed criteria.

B. Provide a steel soleplate to be permanently grouted in place. The thickness and bolting to the discharge head base shall be sufficient to restrain the discharge head against shut off head or any other pump operating condition and provide sufficient rigidity such that the pump and baseplate system meets the specified lateral vibration and critical speed criteria. For fabricated steel discharge heads, the sole plate thickness shall be greater than the top column flange thickness plus the bolt head length. Machine the soleplate topside to mate with a fully machined base of the discharge head.

C. Provide vertical leveling screws spaced for stability on the outside perimeter of the soleplate. Locate the leveling screws adjacent to anchor bolts to minimize distortion during the process of installation. These screws shall be numerous enough to carry the weight of the baseplate, pump, and drive train components without excessive deflection, but in no case shall fewer than six screws be provided. Sandblast the grout contact surfaces of the soleplate in accordance with SSPC SP-6 and coat those surfaces with a primer compatible with epoxy grout.

D. Provide anchor bolts of sufficient quantity and size to restrain any pump operating condition. The anchor bolts shall conform to ASTM A193, Grade B8 with nuts conforming to ASTM A194, Grade 8.

2.11 EQUIPMENT GUARDS

A. Provide equipment safety guards as specified in Section 15050 - Common Work Results for Mechanical Equipment.

2.12 DRIVERS

A. Horsepower:
   1. As scheduled.
   2. Listed driver horsepower is the minimum to be supplied.
      a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
      b. When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.
      c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.

B. Motors: Provide motors as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower and as specified in this Section:
   1. NSF Standard 61 certified.
   2. Revolutions per minute: As scheduled in the Pump Schedule.
   3. Enclosure: As scheduled in the Pump Schedule.
   4. Electrical characteristics: As scheduled in the Pump Schedule.
   5. Motor accessories: As specified in Section 16222 - Low Voltage Motors up to 500 Horsepower and in this Section.
   6. Coordinate motors with the variable frequency drive manufacturer to ensure compatibility between the motor and variable frequency drive.

C. Other drivers: As scheduled and as specified in Sections listed in the Schedule.

D. Non-reverse ratchets: When scheduled, provide driver with non-reverse ratchets or pin mechanism to prevent reverse rotation of the pump and driver in the event of discharge valve failure.

2.13 SUPPORTS

A. Strength: Design pump discharge head and driver (motor or engine) supports to withstand a minimum of 1.5 times the maximum imposed operating loads or the imposed seismic loads, whichever is greater.

B. Resonant frequency: Design supports in conjunction with the pump, shafting, drivers, bearings, and other components to avoid natural resonant frequencies, either torsional, radial, or axial as specified in Section 15958 - Mechanical Equipment Testing.

C. Coordinate pump and drive system supports with the foundation designs as indicated on the Drawings.

2.14 SPARE PARTS AND SPECIAL TOOLS

A. Spare parts: Deliver the following spare parts to Owner; pack and label for storage.
   1. Mechanical seal: 1 complete seal of each size and type.

B. Special tools: Deliver 1 set for each furnished pump type and size needed to assemble and disassemble pump system.

PART 3 EXECUTION

3.01 STERILIZATION

A. Disinfection procedures shall be in accordance with AWWA C654.

B. Samples for bacteriological analysis shall be collected in a sterile container at the pump discharge, and a test made for coliform organisms.
   1. After sterilization, the well shall be pumped at open discharge until at least 100,000 gallons of water have been pumped before the samples are collected.
   2. Water samples shall be collected from the well on 10 successive days and analyzed for coliform organisms with each sample showing that no organisms were found before the well is accepted for showing the water is coliform free.
   3. The samples shall be collected by a laboratory approved by the Owner and the test for coliform organisms shall be made by the laboratory, and the Owner shall be furnished a copy of the laboratory report.
   4. If any coliform organisms are found present in the samples, the Contractor shall re-sterilize the pump and have the water resampled as stated above until such time as no coliform organisms are found present in a water samples collected after at least 100,000 gallons of water have been pumped from the well following sterilization, or until such time as the Owner becomes convinced that coliform organisms exist naturally in the water-bearing formation and are not present in water produced from the well as a result of the operations of the Contractor.
   5. All expenses of sterilization of the pump and laboratory analyses for coliform organisms shall be borne by the Contractor.

C. The water discharged by the pump following disinfection shall be dechlorinated to a level of 2.0 or less milligrams per liter chlorine before it is allowed to leave the site.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer's Certificate of Source Testing.
      b. Manufacturer's Certificate of Installation and Functionality Compliance.
   2. Manufacturer's Representative onsite requirements:
      a. Installation: 1 trip, 5-day minimum.
      b. Functional Testing: 2 trips, 2-day minimum each.
   3. Training:
      a. Maintenance: 4 hours per session, 2 sessions.
      b. Operation: 2 hours per session, 2 sessions.
   4. Process operational period:
      a. As required by Owner or Contractor.

C. Source testing: As specified in Pump Schedule.

D. Functional testing: As specified in Pump Schedule.

Tag Numbers	PMP-10-1 (Gibson Oaks)	PMP-10-2 (Lake Gibson)	PMP-10-3 (Sherwood Lakes Well No. 1)	PMP-10-4 (Sherwood Lakes Well No. 2)
General Characteristics:				
Application	Drinking Water	Drinking Water	Drinking Water	Drinking Water
Service	Raw Well Water	Raw Well Water	Raw Well Water	Raw Well Water
Quantity	1	1	1	1
Inner / Nominal Casing Diameter at land surface, inches	12	16	18	18
Maximum Noise, dBA at 3 feet	70	70	70	70
Torsional Analysis	Required	Required	Required	Required
Minimum Pumped Fluid Degrees Fahrenheit	50	50	50	50
Normal Pumped Fluid Degrees Fahrenheit	75	75	75	75
Maximum Pumped Fluid Degrees Fahrenheit	100	100	100	100
Estimated static water level to surface, feet	15.21	43.42(1)	20.53	19.22
Estimated pumping water level to surface, feet	16.35	70(1)	26.86	24.92
Estimated discharge static head above surface, feet of water	3’-4”	3’-4”	3’-4”	3’-4”
Pump Characteristics:				
Number of Stages	2	3	3	3
Impeller type	Enclosed	Enclosed	Enclosed	Enclosed
Pump Impeller Bowl Bearing Lubrication	Grease	Grease	Grease	Grease
Suction Strainer	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Line Shaft Type	Open	Open	Open	Open
Minimum Line Shaft Bearing Spacing, Feet	10	10	10	10
Line Shaft Lubrication	Water Flush	Water Flush	Water Flush	Water Flush

Discharge Shaft Seal Type	Single Mechanical Cartridge Seal	Single Mechanical Cartridge Seal	Single Mechanical Cartridge Seal	Single Mechanical Cartridge Seal
Column Connection Type	Threaded	Threaded	Threaded	Threaded
Maximum Column Section Lengths, Feet	10	10	10	10
Coupling Type	Threaded	Threaded	Threaded	Threaded
Maximum diameter pump bowl assembly, inches	9.5	14.5 (1)	13.25	13.25
Column pipe internal diameter, inches	6.7	8 (1)	10	10
Speed Control	Constant	Constant	Constant	Constant
Maximum Pump rpm	1,770	1,770	1,770	1,770
Rated Design Point (at Maximum Revolutions per Minute):				
Flow, gpm	500	1250	2100	2100
Head, Feet	60	140	200	200
Minimum Efficiency, Percent	79	82	80	80
Required Condition 2 (at Maximum Revolutions per Minute):				
Flow, gpm	200	600	1100	1100
Head Range, Feet	80	180	275	275
Minimum Efficiency, Percent	53	58	65	65
Required Condition 3 (at Maximum Revolutions per Minute):				
Flow, gpm	600	1600	2600	2600
Head Range, Feet	48	110	150	150
Minimum Efficiency, Percent	75	81	76	76
Other Conditions:				
Minimum Shut Off Head, Feet	100	240	400	400
Maximum NPSHr at every Specified Flow, Feet	20	20	32	32
Pump Materials:				
Suction Bearing	Combination (bronze and rubber) or Marine (rubber only)	Combination (bronze and rubber) or Marine (rubber only)	Combination (bronze and rubber) or Marine (rubber only)	Combination (bronze and rubber) or Marine (rubber only)

Impeller Cases	ASTM A536 grade 65-45-12 ductile iron	ASTM A536 grade 65-45-12 ductile iron	ASTM A536 grade 65-45-12 ductile iron	ASTM A536 grade 65-45-12 ductile iron
Impeller (enclosed)	ASTM B584, C83800 bronze	ASTM B584, C83800 bronze	ASTM B584, C83800 bronze	ASTM B584, C83800 bronze
Impeller Bearing	Combination (bronze and rubber) or Marine	Combination (bronze and rubber) or Marine	Combination (bronze and rubber) or Marine	Combination (bronze and rubber) or Marine
Impeller Shaft Key or Collet	Steel	Steel	Steel	Steel
Line Shaft	Type 416 stainless steel	Type 416 stainless steel	Type 416 stainless steel	Type 416 stainless steel
Line Shaft Coupling	Type 304 stainless steel	Type 304 stainless steel	Type 304 stainless steel	Type 304 stainless steel
Line Shaft Bearings	Bronze	Bronze	Bronze	Bronze
Shaft Enclosing Tube	Schedule 80 Steel Pipe	Schedule 80 Steel Pipe	Schedule 80 Steel Pipe	Schedule 80 Steel Pipe
Column Material and Thickness, Inch	Steel Pipe, 0.500	Steel Pipe, 0.500	Steel Pipe, 0.500	Steel Pipe, 0.500
Discharge Head/Driver Stand	ASTM A36 & A53 grade B or APE X42 steel	ASTM A36 & A53 grade B or APE X42 steel	ASTM A36 & A53 grade B or APE X42 steel	ASTM A36 & A53 grade B or APE X42 steel
Discharge Head Bearing	Steel	Steel	Steel	Steel
Steady Bushing	Bronze	Bronze	Bronze	Bronze
Driver Characteristics:				
Driver Type	Motor	Motor	Motor	Motor
Drive Arrangement	Vertical, Flexibly Coupled	Vertical, Flexibly Coupled	Vertical, Flexibly Coupled	Vertical, Flexibly Coupled
Minimum Horsepower	15	75	150	150
Inverter Duty Rated	No	No	No	No
Motor Voltage/Phases/Hertz	480/3/60	480/3/60	480/3/60	480/3/60
Enclosure Type	TEFC	TEFC	TEFC	TEFC
Non-reverse ratchet	Yes	Yes	Yes	Yes
Source Testing				
Test Witnessing	Not Witnessed	Not Witnessed	Not Witnessed	Not Witnessed
Performance Testing	2	2	2	2

Vibration Test Level	2	2	2	2
Noise Test Level	2	2	2	2
Functional Testing				
Performance Testing	3	3	3	3
Vibration Test Level	3	3	3	3
Noise Test Level	3	3	3	3
Notes: (1) In use well, field verify prior to procuring the pump and associated equipment.				

END OF SECTION

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SECTION 13122

METAL BUILDING SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Prefabricated metal building systems.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.

B. American Institute of Steel Construction (AISC):
   1. 303 - Code of Standard Practice for Steel Buildings and Bridges.
   2. 360 - Specification for Structural Steel Buildings.

C. American Iron and Steel Institute (AISI):
   1. SG02 - North American Specification for the Design of Cold-Formed Steel Structural Members.

D. ASTM International (ASTM):
   1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   4. A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
   5. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
   6. A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   7. A792 - Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
   8. B187 - Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.
   9. B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
   10. D1494 - Standard Test Method for Diffuse Light Transmission Factor of Reinforced Plastics Panels.
   11. F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
   12. F436 - Standard Specification for Hardened Steel Washers.

13. F1852 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

E. American Welding Society (AWS):
   1. D1.1 - Structural Welding Code - Steel.
   2. D1.3 - Structural Welding Code - Sheet Steel.

F. California Code of Regulations (CCR):
   1. Title 24 - Building Standards Code.

G. FM Global (FM).

H. International Accreditation Service (IAS):
   1. AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems.

I. Metal Building Manufacturing Association (MBMA):
   1. Metal Building Systems Manual.

J. Occupational Safety and Health Administration (OSHA):
   1. Occupational Safety and Health Standards:
      a. 1910.23 - Guarding floor and wall openings and holes.

K. Research Council on Structural Connections (RCSC):
   1. Specification for Structural Joints Using High Strength Bolts.

L. Society for Protective Coatings (SSPC):
   1. SSPC-SP2 - Hand Tool Cleaning.

M. Steel Door Institute (SDI):
   1. A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

N. Underwriters' Laboratories, Inc. (UL).
   1. 580 - Tests for Uplift Resistance of Roof Assemblies.

1.03 DEFINITIONS

A. Primary framing: An assemblage of beams and columns that support the secondary framing members, and that collects loads to transfer to the building foundation.

B. Secondary framing: Members which directly support roof, wall, or floor surfaces and convey loads to the primary framing.

1.04 SYSTEM DESCRIPTION

A. System:
   1. Design: Furnish metal building with vertical walls, single-slope roof, and with column layout as indicated on the Drawings**.**
   2. Size:
      a. Furnish metal building of the size and configuration indicated on the Drawings.

b. Coordinate manufacturer's design dimensions for metal building system components, including columns, with equipment foundations, and details indicated on the Drawings.

3. Roof slope: Use a roof slope of 1 inch vertical in 12 inches horizontal or steeper.
4. Provide building with horizontal and vertical bracing where indicated on the Drawings.
5. Column reactions shall be vertical and horizontal only.
   a. No bending moments shall be transferred at column bases.
6. Building indicated on the Drawings is a roof canopy with partial sidewalls only.
7. The building roofing system will be listed for a UL 580, Class 90 designation.

B. Performance requirements:
   1. General:
      a. Design of the metal building structure and its appurtenances shall conform to the requirements of the IBC, the Metal Building Systems Manual, and the requirements of this Section.
         1) Where the Metal Building Systems Manual conflicts with the requirements of this Section, the more restrictive requirements will govern.
      b. Do not include collateral or auxiliary loads in load combinations where dead loads offset other load effects (for example, uplift due to wind loads).
      c. Hot-rolled structural steel sections or welded-up plate sections: Design in accordance with AISC 360.
      d. Cold-formed steel structural members: Design in accordance with the AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
      e. Anchor bolts:
         1) Design anchor bolts to resist column reactions reported from analysis.
         2) Design anchor bolts in accordance with ACI 318 Appendix D for cracked concrete to fail in a ductile manner, yielding the steel section before fracturing the surrounding concrete.
         3) Assume concrete foundation strength, f'c = 4,000 pound per square inch at 28-days.
   2. Loading:
      a. General:
         1) Design building for dead load, live loads, and combinations of loads including unbalanced loads in accordance with the IBC and the MBMA Metal Building Systems Manual, except as modified in this Section.
         2) Reduction in wind, live, or snow loads based on tributary loaded area will not be permitted.
      b . Roof loading requirements:
         1) Live load: Minimum 20 pounds per square foot assumed to act vertically on horizontal projected area of roof.
         2) Ground snow load: Not Applicable.
         3) Rain on snow surcharge load: Not applicable.
      c. Collateral loading: Uniform roof load of 5 pounds per square foot assumed to act vertically on horizontal projected area of roof to account for miscellaneous accessories supported from the structure.
         1) Collateral loading shall be considered a live load.

2) Design primary and secondary framing to support the additional weight of mechanical equipment such as fans, air conditioners, etc. shown on plans.
a) Mechanical equipment weights are in addition to collateral loading.

d. Auxiliary loading:
1) Structural members: Any single point along the secondary roof framing members shall be designed to carry a concentrated load of 200 pounds in addition to the roof live load.
2) Roof panels: Design panels to support a 200 pound load uniformly distributed over a 2 square foot area centered between supporting framing members, without exceeding a panel deflection to span ratio of 1/180 in a 2-span condition.
3) Auxiliary loading shall be considered a live load.
4) Auxiliary is to be considered concurrently with collateral loading.

e. Wind loading requirements: As specified in Section 01614 - Wind Design Criteria.
1) Design roof purlins and structural frames for loads specified.

3. Deflection limitations:
a. Primary frames:
1) Gravity deflection:
a) Live load deflection: L/240.
b) Snow load deflection: L/240.
c) Total load deflection: L/180.
2) Horizontal drift of rigid frames measured at eave indicated on the Drawings:
a) Wind drift limitation: H/100.

b. Secondary framing:
1) Gravity deflection:
a) Live load deflection: L/180.
b) Total load deflection: L/150.
2) Horizontal deflection: L/120.

c. Deflection of roof and wall panels: Span/180.
d. Deflection calculations should be based on the wind loads presented in AISC Design Guide 3.
1) Deflection calculations should be based on the unreduced wind loads required in the IBC (50-year reoccurrence intervals).

4. Climatic conditions:
a. Gutters and downspouts: Design for a rainfall rate of 5 inches per hour.
b. Temperature: Provide for movement (expansion or contraction) caused by a range of ambient temperature of 100 degrees Fahrenheit without detrimental effects.

1.05 SUBMITTALS

A. Product Data:
1. Manufacturer's installation instructions.
2. Manufacturer's standard color charts and profiles:
a. Exterior wall and roof panels.
b. Gutters and downspout trim.

3. Manufacturer's list of approved clamps that may be used to hang suspended items from roof purlins and details of acceptable methods of attachment to purlins.

B. Shop drawings:
   1. Shop drawings: Catalog cuts; design and erection drawings; and other data needed to clearly describe design, materials, construction details, fasteners, and erection.
      a. Erection drawings shall include building dimensions, required foundation footprint, anchor bolt and base plate settings, bracing, main and secondary framing, and sections and details required to fully describe construction of building.
      b. Indicate quantity, size, grade, embedment, and projection, and location of anchor bolts.
   2. Calculations: Submit engineering design calculations for the complete structural system, including coverings and column-to-foundation anchorage, sealed and signed by a Structural Engineer licensed in the state where the project is located.
      a. Clearly indicate foundation reactions at all columns. Identify all applied loads, load factors, and load combinations used to develop the reactions.
      b. Calculations will be submitted for record information only.
         1) Engineer's review of calculations will be for general conformance to the loading requirements of this Section.
         2) The building manufacturer shall remain fully responsible for the structural design and adequacy of the metal building system.
   3. Descriptive data: Submit data for the following items either on the shop drawings or separately: Accessories, each type of flashing, trim closures, caps and similar items, fasteners, doors, roof openings, gutters, and downspouts.

C. Quality control submittals:
   1. Building manufacturer.
      a. If requested by the Engineer, submit a record of manufacturer's metal building systems of similar design manufactured and erected in the 5-year period preceding the bid date for this project.
         1) Include date of installation, location of metal building, and name and address of Owner.
      b. Submit evidence of manufacturer's certification under IAS AC472 Accreditation.
         1) Certification must be valid for the facility at which the metal building will be fabricated.
      c. Confirmation of UL 580 wind uplift rating.
   2. Erector:
      a. Submit welder qualification certificates.

D. Record documents:
   1. 1 set of reproducible "Record Drawings" for the erected structure.
      a. Drawings shall bear the seal and signature of a Structural Engineer, registered in the state where the work is constructed and who provided responsible charge for the design.

E. Closeout submittals: Submit Contract Closeout Submittals as specified in Section 01770 - Closeout Procedures.
   1. Operating and Maintenance Information.
   2. Warranty.
   3. Certificate of Compliance: At the completion of the metal building manufacture, the manufacturer will furnish a letter to the Engineer stating that the work was performed in accordance with the approved construction documents.

1.06 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer shall have been engaged in the design, manufacture, and erection of metal building systems of the type specified for at least 5 years preceding the Bid Date of this Contract.
   1. Building manufacturer shall be certified by IAS AC472 Accreditation.
   2. The manufacturer's Engineer of Record shall hold current license as a Structural Engineer in the state where the work will be constructed.

B. Erector qualifications: Erectors shall be trained, approved, and certified by the manufacturer prior to Bidding of the Project. Erectors shall demonstrate at least 3 years' experience in successfully erecting metal building systems of the type specified in the Drawings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver materials and fabrications to the job site in manufacturer's original containers with seals unbroken and labeled with manufacturer's identification and number.

B. Delivery:
   1. Deliver materials dry and undamaged, and store out of contact with ground.
   2. Cover materials with weathertight coverings and keep dry.
   3. Provide good air circulation and protection from surface staining for roof and wall covering sheets.

C. Storage and protection: Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

1.08 WARRANTY

A. Provide Owner with warranty that exterior finish system for metal panels shall be guaranteed against blister, peeling, cracking, chipping, or material rust-through for a period of 10 years from the date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Buildings: One of the following or equal:
   1. American Buildings Company.
   2. Behlen Building Systems.
   3. Butler Manufacturing Company.

2.02 MATERIALS

A. Primary framing (rigid frames):
   1. Welded plates or hot-rolled steel columns and roof beams, complete with necessary splice or connector plates for bolted field assembly.
      a. Minimum nominal thickness of structural shapes or their elements shall be 1/4-inch.
   2. Welding procedures, welder qualifications, and welding quality standards shall be in accordance with AWS D1.1 and AWS D1.3.
   3. Base, cap, compression plates, and stiffener plates shall be factory-welded in place, and shall have shop-fabricated connection holes.
      a. Provide minimum 4 anchor bolts per column base.
   4. Columns and roof beams shall be fabricated complete with holes in webs and flanges for attaching bracing and roof and sidewall framing.
   5. Shop finishing:
      a. Shop galvanized - hot-dipped:
         1) Hot-dip galvanize members in accordance with ASTM A123.
         2) Provide a minimum zinc coating of not less than 1.4 ounces per square foot.

B. Secondary framing (purlins, girts, framing at endwalls and openings, eave struts, bracing):
   1. Hot rolled structural steel or cold-formed members.
   2. Minimum thickness: 16 gauge.
   3. Bracing elements constructed of wire rope, stranded tendons, or other similar material is not permitted.
      a. Rolled angle sections or solid steel bar is permitted.
   4. Provide factory-punched holes for panel connections.
   5. Shop finishing (hot rolled sections):
      a. Galvanized - hot-dipped:
         1) Hot-dip galvanize members in accordance with ASTM A123.
         2) Provide a minimum zinc coating of not less than 1.4 ounces per square foot.
   6. Shop finishing (cold-formed sections):
      a. Galvanized - hot-dipped:
         1) Hot-dip galvanize members in accordance with ASTM A653 to G90 designation.

C. Roof and wall panels:
   1. Roll-formed minimum 24 gauge steel, factory-finished each side.
   2. Panels shall have interlocking side seams and shall be the manufacturer's maximum standard width Factory cut to maximum possible length to minimize end laps.
   3. Factory pre-punched for fastening.
   4. Panel finish:
      a. Factory pre-painted, pre-finished coating consisting of a UV light-resistant polyvinylidene diflouride (PVDF) resin based paint and primer system having a total thickness not less than 1.0 mil on an approximately 55 percent aluminum-43 percent zinc-1 percent silicone galvanized coating complying with ASTM A792.
      b. The galvanized coating shall be deposited at a minimum rate of 0.50 ounce/square foot.

c. Furnish manufacturer's standard color chart for Owner's selection.

5. Ridge panel: 1-piece, factory formed to match roof slope at each side, of same material as roof panels, and capable of completely sealing roof ridge.

D. Bolted joint components: High-strength steel bolts used for steel-to-steel structural connections.
   1. Galvanized in accordance with ASTM A153.
   2. Bolts: ASTM A325 or A490, Type 1.
   3. Nuts: ASTM A563, heavy hex. Grade and finish to match bolts as specified in RCSC Specification for Structural Joints Using High Strength Bolts.
   4. Washers: ASTM F436; flat unless otherwise noted.
      a. Load indicator devices:
         1) Twist-off type tension-control bolt assemblies: ASTM F1852, with strength level in accordance with ASTM A325.
         2) Compressible washer direct tension indicators: ASTM F959, Type A325 for ASTM A325 bolts.
   5. Bolts furnished for the project shall be a single size and grade.

E. Anchor bolts or anchor rods: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry except that material shall be Type 316 stainless steel unless otherwise indicated on the Drawings.

F. Fasteners and washers:
   1. Fasteners and washers used for attachment of wall and roof panels.
   2. Fasteners: Vinyl-coated steel or stainless steel.
   3. Washers: Neoprene or other accepted type washer capable of being used to assure watertightness at fastening locations.

G. Gutters and downspouts:
   1. 24 gauge steel.
   2. Galvanized in accordance with ASTM A653 to G90 designation.
   3. Field painted. Color to be selected by Owner to complement wall panels.

H. Doors and frames:
   1. Provide hinged doors in accordance with published recommendations of SDI A250.8.
      a. Doors and frames shall be Level III.
   2. Provide each door with a heavy duty, corrosion resistant, cylinder lock set to match locks on Master Key System.
   3. Provide weatherstripping and threshold for exterior doors.

I. Touch-up painting materials:
   1. For structural elements:
      a. Galvanized paint.
   2. For sheet metal skin:
      a. Exterior finish paint: Match specified coating.
         1) Color: Color as selected by the Owner.

J. Caulking material: Elastomer type, manufacturer's standard.

2.03 FABRICATION

A. Shop fabrication:
   1. Structural elements:
      a. Fabricate rigid frame of hot-rolled sections or continuously welded plate sections.
      b. Field connections shall be bolted unless otherwise accepted by the Engineer.
   2. Wall panels:
      a. Provide panels that are 1 piece from base to eave and have fasteners located on inside of panels.
      b. Provide top and bottom closures and bottom supports.
   3. Roof panels:
      a. Panel splicing: Panels may be spliced with minimum end overlap of 9 inches at purlins.
      b. Ridge panel: Provide 1 piece ridge panel, factory formed to match roof slope, of same material as roof panel, and capable of completely sealing roof ridge.
      c. Expansion of roof panels: Provide means to allow expansion of roof panels.
   4. Fasteners for roof and wall panels:
      a. Fasteners: Secure with fasteners that assure maximum weathertightness, proper bearing surface, and permanent seal at point of fastening.
      b. Washers: Use washers capable of assuring watertightness at fastening locations.
   5. Accessories:
      a. Gutters, downspouts, and hangers:
         1) Provide 4-inch gutters, downspouts, and hangers as indicated on the Drawings.

B. Tolerances:
   1. Hot-rolled sections: In accordance with AISC 303.
   2. Cold-formed and Built-up sections: In accordance with MBMA Metal Building Systems Manual.

2.04 SOURCE QUALITY CONTROL

A. General.
   1. Components of the metal building system fabricated in the manufacturer's shop will not be subject to special inspection, as specified in this Section.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Verify site conditions prior to start of work. Unacceptable conditions shall be reported to Engineer.
   2. Starting of erection of metal building system work shall indicate acceptance of existing conditions.

a . Manufacturer or manufacturer's trained erector shall review and examine existing site conditions, foundation, and surface preparation, and adequacy of site-prepared components prior to commencing erection of the building.

3.02 ERECTION

A. General:
1. Erect in accordance with the MBMA, Metal Building Systems Manual and manufacturer's instruction, except as modified in this Section.
2. Separate dissimilar materials with gaskets or suitable insulating coatings.
3. Keep exposed surfaces clean and free from sealant, metal cuttings, and other foreign materials.

B. Framing and structural members:
1. Set anchor rods by template and securely tie into formwork before concrete placement.
2. Provide uniform bearing under baseplates and sills by filling using a nonshrinking grout as specified in Section 03600 - Grouting.

C. Walls and roof:
1. Erect a structure that will be free from water leaks and meet design requirements.
2. Direct side lap edges away from the prevailing winds at the site.
3. Do not exceed the maximum fastener spacings specified.
   a. Space fasteners uniformly not to exceed: 8 inches on center at ends of covering, 12 inches on center at intermediate supports and at roof covering side laps, and 18 inches on center at wall covering side laps.
4. Install fasteners in straight lines within a tolerance of 1/2 inch per bay.
5. Seal side laps, ends of roof, wall coverings, and joints at accessories.
   a. Drive fasteners to the surface and seat gasketed heads and washers.
6. Fasten accessories to framing members, except as otherwise accepted by the Engineer.
7. Wall panels shall be isolated from concrete floor slab and/or foundation.
8. Flashing shall be provided at the base of wall panels to prevent wind-driven rain from entering the building envelope.

D. Gutters and downspouts:
1. Attach securely to the building.
2. Install gutters sloped to drain with adequate provisions for expansion and contraction.

3.03 FIELD QUALITY CONTROL

A. General.
1. Installation of metal building system will be subject to special inspection and evaluation during construction, as specified in this Section.

B. Site inspection.
1. Special inspection of the metal building system components will be performed at the time and frequency outlined in Schedule 13-1.
2. The elements of the metal building system construction that will be subject to special inspection are as indicated in Attachment 13-1.

3.04 ADJUSTING

A. Field painting:
   1. Prepare and touch up abraded or corroded spots on shop-primed coated surfaces immediately after erection.
      a. Use the same material as was used for the shop coat.

B. Touch-up factory finished surfaces of roof and wall panels with the manufacturer's recommended paint where damaged or abraded.

C. Where shop processes such as shearing or punching leave edges of galvanized steel unprotected by galvanization, touch up unprotected edges as specified in this Section.

D. Galvanized surfaces: Repair damaged galvanized surfaces in accordance with ASTM A780.

3.05 CLEANING

A. Remove excess materials, equipment, and debris incidental to this work upon completion.

3.06 PROTECTION

A. During erection, the erector shall be responsible for the protection of this and all adjacent work from damage.

END OF SECTION

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SECTION 13207

WRAPPED PRESTRESSED CONCRETE TANKS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes requirements for the design and construction of prestressed circular concrete tanks.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions.

B. Qualifications and experience with the design and construction of prestressed concrete tanks.

C. Design criteria and fully detailed working drawings for the prestressed concrete tank as specified.

D. If a sliding water stop is used in the floor/wall joint, submit load/shear/deflection data to support shear and deflection calculations for base of wall. Tests must have been generated for the particular water stop configuration proposed.

E. Concrete and Grout mix design and strength test results of trial mixes for all concrete per Section 03300 - Cast-in-Place Concrete.

F. Joint materials per Section 03150 - Concrete Accessories.

G. Mill certificates for prestressing steel and for appurtenant materials and work specified elsewhere in these specifications.

H. Forming construction plans including location of piping, access holes, and embedded items.

I. Prequalifications as described herein.

J. Prestressed Concrete Tank Design:
   1. Design calculations and shop drawings showing details and procedures of construction in sufficient detail to show compliance with these specifications and all required standards shall be submitted to the Owner for review within 60 days after receipt of notice to proceed. After review by the Owner, one set of the accepted drawings and calculations will be returned to the Contractor. Make any revisions found necessary by the Owner and resubmit prior to final acceptance for construction by the Owner.
   2. The design review by the Owner of the drawings and calculations submitted by the Contractor will not in any way relieve the Contractor of full responsibility for the accuracy and completeness of the drawings and calculations.
   3. All tank design calculations and shop drawings shall be stamped by a professional engineer registered in the State of Florida.

K. Guarantee Document: Submit guarantee document in Owner's name in accordance with Section 1.05 of the specifications.

L. Approved manufacturers per County USSM: Crom Corporation, Precon Corporation, or approved equal.

1.03 QUALIFICATIONS AND EXPERIENCE

A. The tank constructor shall be qualified in the design and construction of continuously wire-wound circular prestressed composite tanks. The tank constructor shall have had at least five years' experience in the specialty and shall have built completely in its own name in the past five years no less than 5 prestressed composite tanks of comparable size demonstrating satisfactory service.

B. The tank constructor staff shall include a full-time professional engineer registered in the state of Florida having no less than 5 years' experience in the design and field construction of circular prestressed composite tanks. The staff registered engineer shall be in responsible engineering charge of the work specified. Working drawings and design calculations shall carry the seal of such registered professional engineer.

C. The constructor shall have on the project site at all times during erection a field superintendent with a minimum of five years' qualified experience in the work being performed.

1.04 SYSTEM DESCRIPTION

A. Tanks shall consist of:
   1. Cast-in-place concrete floor.
   2. Prestressed composite wall with steel diaphragm.
   3. Clear span dome roof.
   4. Accessories to include:
      a. Supports for exterior Aluminum staircase.
      b. Aluminum staircase
      c. Liquid level indicator.
      d. Interior fiberglass ladder.
      e. Center vent.
      f. Off center vent
      g. Roof hatches.
      h. Manhole.
      i. Precast concrete overflows sized for a 5-million-gallon tank volume with a positive slope between each overflow.
      j. Handrail as shown on 40M01.
      k. Fall Protection System

B. The design shall be in conformance with ACI Title 372R-03 and AWWA D110-04, Type II.

1.05 CODES AND STANDARDS

A. ACI 372R-03 - Design and Construction of Circular Wire - and Strand-Wrapped Prestressed Concrete Structures.

B. AWWA D110-04 - Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks.

C. AWWA C652 - Disinfection of Potable Water Storage Tanks.

D. ACI 506R - Guide to Shotcrete as outlined in publication CP-60.

E. ASTM A821/A821M Type B - Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks.

1.06 DESIGN CRITERIA

A. Design Method: AWWA D110.

B. Design:
1. Number of Tanks: 1.
2. Nominal Capacity: 1.0 MG.
3. Inside Diameter: 90 feet 0 inch.
4. Sidewall Depth: 21 feet 1 inch.
5. Maximum Process Water Surface Depth (Above Floor): 21 feet 1 inch.
6. Live Load on Roof: 12.0 psf.
7. Soil Bearing Capacity Including Soil and Liquid Loads: Refer to Madrid Engineering Group, Project No. 12818 Geotechnical Engineering Report Proposed Gibson Oaks WPF, Lakeland Florida dated December 14, 2017.

C. Wall Base: Waterstop bearing pad.

D. Roof Design: AWWA D110, Section 3.6.

E. Floor Slab Design: AWWA D110.

F. Floor Slab Thickness: 4.0 inches minimum.

G. Floor Slab Reinforcement Clear:
1. Top: 1.0 inch minimum.
2. Bottom: 1.5 inches minimum.
3. Slab Base Material: For slab base material preparation refer to Geotechnical Report.

1.07 ALLOWABLE MATERIAL DESIGN STRENGTHS AND STRESSES

A. Concrete Compressive Strength: fc = 4,000 pounds per square inch at 28 days.

B. Shotcrete Compressive Strength: fg = 4,000 pounds per square inch or greater at 28 days.

C. Allowable Compressive Stress: fg = 1,250 pounds per square inch + 75t pounds per square inch/in with 0.45 fg maximum (t = thickness of core wall), with a maximum of 2,000 pounds per square inch.

D. Allowable Compressive Stress Due to Initial Prestressing Force: fgi = 1,250 + 75t with 0.5 fgi maximum or less, with a maximum of 2,250 pounds per square inch (where fgi is defined as compressive strength at time the initial prestressing force is applied).

E. Prestressing Wire Size (Diameter): 0.162 inch (8 gauge), 0.192 inch (6 gauge), or larger, but no larger than 0.250 inch.

F. Working Stress, Wall: fs = 115,000 pounds per square inch.

G. Working Stress, Dome Ring: fsd = 120,000 pounds per square inch.

H. Allowable Tensile Stress Before Losses: fsi 145,000 pounds per square inch or no greater than 0.63 f's.

I. Ultimate Tensile Strength: fu = 231,000 pounds per square inch or greater for 8 gauge and 222,000 pounds per square inch or greater for 6 gauge.

J. Reinforcing Steel:
   1. Allowable Tensile Stress: fs = 18,000 pounds per square inch.
   2. Yield Strength: fy = 60,000 pounds per square inch.

1.08 SAMPLING STATION

A. The ground storage tank shall include a sampling station with 3 sample ports servicing varying height and locations within the tank as shown in the drawings.

PART 2 MATERIALS

2.01 TANK DESIGN

A. Prestressed concrete tanks shall consist of shotcrete core walls with a continuous steel shell diaphragm embedded therein, vertical reinforcement steel, prestressed steel circumferentially wound, and shotcrete cover coats. Posttension duct systems are not permitted. Construct the floor slab of cast-in-place concrete.

B. The tank floor shall be of concrete containing no less than 0.625 percent reinforcing steel in each orthogonal direction.

C. The wire-prestressed composite wall shall consist of a shotcrete core wall encasing a steel shell diaphragm continuous the full wall height. All prestressing shall be done with high tensile wire, permanently bonded to the tank wall.

D. The tank roof shall be a circumferentially prestressed free-span dome of concrete or shotcrete construction containing no less than 0.25 percent reinforcing steel in each orthogonal direction.

E. Coordinate tank design with aerator supports prior to submitting tank design shop drawings.

2.02 CONCRETE ADMIXTURES

A. Do not use admixtures containing chlorides, fluorides, sulfides, or nitrates in any concrete mix for prestressed concrete tanks.

2.03 CONCRETE MIX DESIGN

A. Conform to Section 03300 - Cast-in-Place Concrete except as modified herein.

B. A maximum of 25 percent of cementitious material may be fly ash for all concrete mixes.

C. Use classes of concrete as described in the following table as minimum requirements:

Type of Work	Minimum 28-Day Compressive Strength (in pounds per square inch)	Minimum Cement Content (lbs/C.Y.)
Tank Roof	4,000	611
Tank Floor and Footings	4,000	564
Wall Shotcrete	4,000	658
All Other Concrete	3,500	564

D. Slump shall be as follows:
1. Prestressed Tank Roof and Floor: 3 to 5 inches.
2. Walls and Columns (for normal construction): 3 to 5 inches.
3. Walls and Columns (for encasing steel bars and wires): 6 inches maximum.

2.04 SHOTCRETE

A. Shotcrete shall be composed of portland cement, sand, and water applied as a "wet mix." Shotcrete mixes, measured by weight, shall be:
1. First coat on steel shell diaphragm and prestressing wire: one part cementitious material to three parts sand.
2. All other shotcrete: one part cementitious material to four parts sand.
3. Up to 25 percent of cementitious materials may be fly ash.

B. Cement shall be in accordance with Section 03300 - Cast-in-Place Concrete.

C. Do not use admixtures containing chlorides, fluorides, sulfides, or nitrates.

D. Sand shall conform to ASTM C33 for concrete sand.

E. Core Wall Shotcrete shall attain 4,000-pounds per square inch compressive strength at 28 days.

F. Covercoat Shotcrete shall attain 4,000-pounds per square inch compressive strength at 28 days.

G. Maximum Shotcrete Slump: Refer to 2.03 D.

2.05 PRESTRESSING REINFORCEMENT

A. Conform to ASTM A821/A821M Type B.

2.06 WATER STOPS

A. Water stops shall be PVC and shall meet the minimum requirements in accordance with CRD-C572.

2.07 NEOPRENE BEARING PADS

A. Per AWWA D110, paragraph 2.5.

2.08 SPONGE FILLER

A. Per AWWA D110, paragraph 2.5.3.

2.09 EPOXY INJECTION SEALANT

A. The epoxy sealant shall be suitable for bonding to concrete, shotcrete, and steel. The sealant shall conform to the requirements of ASTM C881/C881M, Type III, Grade 1 and shall be a 100 percent solids, moisture insensitive, low modulus epoxy system. When pumped, maximum viscosity of the epoxy shall be 10 poises at 77 degrees Fahrenheit.

2.10 STEEL SHELL WALL DIAPHRAGM

A. Use a 26-gauge (minimum thickness of 0.017 inch) steel tank shell, complying with ASTM A1008 or ASTM A653/A653M, within and throughout the core wall, providing a positive water stop. For weight of zinc Weight of zinc coating shall not be less than G 90 of Table 1 of ASTM A653/A653M.

B. Encase the steel shell diaphragm with concrete no less than 1 inch thick.

C. Form and erect the steel shell such that a mechanical key between the concrete or shotcrete and diaphragm will be created.

D. Seal joints in the diaphragm watertight with epoxy.

E. The steel shell design and its sealing procedure shall have been used and proven satisfactory in five previously constructed tanks.

F. Do not make nail or other holes in the steel shell except for inserting pipe sleeves.

2.11 DOME ROOF

A. Construct the dome roof of reinforced concrete, circumferentially prestressed. Dome shell reinforcement shall consist of reinforcing steel bars or welded wire fabric meeting ASTM A185, not galvanized. Bolsters for wire fabric and reinforcing bars shall be plastic tipped. Wire ties shall be galvanized.

B. Design the dome shell as a free span, spherical thin shell, with a 1/10 rise. The dome ring girder shall be prestressed with sufficient wire to withstand the dome dead load and design live loads. The ring girder shall have a cross-section suitable to accept the applied prestressing forces. Coat surfaces in the wall/dome ring girder joint bonding epoxy.

C. The high water level in the tank shall be permitted to encroach on the dome shell no higher than the upper horizontal plane of the dome ring girder. Provide overflow outlets on the dome roof in such numbers as will provide an overflow open area three times the area of the largest tank pipe.

D. Dome Design: The dome thickness and steel reinforcement shall meet the requirements of AWWA D110, Section 3.6.3. In all cases, the thickness of the dome shall be no less than 3 inches.

E. Dome Edge Design: The dome edge and upper wall shall be designed to resist the moments, thrusts, and shears that occur in this region due to dome and wall prestressing and loading conditions. The following design parameters shall be used:
   1. Dome Edge:
      a. Sufficient concrete thickness at the springline of the dome shall be provided so that no more than 3 feet of the springline haunch is considered in calculating the effective dome edge ring cross-sectional area. Compressive stress in this area shall not exceed 1,000 pounds per square inch when subjected to initial prestressing, offset by dead load only.
   2. Dome Edge Steel Reinforcement:
      a. Throughout the dome edge, the percentage of steel reinforcement, both radially and circumferentially, shall be no less than 0.25 percent of the gross cross-sectional area of concrete.
      b. Along the dome edge, steel reinforcement shall be distributed between the upper and lower layers unless finite element analysis calculations indicate that tensile stress does not exist in the concrete along the bottom face of the dome edge. In that case, only top bars are required radially and circumferentially. In addition, radial and circumferential reinforcing bars will not be required along the bottom face of the dome edge where the calculated typical dome thickness is less than 75 percent of the actual typical dome thickness.
      c. Where reinforcing bars are required in the bottom layer, they shall be anchored near the tank wall to ensure adequate development at the intersection between dome and wall.
      d. In all cases, the percentage of circumferential steel reinforcement in the first 2 feet of the dome edge shall be no less than 1 percent of the gross cross-sectional area of concrete.
      e. Where bottom dome edge steel reinforcement is required, vertical steel reinforcement along the inside face of the tank wall shall be no less than 0.5 percent of the cross-sectional area of wall shotcrete.

2.12 AERATOR

A. Provide one natural draft, cascade-type, fiberglass aerator, with a fiberglass aerator house and other appurtenances, utilizing an induced draft fan to provide aeration of water. Refer to the drawings for detail of the aerator and piping.

B. Design the aerator and anchorage system per the requirements supplemented by structural drawing design criteria.

C. Material Composition:
   1. Construct tray supports, roofs, braces, stiffeners, and screen molding of polyester resin reinforced with not less than 30 percent by weight of glass fiber. Polyester resins shall be Owens-Corning OC37B, ADM 7433T-16, or equal. Glass fiber shall be Type C or E, 10 to 20 mils thick, and strands shall not be larger than No. 130. The resin shall not contain fillers, except up to 5 percent thixotropic agent may be added. Pigments may be added to achieve color. Minimum thickness of any section shall be 0.15 inch. Construct braces, trays, roof, and columns reinforced to prevent sagging or buckling.
   2. Add pigmentation to the gel coat only to provide ultraviolet radiation resistance and to produce an opaque surface of a selected color. Colors shall be light-stable with uniformity of color among the parts of the installation. Mold exposed surfaces with a colored gel coat so as to give them long-time resistance to ultraviolet light and weather conditions.
   3. Use sufficient catalyst and accelerator to achieve a rapid and thorough cure.

D. Aerator House: Enclose the aerator house with FRP panels. Provide one panel with an outlet pipe as sized in the drawing. Extend this pipe down to the FRP fan (at grade) that will draw air through the aerator house. Provide three replaceable screen panels with 24 by 24 mesh vinyl-coated glass fiber screen, located opposite the outlet panel. Provide access into the aerator house by means of a removable screened panel fastened with wing nuts. When closed, the removable panel shall be tight fitting to prevent insect entry.

E. Cascade Trays: Overlap the cascade trays in adjacent tiers so that the tray below is centered under the open space of the tray above. Manufacture and install the trays so that the weir edges are straight and level. Each tier shall have an equal number of trays. Provide drain hole so that each tray can fully drain. Provide drain plug for field testing.

F. Columns: Anchor aerator columns to aerator house curb with minimum 1/4-inch by 1-1/2-inch machine bolts or 1/4-inch by 2-1/4-inch expansion bolts.

G. Metal Anchorage: Metal bolts, nuts, washers, connectors, screws, and other fasteners shall be Type 316L stainless steel.

H. Screening: 24 x 24 mesh vinyl-coated glass fiber.

I. Aerator Service conditions shall be as described below:

Location:	Gibson Oaks Water Production Facility
Capacity:	4,000 gallons per minute
Number of Levels:	3
Total Number of trays:	18

2.13 BAFFLE WALL

A. Provide a CMU wall within the center of the tank to baffle the raw water for disinfection purposes. Discharge from the aerator and bypass shall enter the tank opposite of the wall from the pump suction piping. The wall shall provide the longest path of travel for the disinfected raw water. Refer to the drawings for the baffle wall detail.

2.14 REINFORCING STEEL

A. Conform to ASTM A615, Grade 60.

B. Wire supports shall be carbon steel conforming to ASTM A1064.

2.15 PAINT AND COATING

A. The Ground Storage Tank shall be coated in accordance with the following. The color shall be specified by the Owner with respect to the Service Condition.
   1. Exterior Coating System:
      a. Prepare concrete surfaces in accordance with the manufacturer's recommendations.
      b. Prime and Finish Coat:
         1) Two coats of Tnemac Series 156, Carboline, Sherwin Williams or equal. Apply to thickness of 8.0 mils per coat.
   2. Interior Coating System:
      a. Apply interior coating to all interior walls, interior CMU walls and dome.
      b. The Interior coating shall be compliant with NSF 61.
      c. Prime Coat:
         1) As required for compatibility with the Intermediate coats.
      d. Intermediate and Finish Coat:
         1) Apply the manufacturer’s recommended number of coats to attain the specified minimum coating thickness. Products: Carboline Carboguard 891HS, Tnemec N140, Sherwin-Williams Tank Clad HS B62-W80/B60-V80, or equal; 16 mils total.

2.16 LADDERS

A. All Ladders and Staircases shall conform to Owner, state, and OSHA requirements.
   1. Exterior Staircase:
      a. The design of the staircase shall be the responsibility of the Manufacturer of the Ground Storage Tank. The design of the staircase shall be developed by a Licensed Professional Engineer in the State of Florida. The general arrangement of the staircase and landings shall be as shown in the Drawings.
      b. Aluminum shall be Alloy Type 6061-T6 with Type 316 Stainless Steel fasteners.
      c. Aluminum design, detailing, fabrication and erection shall conform to the latest edition of the Aluminum Construction Manual.
      d. Aluminum in contact with, or embedded, in concrete shall be coated with an alkali resistant bituminous coating system.
      e. All bolts used in connection with Aluminum members shall be stainless steel A316. Provide minimum of 2 bolts per point of connection. Provide galvanic separation where aluminum is contact with steel.

f. All welding of aluminum structures shall conform to "Structural Welding Code - Aluminum," AWS D1.2, Latest Edition.
g. The design live load for the staircase shall be 100 pounds per square foot.

2. Interior Ladder:
   a. Equip the interior ladders with a ladder-centered notched safety climbing tube of ASTM A276, Type 316 Stainless Steel. Provide storage brackets and box mounted on the handrail for the removable portion of the tube which extends above the roof hatch. Provide three sets of safety belts and sleeves.
   b. Construct the interior ladder of fiberglass with Type 316 Stainless Steel fasteners.

2.17 HATCH COVER

A. Laminated fiberglass reinforced polyester resin at least 3/16-inch-thick with sufficient stiffeners to support a live load of 400 pounds. Provide corrosion-resistant hinges and Type 316L stainless-steel fasteners. Minimum inside dimensions are as indicated on the drawings.

2.18 VENTILATORS

A. Roof vent shall be fiberglass with type 316 stainless steel fasteners. Underside and sides of vent shall be covered with 24/24 mesh polypropylene screen.

2.19 WALL MANHOLES

A. Stainless steel frame with stainless steel cover and stainless steel bolts, all Type 316.

2.20 LIQUID LEVEL INDICATOR

A. Fiberglass with Type 316 stainless steel fasteners.

2.21 SAMPLING STATION

A. The ground storage tank shall include a sampling station with three ports located at varying height and locations within the tank and through the wall as shown in the drawings. The sample piping shall be as shown in the drawings. The sample valves shall be 316SS ball valves in accordance with Section 15211 - Ductile Iron Pipe: AWWA C151. Provide a 316L stainless steel box with doors and hinges to cover the sample ports shown in the drawings. The box will include a drain pan sloped to the drain piping at the bottom as shown in the drawings.

2.22 THROUGH-WALL PIPE SLEEVES

A. Type 316 stainless steel sleeves with neoprene modular seal units using stainless steel tightening bolts.

2.23 GUARDRAIL

A. Provide aluminum handrails around the top of the tank as shown on plans and specified in Section 05500 - Metal Fabrications. Fasten with Type 316 stainless steel fasteners. The industrial guard rail height and spacing will be per FBC CH 10, 1032.1. The system shall be compliant with all current standards and design criteria dictated by the United Stated Occupational Safety and Health Administration. The system shall be designed by an Engineer Licensed in the State of Florida. The system shall be submitted for review by the Owner and Engineer as part of the submittal process. The submittal shall include all materials of construction, assumptions, loads, etc.

2.24 PRECAST OVERFLOWS

A. Integrally cast overflows as part of dome. Calculate proper opening size to ensure the safety of the tank (submit with calculations). Coordinate the maximum rate of overflow with the Engineer. Provide a minimum of 4 vertical opening areas of at least 675 square inches. Cover opening with 24/24 mesh polypropylene screen. supported in a removable fiberglass frame. Provide type 316 stainless wing nut fasteners. Invert of overflow is to be set above the high water level.

2.25 TANK HARDWARE

A. All Tank Hardware (fasteners, anchor bolts, nuts, bolts, screws, etc.) for all Work to be performed shall be Type 316 stainless steel.

2.26 FALL PROTECTION SYSTEM

A. The tank manufacturer shall provide the design and installation of a fall protection system around the perimeter handrail of the tank. The system shall be compliant with all current standards and design criteria dictated by the United Stated Occupational Safety and Health Administration. The basis of the system shall be perimeter cable system mounted along the roof of the tank adjacent to the perimeter handrail. The system will be for Operators to harness into with a typical personal fall arrest system using body harness and locking snap hooks. The system shall be designed by an Engineer Licensed in the State of Florida with experience in design of safety systems to serve as the Safety System Design Engineer. The system shall be submitted for review by the Owner and Engineer as part of the submittal process. The submittal shall include all materials of construction, assumptions, loads, etc. and be signed and sealed by the Safety System Design Engineer. Following the construction of the tanks and prior to acceptance by the Owner, the Safety System Design Engineer shall inspect the installation by the Contractor and provide a Certification Letter confirming that the system was installed in accordance with design prepared and submitted.

PART 3 EXECUTION

3.01 CONSTRUCTION TOLERANCE

A. Comply with the following tolerances or allowable deviations for the circular tank exterior wall:

Vertical Alignment in Total Wall Height:	±1/2 inch
Out-of-Round:	±3/4 inch/diameter ±1/2 inch/ 100-foot circumference
Horizontal Gap Between Prestressing Strand and Wall Surface:	3/16 inch

B. Transitions from plus to minus tolerance shall be gradual, even, and smooth.

3.02 CONCRETE JOINTS AND WATER STOPS

A. Concrete joints and water stops shall conform to Sections 03150 - Concrete Accessories and 03300 - Cast-in-Place Concrete and as specified herein.

B. Splice water stops at intersections between wall, wall footing, and floor slab water stops as applicable.

C. Bend up horizontal water stops during placing of concrete until the concrete has been brought to the level of the water stop. Place additional concrete over the water stop and vibrate thoroughly.

D. Securely bond the water stop to the core wall to provide a complete and continuous water barrier.

3.03 CONCRETE FINISHES

A. Conform to Division 03 except as modified herein.

B. Roof: Light broom finish.

C. Wall: Light broom or sponge finish inside, light broom or sponge finish exterior.

D. Floor Slab: Light broom finish.

3.04 CONCRETE CURING

A. Conform to Division 03.

3.05 SHOTCRETE PLACING, CURING, AND FINISHING

A. Conform to ACI 506 as outlined in publication CP-60.

B. Broom each shotcrete layer prior to final set to effect satisfactory bonding of the following layer. Do not apply shotcrete to reinforcing steel or diaphragm that is encrusted with overspray. No less than 1/8-inch-thick shotcrete shall separate reinforcing steel and prestressing wire.

3.06 FLOOR CONSTRUCTION

A. Concrete membrane floors shall be a minimum of 4-inch thick and have a minimum thickness of 8 inches of concrete over all pipe encasements and around sumps. The minimum percentage (0.625 percent) of reinforcing steel applies to these thickened sections and shall extend a minimum of 2 feet into the adjacent membrane floor.

B. Floors shall be vibratory screeded to effect consolidation of concrete and proper encasement of floor reinforcing steel.

C. Floors shall be continuously water cured until tank construction is completed.

3.07 CORE WALL CONSTRUCTION

A. Construct the core wall of shotcrete, encasing a steel shell diaphragm continuously the full wall height without horizontal splices. Design the thickness of the core wall to accept the initial compressive forces applied by prestressing, backfill, and other loads, but in no case be less than 3-1/2 inches thick. The wall may taper uniformly on the inside face from top to bottom as required by design computations. Horizontal sections of the wall shall form true circles without flats, excessive bumps, or hollows. Vertical laps in metal diaphragms shall be interlocking or telescoping and sealed watertight by epoxy injection. No holes are allowed in the metal diaphragm shell except for inserting pipe sleeves and manholes.

B. To compensate for bending moments and for shrinkage, differential drying, and temperature stresses, incorporate the following reinforcing steel in the core wall:
   1. The top 2 feet of core wall shall have not less than 1 percent circumferential reinforcing.
   2. The bottom 3 feet of core wall shall have not less than 1 percent circumferential reinforcing.
   3. Inside Face:
      a. 26-gauge galvanized steel shell diaphragm continuously the full wall height without horizontal splices.
      b. Additional vertical and horizontal reinforcing steel bars as required by design computations.
   4. Outside Face:
      a. Vertical Reinforcing Steel: Minimum of No. 4 bars at 12 inches center-to-center.
      b. Additional vertical and horizontal reinforcing steel bars as required by design computations.
   5. Water cure interior and exterior surfaces of the core wall for a minimum of 7 days or until prestressing starts.

3.08 STEEL SHELL DIAPHRAGM CONSTRUCTION

A. Provide a 26-gauge (minimum) steel tank shell within and throughout the core wall, providing a positive water stop. The steel shell diaphragm shall be encased and protected with shotcrete no less than 1 inch thick at all places. Form and erect the steel shell so that a mechanical key between shotcrete and diaphragm will be created. The sheets of steel diaphragm shall be continuous from top to bottom of wall; horizontal joints or splices will be not permitted.

B. Seal vertical joints in the diaphragm watertight by epoxy injection.

C. Carry out epoxy injection from bottom of wall to top of wall, using a pressure pumping procedure, after the steel shell has been fully encased, inside and outside, with shotcrete.

D. The steel shell design shall have been used in the 10 tanks required in the tank construction company's experience record. No nail or other holes shall be made in the steel shell for erection or other purposes except for inserting pipe sleeves, reinforcing steel, bolts, or other special appurtenances. Seal such penetrations with epoxy sealant.

E. In all tanks designed to use a water stop at the floor/wall joint, the steel shell diaphragm shall be epoxy bonded to this water stop.

3.09 HORIZONTAL PRESTRESSING

A. Achieve circumferential prestressing of the tank by the application of cold-drawn, high-carbon steel wire complying with ASTM A821/A821M, Type B, placed under high tension. Provide an allowance for prestressing losses due to shrinkage and plastic flow in the shotcrete and due to relaxation in the prestressing steel.

B. Place the prestressing steel wire in a continuous and uniform helix of such pitch as to provide in each lineal foot of core wall height an initial force and unit compressive stress equivalent to that shown in the drawings. Splice wire only when completing the application of a full coil of wire or when removing a defective section of wire.

C. Areas to be prestressed shall contain not less than 10 wires per foot of wall for 8 gauge and eight wires per foot of wall for 6 gauge. Provide a maximum of 24 wires per layer per foot for 8 gauge and 20 wires per layer per foot for 6 gauge. Provide shotcrete to completely encase each individual wire and protect it from corrosion. To facilitate this encasement, the clear space between adjacent wires shall be no less than one wire diameter.

D. Accomplish prestressing by a machine capable of continuously inducing a uniform initial tension in the wire before it is positioned on the tank wall. Tension in the wire shall be generated by methods not dependent on cold working or re-drawing of the wire. In determining compliance with design requirements, the aggregate force of all tensioned wires per foot of wall shall be considered rather than the force per individual wire, and such aggregate force shall be no less than that required by the drawings.

3.10 MEASUREMENT OF WIRE STRESS

A. The tank construction company shall supply equipment at the construction site to measure tension in the wire after it is positioned on the tank wall. This stress-measuring equipment shall include electronic direct reading stressometer accurate to within 2 percent, calibrated dynamometers, and test stand to field verify the accuracy of the stressometer. Record the initial tension in each wire.

3.11 CIRCUMFERENTIAL PRESTRESSING

A. Stressing System: Prestress walls circumferentially by prestressing reinforcement that is wound into the wall at the uniform load indicated in the working drawings. Provide the stressing system with means to monitor the force in the strand at any location around the wall and maintain the force in the reinforcement within a tolerance -2 percent to +2 percent of the initial force indicated in the reviewed drawings. Maintain a written record of stress reading and give to the Owner at the completion of the prestressing work.

3.12 PRESTRESS STRESSES

A. The initial force indicated in the reviewed drawings will be based on an initial stress not exceeding 75 percent of the minimum ultimate stress in the reinforcement including allowances for stress losses.

B. The aggregate force of all stressed wires per foot shall be considered in addition to the force per individual wire, and such aggregate force shall not be less than required design values. No circumferential movement of the wire along the tank will be permitted during or after stressing of the wire.

C. Provide stress-measuring equipment capable of measuring forces in the wire during or after it is in place. The equipment shall be certified test calibrated within 30 days prior to use on the project and immediately following final force determinations.

3.13 APPLICATION

A. Anchor each reel of prestressing wire to the wall to minimize the loss of wire in case of a wirebreak. Anchor one wire to a previously wrapped wire permanently. Join prestressed reinforcements by splices that will develop 100 percent of the guaranteed ultimate strength of the wire. Splice material shall be the same alloy as the prestressing wire.

B. If the applied wire force is different from the specified design load, discontinue stressing operations until adjustments are made to the stressing system.

C. The average theoretical vertical spacing between any two wires wrapped circumferentially shall have a minimum clearance of single wire diameter, whichever is larger. Spacing not meeting these requirements shall be spread or otherwise removed.

D. Do not bundle or drape wire around pipe or manhole openings. Spread wires falling in such areas over a predetermined area above and below such wall opening requirements. Stress plates may be used at openings.

E. Place wires wrapped near openings no closer than 2 inches from the exterior opening surface.

F. Unauthorized personnel shall not be permitted in the circumferential stressing area. Do not perform work by personnel other than the prestressing crew within 300 feet of the reservoir wall. Do not use prestressing wire and anchors as a ground for welding operations.

G. Minimum Concrete Strength: At time of initial circumferential stressing, the concrete shall demonstrate a minimum strength of 3,000 pounds per square inch.

3.14 NEOPRENE BEARING PADS

A. Install neoprene pads at the locations indicated in the reviewed drawings. Glue pads to the top of the concrete surface with a compatible glue. Do not nail pads to the supporting concrete surface.

3.15 WALL OPENINGS

A. When it is necessary for a pipe to pass through the tank wall, the invert of such pipe shall be no less than 18 inches above the floor slab and the prestressing wires required at the pipe elevation shall be distributed above and below the opening, leaving an unbanded strip around the entire tank. Ordinarily, unbanded strips shall have a vertical dimension of no more than 36 inches.

B. Provide an axi-symmetric finite element shell analysis for unbanded wall spaces having a vertical dimension greater than 36 inches.

C. Seal pipe sleeves passing through the wall to the steel shell diaphragm by epoxy injection.

3.16 FILLER PADS

A. Filler pads shall be sufficient width to occupy the spaces under the wall adjacent to the bearing pads and water stop. Attach filler pads to the supporting concrete surface as specified for neoprene bearing pads.

3.17 MATERIAL TESTING

A. Prepare and test the number of cylinder sets shown in the prestressed concrete tank design drawings-see notes for specific information regarding number of cylinders (based on 50 cys/sample) following schedule using ASTM C39/C39M.

B. Test shall be made by an independent testing laboratory provided by the Contractor as approved by the Engineer. The testing report shall clearly indicate the exact location of all testing on a scale drawing of the tank. Provide copies of test reports to Owner and Engineer.

3.18 FLOOR SLAB CRACK REPAIRS

A. Conform to the standard requirements in Section 03300 - Cast-in-Place Concrete for cast-in-place concrete repairs.

3.19 LEAKAGE TESTING

A. Leakage testing of the tank shall be in accordance with Section 01759 - Water Leakage Test for Concrete Structures and as specified herein. Perform leakage testing after the tank is certified for use by the tank manufacturer.

B. Fill the ground storage tank with water to every one-quarter increment of the tank height. Fill rate shall not exceed what is specified in Section 01759 - Water Leakage Test for Concrete Structures. Prior to water filling at each incremental stage, the Contractor will establish a monitoring program in accordance with the Owner's and/or the Owner's representative recommendations to determine the amount of the consolidation. The Contractor will provide the equipment used to monitor the settlement. The Owner and/or the Owner's representative will evaluate the results of the settlement monitoring. The next increment of filling shall not be applied until completion of primary consolidation based upon the field monitoring program. Allow a minimum of 3 days between tank filling increments for consolidation to take place. No piping connections shall be completed during the filling procedure.

3.20 INSPECTION FACILITIES

A. Provide the Owner's Representative with facilities for inspection including:
   1. Lighting, ladders, safe staging, and manpower to move same.
   2. Stress-indicating instruments for prestressing.

3.21 THICKENED EDGE AT ANCHORAGE CONNECTIONS

A. Provide a minimum 2-inch thick section with defined 90-degree angled edge as a defined thickening area for all materials, supports, equipment, etc., requiring anchorage to the tank.

3.22 SPARE PARTS

A. 10 gallons of interior tank coating system.

B. 10 gallons of exterior tank coating system.

C. It is the intent of this specification that a singular responsibility for the design and construction of the new Ground Storage Tanks. Subcontractors may be employed for earthwork, mechanical, and other items of work, subject to the conditions of the contract documents.

D. The Owner's acceptance of the tank design or construction procedures does not relieve the Contractor of the guarantee required in these specifications.

E. The Contractor shall provide a written warranty for workmanship and materials on the new Ground Storage Tanks for a period of five years from date of acceptance of the work. In case leakage or other defects appear within the five-year period, the tank constructor shall make repairs upon written notice by the Owner that such defects have been found. Leakage is defined as damp spots where moisture can be picked up by touching with a dry hand on the exterior of the tank surface, the source of which is from the inside of the tank, or the continuous loss of water by volume measure which is determined to be penetrating the bottom slab. Any repair or corrective work shall be the responsibility of the Contractor at no cost to the Owner.

F. Refer to Division 01 for additional requirements.

3.23 CERTIFICATION

A. Provide a written certification from the tank manufacturer that each ground storage tank with appurtenances has been properly installed according to the Contract Documents and the manufacturer's recommendations, and that the tank is operating normally. Make all necessary corrections and adjustments including but not limited to parts, labor, or freight at no additional cost to the County. Refer to Division 01 for additional requirements.

END OF SECTION

SECTION 13208

POLYETHYLENE TANKS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Type 1 and Type 2 polyethylene storage tanks. Type 1 tank shall be made from crosslinked polyethylene resin and Type 2 shall be made from linear (non-crosslinked) polyethylene resin.

1.02 REFERENCES

A. American Society for Mechanical Engineers (ASME):
   1. B16.4 - Gray Iron Threaded Fittings.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.

B. ASTM International (ASTM):
   1. D638 - Standard Test Method for Tensile Properties of Plastics.
   2. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
   3. D1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique.
   4. D1525 - Standard Test Method for Vicat Softening Temperature of Plastics.
   5. D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
   6. D1998 - Standard Specification for Polyethylene Upright Storage Tanks.
   7. D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.

C. National Fire Protection Association (NFPA):
   1. 30 - Flammable and Combustible Liquid Code.

D. National Electrical Manufacturer's Association (NEMA).

E. Occupational Safety and Health Administration (OSHA):
   1. 29 CRF Part 1910 - Occupational Safety and Health Standards.

1.03 DESIGN CRITERIA

A. Tanks: As scheduled.

B. Tank wall thickness: Calculated in accordance with ASTM D1998 using design specific gravity as scheduled. Note that design specific gravity may be higher than specific gravity of tank contents.

C. Design requirements:
   1. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 inch thick:
      T = P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
      T = wall thickness, in.
      SD = hydrostatic design stress, psi
      P = pressure (.433 x S.G. x H), psi
      H = fluid head, ft.
      S.G.= specific gravity, g/cm^3
      O.D. = outside diameter, in.

D. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application.
   1. The hydrostatic design stress is 600 pounds per square inch at 73 degrees Fahrenheit for Type I and Type II materials.
   2. The tank shall have a stratiform (tapered wall thickness) wall.

E. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

F. The minimum design specific gravity shall be 1.9.

G. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support.
   1. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell.

H. The top head must be integrally molded with the cylinder shell.
   1. The minimum thickness of the top head shall be equal to the top of the straight wall.
   2. The top head of tanks with 2,000 or more gallons of capacity shall be designed to provide a minimum of 1,300 square inches of flat area for fitting locations.

I. Tanks with 2,000 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head.
   1. The lifting lugs shall be designed to allow erection of an empty tank.

J. The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head.
   1. The tie-down lugs shall be designed to allow tank retention in wind and seismic loading situations without tank damage.

K. Tank shell thickness:
   1. In accordance with ASTM D1998, Section 6.1.
   2. Design tank wall thickness for liquid with specific gravity as specified.
   3. Provide adequate thickness at all fittings and connection points for mounting of fittings to the tank without damage to the tank or causing excessive deflection.
   4. Maximum allowable hoop stress used in tank wall thickness calculations per ASTM D1998 shall be based on test data in accordance with ASTM D2837.

L. Restraint system:
   1. Design restraint system and anchor bolts as specified in Section 01614 - Wind Design Criteria.
      a. See subsection on "Liquids Stored" herein for the specific gravities of the tank contents.

M. An unreinforced concrete housekeeping pad above the reinforced concrete structural slab shall not be considered to have structural value in the design of the anchor bolts. Tension and shear values for drilled or epoxied anchor shall be FBC approved.

1.04 SUBMITTALS

A. Fabrication drawings for each tank including:
   1. Dimensions.
   2. Tank wall thickness.
   3. Materials of construction.
   4. Tank fittings.
   5. Tank appurtenances.
   6. Tank restraint system.
   7. Tank resin and hoop stress data.

B. Chemical compatibility sheet to include:
   1. Chemical to be stored.
   2. Percentage of chemical.
   3. Temperature of chemical.

C. Engineering design calculations of restraint and anchoring system signed by a civil or structural engineer registered in the state where the project is located.

D. Manufacturer's recommended bolt torques for flanges.

E. Installation instructions for installing tank on a concrete slab.

F. Warranty.

G. Certification that each tank complies with ASTM D1998, Type I for crosslinked HDPE, and is suitable for the specified chemical service, no degradation within warranty period, including tank fittings and gasket material.

H. Proof of qualification: Provide lists of installation and contact information with same type of application and chemical used.

I. Color charts for proposed coating systems.

1.05 WARRANTY

A. Manufacturer warranty against defects:
   1. Tank: 5 years full warranty. Prorated warranties are not acceptable.

1.06 QUALITY ASSURANCE

A. Qualification of manufacturer: Manufacturer with experienced personnel, physical facilities, and management capacity sufficient to produce custom-made rotationally molded polyethylene tanks of the size, exposure, and chemical services specified for minimum 5 years with satisfactory performance record.

PART 2 PRODUCTS

2.01 SCOPE OF SUPPLIES

A. Provide all materials, labor, equipment, and hardware to provide all polyethylene storage tanks with specified fittings and accessories, seismic and wind load restraint systems, anchor bolts, and flange flexible connectors for complete installation in the positions and orientations indicated on the Drawings.

2.02 MANUFACTURERS

A. One of the following (per PCU USSM):
   1. PolyProcessing Company.
   2. Snyder Industries Incorporated.

2.03 TANK MATERIALS

A. Type 1 high-density crosslinked polyethylene (XLPE).

B. Resin:
   1. Manufacturers: One of the following or equal:
      a. PAXON, grade 7204 resin for crosslinkable polyethylene.

C. The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer.
   1. Type 1 tanks shall be made from crosslinked polyethylene resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.
   2. The tank material shall be suitable for storage of 10 percent to 15 percent trade weight sodium hypochlorite solution.

D. Ultraviolet stabilizer:
   1. The polyethylene resin material shall contain a minimum of a UV 8 stabilizer as compounded by the resin manufacturer.
   2. Pigments may be added but shall not exceed 0.25 percent (dry blended) of the total weight.

E. Free of holes, blisters, crazing, cracking, delamination, undispersed raw materials, and any sign of contamination from foreign matter.
   1. The finished tank wail shall be free of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking, and delaminations.
   2. All cut edges where openings are cut into the tanks shall be trimmed smooth.

F. Resin shall meet or exceed the following properties:
   1. Mechanical Properties of Type 1 of Tank Material: Current XLPE Resin:

Property	ASTM	Value
Density (Resin)	D1505	0.938-0.946 g/cc
Tensile (Yield Stress 2"/min)	D638	3,000 psi
Elongation at Break (2"/min.}	D638	>300%
ESCR (100% Igepal, Cond. A, F50)	D1693	>1000 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	>1000 hours
Vicat Softening Temperature,	D1525	250
Flexural Modulus	D790	100,000 psi

G. The top head shall be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. Design the top head of tanks to accommodate the fittings and nozzles indicated.

H. Determine wall thickness per ASTM D1998, Section 6, assuming a fluid specific gravity as described in the subsection on "Service Conditions" with a minimum specific gravity of 1.9. Minimum total wall thickness shall be 3/8 inch for tanks having a diameter 4 feet 0 inch or less and a height of 8 feet 0 inch or less. Wall thickness for larger tanks (in either diameter or height dimension) shall be at least 1/2 inch. The minimum required wall thickness for the cylinder straight shell shall be sufficient to support its own weight in an upright position without any external support.

I. Provide flat areas to allow the attachment of fittings on the cylinder straight shell.

J. Gel test:
   1. Inner portion of tank wall:
      a. Not less than 65 percent.
      b. ASTM D1998 requirements.
   2. Entire wall thickness: Not less than 80 percent.

K. Restraint system:
   1. Anchor bolts:
      a. Type 316 stainless steel. Bolts shall conform to ASTM A193, Grade B8M or ASTM F593, Type 316. Nuts shall conform to ASTM A194, Grade 8M or ASTM F594, Type 316. Use ASTM A194 nuts with ASTM A193 bolts; use ASTM F594 nuts with ASTM F593 bolts. Provide washers around the anchor bolts.
      b. The anchor bolts shall be supplied by the tank manufacturer.
   2. If the wind load restraint system includes the use of cables, tensioning and adjustment devices, such as turnbuckles, shall be used to allow for easy adjustment of the cables.
      a. Provide 316 stainless steel cables and turnbuckles.
      b. The cables and turnbuckles shall be supplied by the tank manufacturer.
   3. Concrete anchors or flush shells shall not be used.

2.04 FITTINGS

A. Place fittings at least 6 inches away from tank knuckle radius and flange lines.

B. Orientation of flange fittings shall have bolt holes straddling the principal centerline of the tank in accordance with ANSI/ASME B16.5.

C. Flanges shall be flat faced. The flange face shall be 4 to 6 inches from the tank shell.

D. Locate fittings in the general orientation shown in the drawings.

E. Terminate in socket, threaded, or flanged connections:
   1. Flanges: 150-pound ASME B16.5.
   2. Threaded connections: ASME B16.4.

F. Fittings at upper tank sidewall or top:
   1. Compression threaded type, long shank, polyvinyl chloride flanged fittings with deep cut threads (not injection molded thread) and with dual wide nuts.
   2. The bulkhead fittings shall be constructed of PVC, PP, or other specified material.
   3. Gaskets shall be a minimum of 1/4 inch thickness and constructed of 40 to 50 durometer EPDM, 60 to 70 durometer Viton or other specified material.

G. Fittings on tank top:
   1. Bosses molded into the tank.
   2. Fittings shall be vertical.
   3. The top head shall be integrally molded with the cylinder shell.
   4. The minimum thickness of the top head shall be equal to the top of the straight wall.
   5. The top head of tanks with 2,000 or more gallons of capacity shall be designed to provide a minimum of 1,300 square inches of flat area for fitting locations.

H. Fittings and appurtenances for each tank:
   1. One minimum 2-inch flanged inlet nozzle entering the tank in the top near the wall.
   2. One minimum 2-inch flanged outlet/drain nozzle integrally molded with tank wall.
   3. One 4-inch flanged overflow nozzle.
   4. One 4-inch flanged roof nozzle for mounting of tank level sensor.
   5. One 6-inch flanged roof nozzle for mounting of tank level gauge.
   6. One 4-inch flanged roof vent.
   7. One 24-inch flanged type or molded screw type manway lid on top of the tank.
      a. Manway shall be sealed and shall be constructed of the same material as tank.
      b. The bolts shall be stainless steel.
      c. The gaskets shall be per tank manufacturer recommendation for the chemical stored.
   8. The bolted double flange fittings shall allow tank wall thickness up to 2-1/2 inches.

9. Each bolted double flange fitting shall consist of one flange each on the inner and outer shell surfaces and shall be constructed with two each 150-pound flanges, two each 150-pound flange gaskets, and the correct number and size of all-thread bolts for the flange specified by the flange manufacturer. Construct the fittings of PVC Type I, Grade I. Provide a minimum of four each all-thread bolts. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in Type II polyethylene material. Design the encapsulated bolt to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully cover the bolt head and a minimum of 1/4 inch of the threads closest to the bolt head. The polyethylene shall be color coded to distinguish bolt material. Each encapsulated bolt shall have a gasket to provide a bolt sealing surface against the inner flange.
10. Fill pipes shall be supported at 4-foot-maximum intervals with support structures. Down pipes and fill pipes shall be Schedule 80 PVC.

2.05 ACCESSORIES

A. Finish coating:
   1. Waterproof and ultra-violet light resistant.
   2. Acrylic enamel or latex mastic.
   3. 2 coats.
   4. Minimum dry film thickness: 5 mil.
   5. Color: Selected by Engineer.

B. Ladder and platform:
   1. Provide a galvanized steel or fiberglass reinforced plastic ladder and landing platform for each storage tank for access to the top manway.
   2. In accordance with OSHA standards.
   3. Provide handrail around the platform.
   4. Steel components: Hot-dip galvanized after fabrication.
   5. Fasteners: Type 304 stainless steel.
   6. Anchor bolts: Type 304 stainless steel.
   7. Secure ladder to the tank using special stainless steel or Hastalloy bolts with polyethylene encapsulated heads.
   8. Support ladder directly on the concrete foundation and from the tank wall.

C. Level gauge:
   1. Provide each tank with:
      a. Level gauge shall be a magnetic flap type or "reverse float type" made of 2-inch polyvinyl chloride or PVDF stilling well tube.
      b. Float.
      c. Polypropylene rope.
      d. Clear polyvinyl chloride sight tube.
   2. Materials: Suitable for the specified chemical service for the individual tanks.
   3. Tank level staff gauge:
      a. Resistant to abrasion and corrosion.
      b. Mounted on the tank adjacent to the indicator.
      c. Calibrated in nominal 500-gallon increments.

D. Tank vents:
   1. Each tank shall be properly vented for the type of material and flow rates expected.
   2. Vents must comply with OSHA Part 1910 normal venting for atmospheric tanks or other accepted standard or shall be as large as the filling or withdrawal connection, whichever is larger but in no case less than 2 inches nominal inside diameter with screening.
   3. Construct vents of Schedule 80 PVC.

2.06 TANK FABRICATION

A. Rotationally molded construction in accordance with ASTM D1998.

B. Provide for each tank the following shop finishing:
   1. Shipping label identifying:
      a. Tank tag number.
      b. Chemical service.
   2. Coating:
      a. Coat each tank and appurtenances after installation as specified in Section 09960 - High-Performance Coatings.
      b. Color: Selected by the Engineer.
   3. Permanent labels:
      a. Identification label.
      b. NFPA label specifically coded for the tank contents in accordance with NFPA 30.
      c. Paint or affix label onto the tank wall to be clearly visible from outside the tank enclosure.

2.07 TESTING

A. Each tank shall be leak tested by the manufacturer prior to shipment by filling with clean water for a period of at least 4 hours with all fittings installed and blinded.
   1. There shall be no measurable drop in liquid surface.
   2. Check tank and nozzles and knuckles for leaks.
   3. Any leaks shall be noted and repaired and the tank shall be re-tested for an additional 4 hours minimum.
      a. Reason for leak and method of repair shall be recorded and submitted to the Engineer.
   4. Any defects or leaks that have not been adequately repaired will be cause for rejection of the tank.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Factory cleaning: Remove dirt, chips, and debris from interior surfaces. Rinse with clean water. Rinse exterior with clean water and dry.
   2. Transportation, handling, storage of the tanks, and installation shall be in accordance with the manufacturer's printed instructions.
   3. Repair any damage to tank components or the insulation due to transportation or installation.

4. Install piping to tank with sufficient flexibility to allow tank movement of 1 inch in any direction without damage to piping.

B. All tank fitting attachments shall be equipped with flexible couplers or other movement provisions provided by the tank customer.
   1. The tank will deflect based upon tank loading, chemical temperature and storage time duration.
   2. Tank piping flexible couplers shall be designed to allow 4 percent design movement.
   3. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's field service:
   1. Inspect the installed tanks for proper installation.
   2. Instruct Owner's personnel on operations and maintenance of the tanks.

B. Field Testing:
   1. Fill each tank with water and allow tank to set for seven days. Do not attach connecting piping until after the test period to allow for any differential settlement. Check for leaks and correct or repair any leaking areas.
   2. During the tank filling, check that the liquid level gauges operate smoothly and without binding. Assure that floats and targets move up and down without sticking.

C. Certification: Provide a written certification from the equipment manufacturer that the equipment has been properly installed according to the plans, specifications and manufacturer's specifications, and that the equipment is operating normally. Make all necessary corrections and adjustments at no additional cost to the Owner.

D. Warranty: The minimum warranty period for workmanship and materials shall be 3 years from the date of substantial completion.

3.03 SCHEDULE

A. Tank schedule as follows:

Tag Number	TNK-80-1 AND TNK 80-2
Service	Sodium Hypochlorite at 12.5% solution
Chemical pH	13
Chemical Specific Gravity	1.16
Number of Tanks	2
Usable Capacity, each	3000 gal
Type of Tank	Dual Containment
General Design	Flat bottom, dished top
Installation	Vertical
Diameter (feet)	8.5
Height (feet)	11.83

Tag Number	TNK-80-1 AND TNK 80-2
Inlet Nozzle Size (inches)	2
Outlet Nozzle Size (inches)	2
Drain Nozzle Size (inches)	2
Overflow Nozzle Size (inches)	4
Vent Nozzle Size (inches)	4
Roof Nozzle Size (inches)	6-inch nozzle for mounting ultrasonic level sensor
Top Manway (inches)	24
Ladder	Required
Lifting Lugs	Required
Level indicator	Required
Pipe and Conduit Supports	Required

END OF SECTION

SECTION 13446

MANUAL ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Valve and gate actuators.
   2. Handwheel actuators.
   3. Hand-cranked geared actuators.
   4. Floor Boxes.
   5. Floor stands.
   6. Key operated valves.
   7. Bench stands.
   8. Accessory equipment and floor boxes.

1.02 REFERENCES

A. Aluminum Association (AA):
   1. DAF-45 - Designation System for Aluminum Finishes.

B. American Water Works Association (AWWA).

C. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

D. National Electrical Code (NEC).

1.03 DEFINITIONS

A. NEMA:
   1. Type 4X enclosure in accordance with NEMA 250.
   2. Type 7 enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

A. Shop drawings: Include shop drawings and product data with associated gate or valve as an integrated unit.

1.05 QUALITY ASSURANCE

A. Provide valve actuators integral with valve or gate, except for valve actuators utilizing T-wrenches or keys, and portable actuators intended to operate more than 1 valve.

B. Provide similar actuators by 1 manufacturer.

C. Provide gates and hand operating lifts by 1 manufacturer.

D. Provide hydraulic gate lifts by 1 manufacturer.

E. Provide hydraulic valve actuators and motorized actuators by 1 manufacturer.

1.06 MAINTENANCE

A. Extra materials:
   1. Key operated valve keys or wrenches: Furnish a minimum 4 keys with 4-foot shafts and 3-foot pipe handles or wrenches with 4-foot shafts and 3-foot handles for operating key operated valves.

PART 2 PRODUCTS

2.01 VALVE AND GATE ACTUATORS

A. Valve actuators:
   1. Motorized actuators are specified in Section 13447 - Electric Motorized Actuators.
   2. Manual actuators:
      a. Material: Type 316 stainless steel.
      b. Design: Hand lever.
      c. Spring release handle: 12-inch.
      d. Notch plate: 10 position.
      e. Secure with mounting bolts.
      f. Locking device so that valve can be locked in any position with a wing nut.
   3. Stem and cover:
      a. For submerged valves, provide extension stem as indicated on the Drawings.
   4. Limit switches: Provide limit switches on manually actuated valves where indicated on the Drawings:
      a. Limit switches: Heavy-duty, industrial grade, oiltight, with not less than 2 auxiliary contacts.
      b. Rating: Rated for 10 amps, 120 volts alternating current.
      c. Enclosure: NEMA Type 4X enclosure and with stainless steel levers and arms. Provide switch with NEMA Type 7 enclosure when switch is located within areas with NEC Class 1, Division 1 or Class 1, Division 2 designations as indicated on the Drawings.

B. Stem covers:
   1. Aluminum pipe.
   2. Threaded cap on top.
   3. Bolted aluminum flange on bottom.
   4. Slots cut 1- by 12-inch at 18 inches on center in front and back of pipe.
   5. Capable of covering threaded portion of greased stems that project above actuators when gates or valves are opened or closed.
   6. Ultraviolet light resistant, clear butyrate plastic or polycarbonate pipe:
      a. Capped on the upper end.
      b. Either threaded into the top of the gate operators or held in place by bolt-down aluminum brackets.
      c. Capable of covering threaded portion of greased stems that project above actuators when gates or valves are opened or closed.

7. Staff gauges:
    a. Adhesive-backed mylar, suitable for outdoor service.
    b. Calibrated in hundredths of feet.
    c. Read the weir crest elevations directly.
    d. Gauge range: 1.5 feet minimum.
    e. Indicate the following elevations on each staff gauge:
        1) -0.75, -0.50, -0.25, 0.0, 0.25, 0.50, 0.75.
    f. Supplement with a stem-mounted pointer or indicator that permits direct observation of the weir gate crest elevation.
    g. Apply staff gauges to each stem cover after installation of the cover and after calibration and testing of the weir gates.
    h. Set gauges precisely by a survey crew using instruments acceptable to the Engineer.

C. Stem cover flanges, pipes and caps:
    1. After fabrication, etch and anodize to produce the following chemical finishes in accordance with AA publication DAF-45:
        a. A 41 - Clear Anodic Coating.
        b. C 22 - Medium Matte Finish.

D. Gate stem covers: Concentric with stem.

E. Position indicators:
    1. For all aboveground worm gear or traveling nut manual actuators, provide position indication on the actuator enclosure.
    2. Tail rods on hydraulic cylinders, or dial indicators with clear full-open and closed position indicators, calibrated in number of turns or percentage of opening.

F. Manual or power actuator size:
    1. Sized to deliver maximum force required under most severe specified operating condition, including static and dynamic forces, seat and wedge friction, and seating and unseating forces with safety factor of 5, unless otherwise specified.

G. Actuator size: Capable of supporting weight of suspended shafting unless carried by bottom thrust bearings; shaft guides with wall mounting brackets.

H. Provisions for alternate operation: Where specified or indicated on the Drawings, position and equip crank or handwheel operated geared valve actuators or lifts for alternate operation with tripod mounted portable gate actuators.

I. Operation: Counterclockwise to open with suitable and adequate stops, capable of resisting at least twice normal operating force to prevent overrun of valve or gate in open or closed position.

J. Open direction indicator: Cast arrow and legend indicating direction to rotate actuator on handwheel, chain wheel rim, crank, or other prominent place.

K. Worm gear actuators: Provide gearing on worm gear actuators that is self-locking with gear ratio such that torque in excess of 160 foot-pounds will not need to be applied to operate valve at most adverse conditions for which valve is designed.

L. Traveling nut actuators: Capable of requiring maximum 100 foot-pounds of torque when operating valve under most adverse condition; limit stops on input shaft of manual actuators for fully open and closed positions; non-moving vertical axis of operating nut when opening or closing valve.

2.02 HANDWHEEL ACTUATORS

A. Manufacturers: One of the following or equal:
   1. Rodney Hunt Company.
   2. Waterman Industries, Incorporated.

B. Coating: Handwheel as specified in Section 09960 - High-Performance Coatings.

C. Mounting: Floor stand or bench stand. Unless otherwise indicated on the Drawings position actuator 36 inches (nominal) above top of walkway surface.

D. Bearings above and below finished threaded bronze operating nut: Ball or roller.

E. Wheel diameter: Minimum 24 inches.

F. Indicator: Counterclockwise opening with arrow, and word OPEN cast on top of handwheel indicating direction for opening.

G. Pull to operate: Maximum 40 pounds pull at most adverse design condition.

H. Stem travel limiting device: Setscrew locked stop nuts above and below lift nut.

I. Grease fittings: Suitable for lubrication of bearings.

2.03 HAND-CRANKED GEARED ACTUATORS

A. Type: Single removable crank; fully enclosed.

B. Mounting: Floor and bench stand. Unless otherwise indicated on the Drawings position actuator 36 inches (nominal) above top of walkway surface.

C. Operating nut: When scheduled for portable actuators.

D. Geared lifts: 2-speed with minimum ratio of 4 to 1.

E. Teeth on gears, spur pinions, bevel gears, and bevel pinions: Cut.

F. Lift nuts: Cast manganese bronze.

G. Exterior surfaces on cast-iron lift parts: Smooth.

H. Bearings above and below flange on lift nuts: Ball or roller; capable of taking thrust developed by opening and closing of gates under maximum operating head; with bronze sleeve bearings and sufficient grease fittings for lubrication of moving parts, including bearings and gears.

I. Crank rotation indicator: Cast arrow with word OPEN in prominent location readily visible indicating correct rotation of crank to open gate.

J. Hand cranks: 15-inch radius; requiring maximum 25 pounds pull to operate gate at maximum operating head; with:
   1. Revolving brass sleeves.
   2. Gears, spur pinions, bevel gears, and bevel pinions with cut teeth.
   3. Cast manganese bronze lift nuts.
   4. Cast-iron lift parts with smooth exterior surfaces.

K. Indicator: Dial position type mounted on gear actuator; enclosed in cast-iron or aluminum housing with clear plastic cover; marked with fully open, 3/4, 1/2, 1/4, and closed positions.

2.04 FLOOR BOXES

A. Manufacturers: One of the following or equal:
   1. Waterman industries, Inc.

B. Floor boxes: Cast-iron; with:
   1. Counter type indicator.
   2. Hinged, lockable lid with directional arrow.
   3. 2-inch square AWWA operating nut.
   4. Packing gland providing drip-tight seal around valve shaft.

2.05 FLOOR STAND

A. Manufacturers: One of the following or equal:
   1. Rodney Hunt Company.
   2. Waterman industries, Inc.

B. Floor stand assemblies: Heavy-duty cast-iron, suitable for mounting specified actuator.

2.06 BENCH STANDS

A. Manufacturers: One of the following or equal:
   1. Rodney Hunt Company.
   2. Waterman industries, Inc.

B. Bench stands: Handwheel actuators or hand crank, geared actuators conforming to hand-cranked geared actuator requirements, except capacity to be mounted on haunch, wall bracket, or self-contained gate yoke.

2.07 ACCESSORY EQUIPMENT

A. Wall brackets or haunches: As indicated on the Drawings.

B. Stems: Stainless steel; sized to match output of actuator; minimum gate or valve operating stem diameter; maximum 200 slenderness ratio.

C. Stem couplings: Stainless steel; internally threaded to match stem; lockable to stem by set screw.

D. Stem guides: Cast-iron with silicon bronze bushing; maximum 200 slenderness ratio; capable of being mounted with wall bracket; adjustable in 2 directions.

E. Stem stuffing boxes: Cast-iron, with adjustable gland and packing.

F. Fasteners: Type 316 stainless steel.

G. Anchor bolts: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry except that the material shall be Type 316 stainless steel.

H. Geared valve actuators: Provided with cut gears, either spur or worm; sized to operate valves at most adverse design condition; with maximum 40-pound pull at handwheel or chain wheel rim.

I. Geared valve traveling nut actuators: Acceptable only where specified or indicated on the Drawings.

J. Accessory equipment for valves and gates requiring remote actuators: Operating stems, stem couplings, stem guides, wall brackets, and stem stuffing boxes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install floor boxes in concrete floor with lid flush with floor.

B. After installation of gate and stem covers, mark stem covers at point where top of stems are at full-open position and at closed position.

C. Attach floor stand to structure with anchor bolts.

D. Install stem stuffing boxes where operating stems pass through intermediate concrete floor slabs.

3.02 SCHEDULES

A. Geared actuators: Provide geared actuators for following valves:
   1. Butterfly valves larger than 6 inches, nominal size, on liquid service.
   2. Butterfly valves larger than 10 inches, nominal size, on gas and air service.
   3. Plug valves 6 inches, nominal size, and larger.

B. Handwheel actuators: Provide handwheel actuators for valves mounted 6 feet or less above floors.

C. Chain wheel actuators: Provide chain wheel actuators for valves mounted more than 6 feet to centerline above floors.

END OF SECTION