Orange County Utilities

Eastern Water Reclamation Facility
Centrifuge Dewatering Improvements

Bid Package B

Technical Specifications

Prepared By:

AECOM

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Bid Set
April 2014

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ORANGE COUNTY UTILITIES
EASTERN WATER RECLAMATION FACILITY
CENTRIFUGE DEWATERING IMPROVEMENTS
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February 11, 2011

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Nodarse & Associates – A Terracon Company
March 2013

DIVISION 1 - GENERAL REQUIREMENTS

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SECTION 01010 SUMMARY OF WORK

PART 1 - GENERAL

A. Work Under This Contract

The Centrifuge Dewatering Improvements will provide facilities to dewater waste activated sludge (WAS) for the design wastewater flow of 24 MGD AADF at the EWRF. The centrifuges are designed so that two (2) centrifuges can process the average WAS production from an average daily flow of 24 mgd. The new centrifuge facility will be located in the northwest part of the EWRF site near the existing dewatering building. Construct the following improvements as shown on the drawings and stated within the technical specifications:

1. Process 140 – Existing Control Building: Electrical Improvements for the new Process 610 pumps.

2. Process 150 – Existing North Electrical Building: Demolition of existing electrical and HVAC equipment. Installation of new HVAC and electrical equipment. The electrical equipment for the new Process 650 Centrifuge Dewatering Building will be installed within this building.

3. Process 610 – New Phase I/II Waste Activated Sludge (WAS) Pumping Station: One (1) new temporary in-line booster pump station including two (2) pumps to improve conveyance of WAS from the Phase I/II biological treatment train into the WAS storage tanks.

4. Process 620 - Existing Waste Activated Sludge (WAS) Holding Tanks: The process was originally constructed for Dissolved Aeration Floatation (DAF). The DAF equipment is presently abandoned and the two (2) tanks are being used for WAS storage. WAS is pumped from the existing nine (9) secondary clarifiers to tanks. The pumps within Process 630 draw flow from the WAS Holding Tanks and pump to the belt filter presses within Process 640. The external DAF equipment will be demolished. The existing internal mechanism and grout will be demolished. Two (2) new internal mechanisms for gravity thickening of WAS will be installed. Drain piping will be installed to convey scum collected by the new mechanisms to the in-plant lift station.

5. Process 630 - Existing Biosolids Handling Building: The process contains three (3) pumps that currently convey waste activated sludge (WAS) from the WAS Holding Tanks (Process 620) to the belt filter presses within Process 640. The existing piping will be modified in order to dedicate the three (3) pumps to the three (3) new centrifuges in Process 650. The existing three (3) pumps used for metering polymer into the WAS will be salvaged to the County. The polymer pumps will be replaced with three (3) larger capacity pumps. The polymer piping will be modified to direct the three (3) polymer pumps to the new three (3) centrifuges in Process 650.

6. Process 640 – Existing Belt Filter Press Building: The existing four (4) belt conveyors will be demolished. The existing utilities and electrical services to the two (2) belt filter presses will be demolished. The belt filter presses will be abandoned in place for removal by Others.

7. Process 650 – New Centrifuge Dewatering Building: One (1) new building to house four (4) centrifuges, three (3) per this project and one (1) future. The building will contain an elevated equipment platform for positioning the centrifuges above a truck loading area. The truck loading area will accommodate two (2) sludge cake hauling trucks. The process will include three (3) screw conveyors for discharge of dewatered solids into the trailers. The process includes two (2) interior scales for weighing the trucks. A carbon adsorption system will be provided for odor control within the trailer loading area. A ten (10) ton bridge crane will be provided for maintenance of the centrifuges.

8. Instrumentation, SCADA and Electrical improvements for the Work.

9. Access road modifications to provide access to the centrifuge dewatering facility.

10. Construct miscellaneous site improvements and yard piping associated with the new facilities, as shown on the drawings and specified herein, including yard piping, electric ductbanks and wiring, loop switches, transformers, grading modifications, concrete slabs, drainage ditches, sidewalks, and other items shown on the drawings or specified herein, or as necessary to provide a complete operating system.

11. The Contractor shall furnish all labor, superintendence, materials, power, light, heat, fuel, water, tools, appliances, equipment, supplies, and other means of construction necessary or proper for performing and completing the work.

B. Work Performed by Others

1. All existing valves, equipment and facilities are to be operated only by the County. The Contractor shall coordinate and schedule operation and shutdown control of existing valves and facilities with the County at least seven (7) days in advance by processing a C.A.R (Construction Assistance Request).

2. Existing North Electrical Building Storage Improvements – The County is administering a contract to improve the North Electrical Building (Process 150) for demolition and provide additional internal storage facilities. The Work by Others will be primarily performed outside the Electrical Room, where this Work is primarily being performed.

3. Southern Regional Water Reclamation Facility (SWRF) Dewatering Improvements - The County is administering a contract to improve dewatering facilities at the SWRF. That contract includes the removal and relocation of the existing belt filter presses within Process 640. The relocation will be performed following substantial completion of the Work being performed under this contract.

C. Training

1. Submit a construction submittal with the format, trainers and course material and specify whether training will be hands on or in a classroom setting for review and acceptance by the Owner and Engineer.

2. Contractor shall prepare a list of all equipment and electrical installations for owner to review and choose training.

3. Unless otherwise specified, a minimum of 2 days of training shall be provided for each piece of equipment supplied, including all electrical installations and testing equipment. Contractor shall video and audio record to a DVD all training given to operations staff, a copy of the DVD will be supplied to the County. The Contractor shall submit a C.A.R (Construction Assistance Request) form seven days prior to beginning of training to coordinate training schedule with Owner. Owner shall

approve training schedule to ensure critical staff is available during training. Video equipment shall be accompanied with independent microphone for instructor to speak into for audio recording.

D. Intended Mode of Operation

WAS is pumped from the nine (9) secondary clarifiers to the Process 620 WAS Holding tanks. The mechanisms within the WAS Holding tanks will provide gravity thickening of the WAS prior to discharge to the centrifuges. The three (3) pumps within Process 630 draw flow from the WAS Holding Tanks and will pump to the three (3) new centrifuges in Process 650. Each centrifuge will have a dedicated feed pump in Process 630 for both polymer and WAS. Both WAS and polymer will be flow paced to pump an operator adjustable volume of flow to the centrifuges. Each centrifuge has a dedicated screw conveyor that is suspended within the truck loading area under the elevated platform where the centrifuge is installed. Dewatered biosolids from the centrifuges drops into the screw conveyor where it is then deposited within trucks used for hauling the material offsite.

E. Demolition

1. Perform demolition as designated within the Contract Documents.

2. Unless otherwise noted, remove all materials and equipment from areas indicated for demolition.

3. Cap abandoned utilities and conduit that remain in place.

4. Utilities to be abandoned in place are to be capped and grout filled.

5. Dispose of all removed materials and equipment as required by the appropriate jurisdictional authority, or as directed by the County, to an acceptable disposal site.

6. Disconnect existing electrical services and controls to items being removed by others as a requirement of this section. Conduit is to be cut down to finished floor elevation and capped or sealed. Unless otherwise noted, cables are to be removed to their source.

F. Mutilation

All damage or mutilation of concrete structures, equipment, pipes, ducts, fixtures, etc., shall be properly repaired by the Contractor at no expense to the County.

G. Electrical Interlocks

Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, the Contractor shall provide wiring diagrams and coordinate between the various subcontractors and suppliers so that proper wiring of the equipment involved is effected.

H. Disturbed Areas

Restore all areas disturbed by construction to a condition at least equal to the preconstruction condition including, but not limited to, all landscaping, driveways, roads, sprinkler systems, and other improvements. Grassed areas shall be sodded. Maintain ingress and egress to all properties adjacent to the construction and minimize inconvenience to abutting property occupants.

I. Permits

1. The County has obtained Domestic Wastewater Facility Operating permits for this project from the Florida Department of Environmental Protection (FDEP).

2. The County has obtained an Environmental Resource permits for this project from the Florida Department of Environmental Protection (FDEP).

3. The County will also apply for and pay for the General Commercial Building Permit as issued by the Orange County Division of Building Safety. As set forth in the General Conditions and Section 01065, the Contractor shall obtain the General Commercial Building Permit.

4. The Contractor shall pay for and obtain all the Sub-trade Commercial Building Permits associated with the General Building Permit as administered and issued by the Orange County Division of Building Safety. The Contractor shall be responsible for scheduling and paying for all inspection services associated with the Building Permit in order to obtain final approval.

5. The Contractor shall pay for and obtain a permit from the Orange County Division of Building Safety for the fire alarm systems associated with the Work.

6. The Contractor shall pay for and obtain a permit from the Orange County Division of Building Safety for the chain link fence surrounding the proposed improvements.

7. The Contractor shall pay for and obtain a Notice of Intent to use the Generic Construction NPDES permit from the Florida Department of Environmental Protection (FDEP).

8. The Contractor shall pay for and obtain a St. John's River Water Management District Dewatering Permit.

9. The Contractor shall pay for and obtain all other permits as required to perform the Work.

J. Containers for Spare Parts

1. Spare parts shall be packaged in sealed, rotationally moulded LLDPE military grade storage containers that can be stacked. Storage containers shall have exterior metallic hinges, clasps and handles. The Contractor shall produce a construction submittal for type of containers intended to be supplied for review and acceptance by the Owner and Engineer.

2. Pertaining to general inventory of all containers, the Contractor shall provide a general ascending alpha-numerical numbering convention to label all individual containers supplied. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

3. Pertaining to contents, the containers shall include exterior labeling that shall include the following at a minimum; Process description and Process number, equipment description, equipment tag, Manufacturer's information. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

4. The Contractor shall provide an electronic log in MS Excel of all containers which include the following at a minimum; container alpha-numerical designation, content description, site storage location, O&M Manual volume subsection reference.

5. A copy of all inventory and manufactures product information data sheets shall be provided within a file pocket attached within the container.

6. Containers shall be positioned on site as designated by the Owner's Representative

PART 2 - PRODUCTS

A. Manufacturers and Materials

Unless otherwise specified herein, all manufacturers and materials shall conform to the current Orange County Utilities List of Approved Manufacturers and Materials.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01015 PROJECT REQUIREMENTS

A. General Description of Work

The Work to be performed under these Contract Documents is presented in the drawings and specifications. The Work is generally described as follows:

Centrifuge Dewatering Improvements:

The Centrifuge Dewatering Improvements will provide facilities to dewater waste activated sludge (WAS) for the design wastewater flow of 24 MGD AADF at the EWRF. The centrifuges are designed so that two (2) centrifuges can process the average WAS production from an average daily flow of 24 mgd. The new centrifuge facility will be located in the northwest part of the EWRF site near the existing dewatering building. Construct the following improvements as shown on the drawings and stated within the technical specifications:

1. Process 140 – Existing Control Building: Electrical Improvements for the new Process 610 pumps.

2. Process 150 – Existing North Electrical Building: Demolition of existing electrical and HVAC equipment. Installation of new HVAC and electrical equipment. The electrical equipment for the new Process 650 Centrifuge Dewatering Building will be installed within this building.

3. Process 610 – New Phase I/II Waste Activated Sludge (WAS) Pumping Station: One (1) new temporary in-line booster pump station including two (2) pumps to improve conveyance of WAS from the Phase I/II biological treatment train into the WAS storage tanks.

4. Process 620 - Existing Waste Activated Sludge (WAS) Holding Tanks: The process was originally constructed for Dissolved Aeration Floatation (DAF). The DAF equipment is presently abandoned and the two (2) tanks are being used for WAS storage. WAS is pumped from the existing nine (9) secondary clarifiers to tanks. The pumps within Process 630 draw flow from the WAS Holding Tanks and pump to the belt filter presses within Process 640. The external DAF equipment will be demolished. The existing internal mechanism and grout will be demolished. Two (2) new internal mechanisms for gravity thickening of WAS will be installed. Drain piping will

be installed to convey scum collected by the new mechanisms to the in-plant lift station.

5. Process 630 - Existing Biosolids Handling Building: The process contains three (3) pumps that currently convey waste activated sludge (WAS) from the WAS Holding Tanks (Process 620) to the belt filter presses within Process 640. The existing piping will be modified in order to dedicate the three (3) pumps to the three (3) new centrifuges in Process 650. The existing three (3) pumps used for metering polymer into the WAS will be salvaged to the County. The polymer pumps will be replaced with three (3) larger capacity pumps. The polymer piping will be modified to direct the three (3) polymer pumps to the new three (3) centrifuges in Process 650.

6. Process 640 – Existing Belt Filter Press Building: The existing four (4) belt conveyors will be demolished. The existing utilities and electrical services to the two (2) belt filter presses will be demolished. The belt filter presses will be abandoned in place for removal by Others.

7. Process 650 – New Centrifuge Dewatering Building: One (1) new building to house four (4) centrifuges, three (3) per this project and one (1) future. The building will contain an elevated equipment platform for positioning the centrifuges above a truck loading area. The truck loading area will accommodate two (2) sludge cake hauling trucks. The process will include three (3) screw conveyors for discharge of dewatered solids into the trailers. The process includes two (2) interior scales for weighing the trucks. A carbon adsorption system will be provided for odor control within the trailer loading area. A ten (10) ton bridge crane will be provided for maintenance of the centrifuges.

8. Instrumentation, SCADA and Electrical improvements for the Work.

9. Access road modifications to provide access to the centrifuge dewatering facility.

10. Construct miscellaneous site improvements and yard piping associated with the new facilities, as shown on the drawings and specified herein, including yard piping, electric ductbanks and wiring, loop switches, transformers, grading modifications, concrete slabs,

drainage ditches, sidewalks, and other items shown on the drawings or specified herein, or as necessary to provide a complete operating system.

11. The Contractor shall furnish all labor, superintendence, materials, power, light, heat, fuel, water, tools, appliances, equipment, supplies, and other means of construction necessary or proper for performing and completing the work.

B. Site Administration

CONTRACTOR shall be responsible for all areas of the Site used by it and by all Subcontractors in the performance of the Work. CONTRACTOR shall exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to OWNER or others. CONTRACTOR shall have the right to exclude from the Site all persons who have no purpose related to the Work or its inspection, and may require all persons on the Site (except OWNER's employees) to observe the same regulations as CONTRACTOR requires of its employees.

Access to the Site during construction will be limited to Contractor's and/or Subcontractor's employees, agents, and vendors (hereinafter "Representatives") for the sole purpose of performing the Work. Contractor/Subcontractor Representative's identity and business purpose will be subject to verification by Owner's security representative. Access to the Site will be limited to the main gate off Alafaya Trail unless specific alternate arrangements are made with the Owner. Contractor will supply list, and periodically update it, which will contain the names of all personnel with driver licenses numbers and license plate numbers of all vehicles that will be on-site during construction.

OWNER reserves the right to direct CONTRACTOR to permanently remove any subcontractor or subcontracted employee from the site for breach of security, policy, unsafe working practice, unprofessional behavior, or failure to comply with access restrictions.

C. Working Hours

Normal Working hours shall be defined as the period occurring between the hours beginning at 7:00 a.m. and ending at 7:00 p.m. Work during other than normal Working

hours may be scheduled by CONTRACTOR with notice to Owner. The County Resident Project Representative shall be notified a minimum of 48-hrs in advance in anticipation of working on the weekends, Holidays or durations outside of the normal working hours of 7:00 a.m. to 7:00 p.m. period.

D. County Resident Project Representative (RPR) Working Hours

The normal daily work period for the County's RPR(s) is any 10 hour period between the hours of 7:00 A.M. and 7:00 P.M. on the weekdays of Monday through Friday. County's RPR(s) work outside the 10 hour period shall be paid for by the Contractor and is to be requested, in writing, 48 hours in advance. Any County's RPR(s) weekend work required on Saturday or Sunday shall be paid for by the Contractor and is to be requested, in writing, 48 hours in advance.

E. County RPR Overtime and Weekend Work Pay Rate

All overtime and weekend work by the County's RPR(s) shall be paid for by the Contractor at the overtime work pay rate of $47.00 per hour. This rate is subject to adjustment by the County.

F. Method of Payment

Contractor agrees that the County shall deduct charges for the County's RPR's work outside normal work hours and for overtime pay from payments due the Contractor.

G. Communication with Owner

All communication with Owner personnel for any purpose shall be administered solely though the County R.P.R. Any other communication with the Owner personnel that is not initiated through the County R.P.R. will be null and void.

H. Security

CONTRACTOR shall be responsible for protection of the Site, and all Work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons. Contractor shall comply with Orange County's security requirements to protect the Eastern Water Reclamation Facility (EWRF) site.

The OWNER is implementing special security measures to protect the public wastewater system and the CONTRACTOR shall provide the same level of security. The CONTRACTOR shall provide the following security measures:

1. Contractor will supply list of all personal that will on EWRF site each morning to OWNER's R.P.R.

2. All personnel, employees and or subcontractors and suppliers that pass through the security perimeter shall wear Contractor issued photo identification badges.

3. Contractor will supply list with names, driver license, and license plate numbers of all personnel.

4. Contractor shall perform background checks to identify any historical crimes dealing with terrorism, sabotage, or other government related illegal activities for all personnel passing through the security perimeter.

5. All project deliveries shall be inspected prior to entering the security perimeter of the Facility in order to verify contents. All delivery personnel and delivery vehicles shall be under supervision while within the security perimeter of the Facility in lieu of issuance of photo identification badges. The Contractor shall maintain staff to accept all deliveries to the site, the Owner will not be responsible for receipt of any deliveries.

6. If access other than the main gate off Alafaya Trail is utilized, a full time guard shall be provided at the construction gate during contractor working hours. All arrangements for alternative access shall be pre-arranged with the Owner. All alternative access must be secured and locked when not in use.

No Claim shall be made against OWNER by reason of any act of an employee or trespasser, and CONTRACTOR shall make good all damage to OWNER's property resulting from CONTRACTOR's failure to provide security measures as specified.

I. Construction Administration Request (CAR) Form

The Contractor is responsible to submit a CAR to the Owner's Representative for any interaction requiring the involvement of the Owner's Operational Staff for the EWRF, including but not limited to the following examples; existing valve actuation, process interruptions, equipment operation interruption, power interruption, flow diversions, training.

The Contractor will not have contact with the Operations Staff without Owner's Representatives' knowledge. The Owner's Representative reserves the right to direct the Contractor to provide a CAR at his discretion. Unless otherwise noted by the Owner's Representative, a CAR shall be submitted a minimum of seven (7) calendar days in advance of the intended operation noted within the CAR. Unless otherwise noted within the Contract Documents, for all activities affecting treatment process operation, a CAR shall be submitted a minimum of thirty (30) days in advance of the scheduled activity. Unless otherwise noted within the Contract Documents, the schedule for performing work which will require shutting down a unit process must be coordinated with the Owner by CAR submittal a minimum of sixty (60) days in advance of the scheduled activity. Reference a blank copy of the form within this section.

J. Smoking Policy – Smoke Free Campus

In order to protect the public health, safety and welfare of citizens and employees, smoking tobacco, or any other substance, is prohibited in County owned or operated facilities and vehicles. Contractor's personnel will not be permitted to smoke tobacco products on County property, including County parking lots, break areas, and worksites. Smoking means the lighting of any cigarette, cigar or pipe, or the possession of any lighted cigarette, cigar or pipe, regardless of its composition. This requirement shall be enforced from the beginning of construction and violators will be removed from the property.

K. Operator Training

A minimum of 2 days of training shall be provided for each piece of equipment supplied, including all electrical installation, instruments and testing equipment. The Contractor shall video and audio record each training session. The Contractor shall provide the County with a DVD compiling all of the training sessions on the project. The DVD shall be able to be indexed per respective piece of equipment. The DVD shall be accompanied by an electronic compilation (.PDF format) of all the handout materials provided to Operators during those training sessions. At a minimum of 7 days in anticipation of scheduling a training session, the Contractor is responsible to submit a CAR Form to the County RPR. The purpose of the submittal of the CAR Form is to request if the Contractor may conduct a training session with the Operations Staff on an anticipated date. The CAR is to be accompanied by the training agenda and all

handouts to be provided. The County reserves the right to reject the date submitted in instances where Operations staff is unable to accommodate that date because of a scheduling conflict. From the training materials submitted, the County reserves the right to request additional materials to enhance the training. At a minimum, the training and those materials provided shall be based upon the Manufacturer's recommendations and the Manufacturer's Operations and Maintenance manuals.

CONTRACTOR'S ASSISTANCE REQUEST
FOR ACCESS TO COUNTY FACILITIES

PROJECT: EWRF Centrifuge Dewatering Improvements

DATE: _____ **NUMBER:** _____

LOCATION/STRUCTURE: _____

_____

PURPOSE: _____

_____

_____

ADDITIONAL ASSISTANCE REQUESTED _____

_____

_____

_____

DATE ACCESS NEEDED: _____

DURATION OF WORK: _____

_____ _____

Contractor **O.C.U. Construction**

COMMENTS/RESTRICTIONS: _____

_____

_____

_____

_____

_____

_____

PLANT SUPERVISOR

END SECTION

SECTION 01025 MEASUREMENT AND PAYMENT

A. Payment

1. Work under this contract will be paid for on a lump sum basis as described on the Bid Schedule. The amount of payment will be as defined in the Construction Contract.

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

3. Additions, deletions, modifications or changes to the work as defined by this contract will be performed by change order according to the General Conditions.

B. General

1. All work under this contract shall be included in the lump sum amount listed on the Bid Schedule.

2. 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 County.

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

4. Payment for repair and replacement of existing utilities will be included in the lump sum bid amount for the new construction.

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

C. Partial Pay Request

1. The installation of pipe and fittings includes backfilling, compacting, hydrostatic testing, fine grading, property restoration, clean up, and placing the facilities in operation. When measurements of the amount of work constructed each month are made, for the purpose of partial payment, the following will be considered:

   a. In addition to the retainage as set out in the Construction Contract, 10% of the amount of footage of pipe shall be withheld if the trench has not been backfilled, compacted, and tested.

   b. In addition to the above, 10% of the amount of footage of pipe shall be withheld if the area has not been fine graded, properly restored to its

previous condition, cleaned up, sodded, pressure tested, and ready to be placed in operation.

2. No less than 2% of the contract price shall be retained until the record drawings, specifications, addenda, modifications, and shop drawings are delivered and reviewed by the County.

3. The Contractor will provide the following with each Partial Pay Request:

   a. Current record drawings for the County's review.

   b. Partial release of liens from all Vendors and Subcontractors.

   c. Photos of work completed.

   d. Consent of Surety Company for Partial Payment.

D. Description of Lump Sum Pay Items – Bid Package B

Described below is a brief summary of the work to be accomplished for the lump sum amount in the Bid Schedule. The lump sum amount will include shop drawings, sample submittals, record drawing submittals, O&M manual submittals, clean-up, start-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. Description of Base Bid Pay Items - Bid Package B:

   a. Bid Package B - Base Bid Item No. 1B (The Centrifuge Dewatering Improvements) - This lump sum bid item is for the following elements as generally defined within the Contract Documents;

      (1) Existing Control Building Improvements(Process 140) - This includes all labor, materials, supplies and equipment for constructing and testing the new electrical improvements including but not limited to the following; demolition, equipment, start-up, testing electrical & control improvements, and any other elements associated with this process.

      (2) Existing North Electrical Building Improvements (Process 150) - This includes all labor, materials, supplies and equipment for constructing and testing the new electrical and HVAC improvements including but not

limited to the following; demolition, structural improvements, coating, equipment, lighting, architectural improvements, start-up, testing electrical & control improvements, and any other elements associated with this process.

(3) New Phase I/II WAS Booster Pump Station (Process 610) – This includes all labor, materials, supplies and equipment for constructing the new booster pump station including but not limited to the following; pumps, valves, piping, reinforcement, concrete, coating, pipe supports, start-up, testing, electrical & control improvements, and any other elements associated with this process.

(4) Existing Waste Activated Sludge (WAS) Holding Tank Improvements (Process 620) – This includes all labor, materials, supplies and equipment for the improvements to WAS Holding Tanks including but not limited to the following; demolition, thickening mechanisms, valves, piping, concrete, coating, pipe supports, start-up, testing, electrical & control improvements, and any other elements associated with this process.

(5) Existing Biosolids Handling Building Improvements (Process 630) – This includes all labor, materials, supplies and equipment for constructing the improvements including but not limited to the following; grinders, flow meters, polymer metering pumps, valves, piping, reinforcement, concrete, coating, pipe supports, testing, electrical & control improvements, polymer, and any other elements associated with this process.

(6) Existing Belt Filter Press Dewatering Building Improvements (Process 640) – This includes all labor, materials, supplies and equipment for constructing the improvements including but not limited to the following; demolition, abandonment of the belt filter presses and electrical and instrumentation equipment, handrail, testing, electrical & control improvements, and any other elements associated with this process.

(7) New Centrifuge Dewatering Building (Process 650) - This includes all labor, materials, supplies and equipment for constructing the centrifuge dewatering building including but not limited to the following; structural, electrical, instrumentation, architectural and HVAC improvements, start-up, testing, any other elements associated with this process.

(8) Construct miscellaneous site improvements and yard piping associated with the new facilities, as shown on the drawings and specified herein, including yard piping, electric ductbanks and wiring, loop switches, transformers, grading modifications, concrete slabs, drainage ditches, sidewalks, and other items shown on the drawings or specified herein, or as necessary to provide a complete operating system.

(9) The Contractor shall furnish all labor, superintendence, materials, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, and other means of construction necessary or proper for performing and completing the work.

(10) Construct miscellaneous site improvements and yard piping - This includes all labor, materials, supplies and equipment for the miscellaneous site improvements including grading modifications, concrete slabs, drainage ditches, sidewalks, process yard piping demolition and improvements (WAS drainage, potable water, reuse, NPW etc.) manholes, stormwater conveyance & treatment, existing roadway & storm drain repairs, cleanouts, valve boxes, valves, concrete, reinforcement, excavation, sheeting/shoring, dewatering, backfilling, restoration, testing, and other items shown on the drawings or specified herein, or as necessary to provide a complete operating system.

(11) Electrical Site Improvements - This includes all labor, materials, supplies and equipment for the various external electrical improvements associated with the centrifuge dewatering improvements including but not limited to ductbanks, wiring, loop switches, substations, transformers, pull boxes, vaults, pedestals, reinforcement, concrete pads, and

other elements associated with the electrical system.

(12) Grading, Landscaping and Miscellaneous Site Improvements - This includes all labor, materials, supplies and equipment for the various site improvements associated with the Centrifuge Dewatering Improvements expansion, including but not limited to clearing, grubbing, stripping, hauling, mass grading, masonry block walls, bollards, watering, excavation, storm water best management practices, compaction, fine grading and landscaping.

(13) General Requirements/ Mobilization/Demobilization – This includes all costs associated with mobilization, temporary control facilities, utilities, permits and demobilization as specified herein.

(14) Bonds/Permits/Indemnification – This includes all costs associated with bonds and permits as specified herein. The item shall include an amount for indemnifications specified in the Contract Documents and any addenda and modifications made thereto.

E. Additive Bid Items – Bid Package B

1. Bid Package B - Additive Bid Item No.1B (2 Year Additive Equipment Warranty increasing the Base Bid 3 Year Equipment Warranty up to 5 Years):

a. Additive Equipment Warranty – This lump sum alternative bid item shall be for a two (2) year extension of the equipment warranty supplied on the project. Excluding that equipment defined in Section 11371, Centrifuges and Appurtenances, and for the equipment identified within the Contract Documents for a warranty duration of three (3) years from the date of substantial completion of the respective process from which the equipment is installed, the alternative bid item shall encompass an additional two (2) years for extension of the warranty, providing total of five (5) years from the date of substantial completion of the respective process from which the equipment is installed within. For the equipment identified within Section 11371, Centrifuges and Appurtenances, for a warranty and preventative maintenance service duration of

five (5) years from the date of substantial completion of Process 650, the alternative bid item shall encompass an additional two (2) years for extension of the warranty and preventative maintenance service duration, providing total of seven (7) years from the date of substantial completion of Process 650.

END OF SECTION

SECTION 01027 APPLICATION FOR PAYMENT

PART 1 GENERAL

A. Requirement

1. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

2. Prior to submitting a monthly payment application, the Contractor’s progressive As-Built Drawings and As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection Tables shall be accepted by the County.

3. Progressive As-Built Drawings shall indicate the horizontal and vertical locations of all current constructed improvements with sufficient information and notes to easily determine if the improvements were constructed in conformance with the Contract Documents. The progressive As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection Tables shall include a Surveyor’s certified statement regarding the constructed improvements being within the specified accuracies or if not, indicating the variances as described in specification Section 01050 "Surveying and Field Engineering", Table 01050-1 Minimum Survey Accuracies.

B. FORMAT

Format and Content: Use the accepted Schedule of Values.

1. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:

   a. Generic name

   b. Related Specification Section

   c. Name of Subcontractor

   d. Name of manufacturer or fabricator

e. Name of supplier

f. Dollar value

2. Round amounts off to the nearest whole dollar. The total shall equal the Contract Amount.

C. Preparation of Application

1. Each Application for Payment shall be consistent with previous applications and payments as certified and paid for by the County.

   a. The initial Application for Payment: The Application for Payment at time of Substantial Completion and the final Application for Payment involve additional requirements.

2. Payment Application Times: As stated in the General Conditions, Payment applications are to be submitted monthly on a day of the month to be established by the County at the Pre-Construction conference.

3. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Contractor. Incomplete applications will be returned without action.

   a. Submit applications typed on forms provided by the County.

   b. Use data on Bid Form and approved Schedule of Values. Provide dollar value in each column for each line item for portion of Work performed and for stored products.

   c. List each authorized Change Order and an extension or continuation sheet, listing Change Order number and dollar amount as for an original item of work.

   d. Each item shall have an assigned dollar value for the current pay period and a cumulative value for the project to-date.

   e. Submit stored material log, partial waivers of claims and mechanic liens, and consent of surety with each application, as further explained below.

4. Submit a stored material log with each application for payment which identifies the type, quantity and value of all stored material, and that tracks when the stored materials are installed and deducts them from stored quantity at that time. Include original invoices for all stored materials that payment is requested.

5. Waivers of Claims and Mechanics Lien: With each Application for Payment submit waivers of claims and mechanics liens from Subcontractors or Sub-subcontractors and suppliers for the construction period covered by the previous applications.

    a. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.

    b. When an application shows completion of an item, submit final or full waivers.

    c. The County reserves the right to designate which entities involved in the Work must submit waivers.

    d. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of work covered by the application that could lawfully be entitled to a payment claim or lien.

    e. Waiver Forms: Submit waivers of claims and lien on forms and executed in a manner acceptable to the County.

6. Transmittal: Submit four (4) executed copies of each Application for Payment to the County by means ensuring receipt within 24-hours. One (1) copy shall be complete, including waivers of lien and similar attachments when required.

    a. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the County.

    b. The Contractor shall include a certification with each application stating that all previous payments received from the County under the

Contract have been applied by the Contractor to discharge in full all obligations of the Contractor in connection with the Work by prior applications for payment, and all materials and equipment incorporated into the Work are free and clear of all liens, claims, security interest and encumbrances.

7. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:

   a. List of Subcontractors

   b. List of principal suppliers and fabricators

   c. Schedule of Values

   d. Contractor's Construction Progress Schedule (accepted)

   e. List of Contractor's staff assignments

   f. Copies of building permits

   g. Copies of authorizations and licenses from governing authorities for performance of the Work

   h. Certificates of insurance and insurance polices

   i. Performance and Payment bonds (if required)

   j. Data needed to acquire County's insurance

8. Monthly Application for Partial Payment: Administrative actions and submittals that must precede or coincide with submittal of Monthly Partial Payments include the following:

   a. Relevant tests

   b. Progressive As-builts (one (1) paper copy and electronic copy)

   c. Table 01050-2 Asset Attribute Data Form Examples (one (1) paper copy and electronic copy)

d. Table 01050-3 Pipe Deflection Table Example (one (1) paper copy and electronic copy)

e. Table 01050-4 Gravity Main Table (one (1) paper copy and electronic copy)

f. An electronic copy of all survey field notes

g. Partial Release of lien

h. Partial consent of surety

i. Site photographs

j. Updated Progress Schedule: submit one (1) electronic copy and five (5) copies

k. Summary of Values

l. Pay Request

m. On-Site Storage

9. Substantial Completion Application for Payment: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment. This application shall reflect any Certificates of Partial Substantial Completion issued previously for County occupancy of designated portions of the Work.

   Administrative actions and submittals that shall precede or coincide with this application include:

   a. Occupancy permits and similar approvals

   b. Warranties (guarantees) and maintenance agreements

   c. Test/adjust/balance records

   d. Maintenance instructions

   e. Meter readings

   f. Start-up performance reports

   g. Change-over information related to the County's occupancy, use, operation and maintenance

h. Final Cleaning

i. Application for reduction of retainage and consent of surety

j. Advice on shifting insurance coverage

k. List of incomplete Work, recognized as exceptions to County's Certificate of Substantial Completion

10. Final Completion Application for Payment: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:

    a. Prior to submitting a request for final payment or the County issuing a Certificate of Completion for the Work, the Contractor shall submit the final Record Documents to the County for approval. Retainage funds will be withheld at the County's discretion based on the quality and accuracy of the final Record Documents.

    b. Completion of project close-out requirements

    c. Completion of items specified for completion after Substantial Completion

    d. Assurance that unsettled claims are settled

    e. Assurance that work not complete and accepted is now completed

    f. Transmittal of required project construction records to the County

    g. Proof those taxes, fees and similar obligations have been paid

    h. Removal of temporary facilities and services has been completed.

    i. Removal of surplus materials, rubbish and similar elements

    j. Change of door locks to County's access

k. Execute certification by signature of authorized officer.

l. Prepare Application for Final Payment as required in General Conditions.

D. Submittal Procedures

1. Submit four (4) copies of each Application for Payment at time stipulated in Agreement.

2. Submit under transmittal letter.

E. Substantiating Data

1. When the County requires substantiating information, submit data justifying line item amounts in question.

2. Provide one (1) copy of data with cover letter for each copy of submittal. Show Application number and date, and line item by number and description.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01040 CONSTRUCTION COORDINATION

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.

3. Coordinate your activities in the interface or common areas with these other contractors. Submit to the Owner and Engineer a description and schedule as to how the common areas will be utilized, recognizing the required coordination with other contractors.

4. The existing wastewater treatment facilities must remain in service at all times during construction with the exception of the following;

Unit Process	Outage Duration	Work to be Performed
Existing North Electrical Building	24 hrs	Process 150
Existing WAS Holding Tanks	48 hrs	Process 620
Existing Biosolids Handling Building	48 hrs	Process 630
Existing Belt Filter Press Dewatering Building	48 hrs	Process 640

5. All contact, request, coordination with all County Personnel including but not limited to the EWRF Operation staff for any reason shall be initiated through Owner’s Resident Project Representative (R.P.R.)in writing by the Contractor processing a Construction Assistance Request (C.A.R.). Contractor will not have contact with any County personnel without processing of a C.A.R. through the County’s R.P.R.

6. Unless otherwise noted within the Contract Documents, for all activities affecting treatment process operation, a CAR shall be submitted a minimum of thirty (30) days in advance of the scheduled activity. Unless otherwise noted within the Contract Documents, the

schedule for performing work which will require shutting down a unit process must be coordinated with the Owner by CAR submittal a minimum of sixty (60) days in advance of the scheduled activity. Connections to existing piping and structures must be coordinated with the Owner as described herein or other pertinent Sections. The Owner will provide the Contractor with the day and start/stop points for the aforementioned allotted time period. Utilities

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

B. Cutting and Patching

No cutting and patching of new work will be accepted. All work must be new and continuous in its final form.

C. Scheduling

Certain items cannot be removed, replaced, abandoned, or demolished until certain other work has been accomplished. The following describes the other work to be accomplished before such work may be performed. The contractor shall take the following items into account when creating the construction schedule required by Section 01323:

1. General Sequence of Construction

   a. Install storm water Best Management Practices prior to any work on the sites.

   b. Perform demolition and abandonment of existing utilities. Reference the Drawings and other Sections for areas of demolition and abandonment that require coordination with replacement utilities or other process improvements.

   c. Clear and grub site. Install on-site yard piping and electrical/instrumentation & control improvements. Test yard piping and electrical/instrumentation & control facilities.

   d. Construct electric ductbanks, external electrical, mechanical and HVAC components.

   e. Construct centrifuge dewatering building, WAS booster pump station and WAS storage tank modifications.

f. Perform field testing of individual process equipment, as described in the equipment specifications. Perform start-up testing and system testing of treatment process, as described in Section 01664.

g. As described in Section 01664, Part 1.A.4, the Contractor is to perform system start-up and system testing procedure for the following major facilities;

(1) Existing North Electrical Building (Process 150)

(a) Unit Substation 1

(b) Unit Substation 2

(2) New WAS Booster Pump Station (Process 610)

(3) Existing WAS Holding Tanks (Process 620)

(a) WAS Holding Tank 1, 620–TK-1

(b) Was Holding Tank 2, 620–TK-2

(4) Existing Biosolids Handling Building (Process 630)

(5) Existing Belt Filter Press Dewatering Building (Process 640)

(6) New Centrifuge Dewatering System (Process 650)

(a) Centrifuge 1, 650–CF–1

(b) Centrifuge 2, 650–CF–2

(c) Centrifuge 3, 650–CF–3

All equipment and facilities associated with each centrifuge is also to be performed coincident to the start-up and system testing procedure for the centrifuge.

(7) As described in Section 01664, the Contractor is to perform system start-up and system testing procedure for the remaining facilities;

(8) Existing roadway & storm drain repairs, sidewalks and perform fine grading over the site.

2. Specific Construction Sequencing

(1) Construction of the Centrifuge Dewatering Improvements (Bid Package B) shall commence coincident to the commencement of construction of the Phase V Improvements (Bid Package A). The Contractor shall not delay initiation of construction of the Centrifuge Dewatering Improvements.

(2) Excluding the duration(s) noted in Part A.4 herein; service must be maintained continuously throughout the duration of the contract. Per Parts A.5, for the performing the shutdown designated in Part A.4; a Construction Administration Form C.A.R. Form is to be processed with the Owner's R.P.R. The Contractor shall execute the Work by performing the following specific sequences;

(a) Existing North Electrical Building (Process 150) – The Contractor shall perform the Work designed in Process 150 one unit substation at a time, in order to maintain electrical service to facilities and processes served by Substations 1 and 2 at all times. Work on the second substation shall not be performed until the Owner has satisfactory beneficial use, as designated by the Owner's R.P.R, of the first substation that was improved. Reference the Electrical Drawings and Sections for further coordination and details. The existing HVAC and electrical equipment shall not be demolished until the new HVAC system is tested and the Owner has beneficial use of the equipment, or temporary HVAC equipment is provided by the Contractor.

(b) Existing WAS Holding Tanks (Process 620) – The Contractor shall perform the Work designed in Process 620 one tank at a time, in order to maintain service to facilities and processes served by Process 620 at all times. Work on the second tank shall not be performed until the Owner has satisfactory beneficial use, as designated by the Owner's R.P.R, of the first tank that was improved.

(c) Existing Biosolids Handling Building (Process 630) – The Contractor shall perform the Work associated with the WAS pumps and polymer pumps in such a manner to maintain service to Processes 620 and 640 at all times. The polymer pumps shall be replaced in sequence such that there are always two operational pumps at all times. The piping and equipment improvements to the WAS pumps shall be performed in such a manner that there are always two pumps in operation at all times. The Contractor shall provide temporary piping, valves and appurtenances to bypass the existing WAS piping in order to perform the Work and maintain service at all times.

(d) Existing Belt Filter Press Dewatering Building (Process 640) – Reference Part D.2(c) for coordination and sequencing with Process 630. The demolition of the conveyors and abandonment of the existing belt filter presses shall not be performed until Process 650 is substantially complete. Excluding the duration noted in Part A.4 herein; Process 640 must be operable continuously throughout the duration of the contract. Work will be performed surrounding Process 640 that will prevent solids hauling trucks from accessing the truck bay. Reference the Drawings, the Work is to be performed in such a manner so as to only restrict vehicular access to Process 640 for the outage duration(s) noted in Part A.4.

(e) New Centrifuge Dewatering Improvements (Process 650) – Reference parts herein for other process areas associated with Process 650. The Contractor is perform the Work associated with Processes 610, 620 and 630 prior to performing start up and testing of Process 650. The centrifuges and associated equipment with each centrifuge shall be started-up and tested one centrifuge at a time. The WAS and polymer pumps in Process 630 shall be isolated from Process 640 to direct WAS and polymer to each respective centrifuge in order to

perform start-up and testing in sequence. During start-up and testing of the centrifuges the Owner shall have the capability of using both belt filter presses in Process 640 for dewatering. Start-up and testing on the second centrifuge shall not be performed until the Owner has satisfactory beneficial use, as designated by the Owner's R.P.R, of the first centrifuge. Start-up and testing on the third centrifuge shall not be performed until the Owner has satisfactory beneficial use, as designated by the Owner's R.P.R, of the first and second centrifuges. Substantial completion of Process 650 shall not be issued until the Owner has satisfactory beneficial use, as designated by the Owner's R.P.R, for Processes 140, 150, 610, 620 and 630.

END OF SECTION

SECTION 01050 SURVEYING AND FIELD ENGINEERING

PART 1 - GENERAL

A. Description

1. Professional Surveyor: Provide professional surveying and mapping work required for the execution of the contract, including verification of existing survey data, construction layout, and production of the As-Built Drawings. This Work shall be performed by a Surveyor that is licensed by the State of Florida as a Professional Surveyor and Mapper pursuant to Chapter 472, F.S.

2. Professional Engineer: The Contractor shall provide the services of a Registered Professional Engineer currently licensed in the State of Florida for the following specific services as applicable to the Work.

B. REQUIREMENTS

1. Survey Services

a. The Contractor shall retain the services of a registered Surveyor and Mapper licensed in the State of Florida to provide professional surveying and mapping services, and maintain both a control survey and an as-built survey during construction. The Surveyor will identify control points (monuments and benchmarks noted on the Drawings). The construction layout survey shall be established from the control points shown on the Construction Drawings and confirmed. The method of field staking for the construction of the Work shall be at the option of Contractor. The accuracy of any method of staking shall be the responsibility of Surveyor. All staking shall be done to provide for easy verification of the Work by the County. The Contractor shall provide all surveys necessary for the construction of the Work.

2. Engineering Services

a. The Engineer shall be responsible for duties during

Construction to include, but not limited to:

1) Inspections, testing, witnessing requiring a licensed Professional Engineer.

2) Design of temporary shoring, bridging, scaffolding or other temporary construction, formwork and protection of existing structures.

3) Other requirements as specified herein.

b. Engineering related designs, tests and inspections shall be signed by the licensed Professional Engineer as required by the County.

C. Qualifications of the Surveyor

The Surveyor, who is proposed by the Contractor to provide services for the Project, is subject to the approval of the County. Prior to any services being performed, the Contractor shall submit the name and address of any proposed Surveyor and a written acknowledgement from the Surveyor stating that he has the hardware, software and adequate scope of services in his agreement with the Contractor to fully comply with the requirements of this specification. These submittals shall be provided to the County prior to Notice to Proceed. It is recommended that the Surveyor attend the Pre-Construction meeting. Any Surveyor, who has not previously performed work for the County shall attend the Pre-Construction meeting.

D. Submittals

1. Provide qualifications of the Surveyor or Engineer.

a. A Florida Registered Professional Engineer or Registered Surveyor and Mapper, who is proposed by the Contractor to provide services for the Work, shall be acceptable to the County prior to field services being performed.

b. A Professional Engineer shall be of the discipline required for the specific service for the Work.

c. Submit name, address and telephone number of the Surveyor and/or Engineer, as appropriate to the

County for acceptance before starting survey or engineering work.

2. On request, submit documentation verifying accuracy of survey work.

3. Surveyor shall certify all elevations and locations included in Table 01050- 2, 3, and 4.

PART 2 - PRODUCTS

A. Survey Documents

1. Survey documents shall comply with the Minimum Technical Standards of Chapter 5J-17 of the Florida Administrative Code (FAC) and Table 01050-1 Minimum Survey Accuracies, whichever are more stringent. All coordinates shall be geographically registered in the Florida State Plan Coordinate System using the contract Drawings control points for horizontal and vertical controls.

2. The Surveyor shall not copyright any of their Work related to this project.

Table 01050-1
Minimum Survey Accuracies

Asset	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: Horizontal Center and Vertical Top, unless otherwise specified
Bench Marks	0.01	0.01	Point
Baseline Control Locational Accuracy	0.01	N/A	Point
Tract and Easement Corners	*	N/A	Survey Monuments
Mains at 100-feet maximum intervals	0.1	0.1	Pipe, Pipe at Valves, Pipe at Bore & Jack Casing
PVC pipe >16-inch at every pipe joint	0.1	0.1	Pipe, Pipe at Valves, Pipe at Bore & Jack Casing
Fittings, Sleeve, Tapping Saddle, and end of the pipe if Plugged or Capped.	0.1	0.1	Fitting

Table 01050-1
Minimum Survey Accuracies

Asset	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: Horizontal Center and Vertical Top, unless otherwise specified
Restrained Pipe	0.1	N/A	Restrained Joint Limits
Connections	0.1	0.1	Pipe
Bore & Jack Casing	0.1	0.1	Top of Casing at the Casing Limits
Directional Drill	0.1	0.1	10-foot intervals during the directional drill operation
Hydrants	0.1	N/A	Operating Nut of Hydrant
Valves	0.1	0.1	Operating Nut
Air Release, Blow off, and Backflow Valves	0.1	N/A	Valve Enclosure
Master Meters, Deduct Meters & Wastewater Meters	0.1	N/A	Register
Meter Box	0.1	N/A	Meter Box
Clean out	0.1	N/A	Clean out
Manhole Rim	0.1	0.1	Manhole
Manhole Inverts	N/A	0.01	Pipe Inverts
Pump Station (Public & Private)	0.1	0.01	Wetwell and Pipe Inverts
Production Well or Monitoring Well	0.1	0.1	Well
Grease Interceptor	0.1	0.1	
Oil / Water Separators	0.1	0.1	
Demolished Pipe (abandoned in place or removed)	0.1	0.1	Limits of Abandoned or Removed Pipe
Existing Utilities water, wastewater, reclaimed water, and appurtenant structures **	0.1	0.1	Pipe or Structure
* Shall conform to the requirements of the "Chapter 5J-17, 'Minimum Technical Standards', FAC", certified by a SURVEYOR.			

Table 01050-1
Minimum Survey Accuracies

Asset	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: Horizontal Center and Vertical Top, unless otherwise specified
** Existing utilities including but not limited to water, wastewater, reclaimed water, stormwater, fiber optic cable, electric, gas and structures within the limits of construction.			

TABLE 01050-2

Asset Attribute Data Form Examples

Hydrants Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Manufacturer	Model #	Comments
2	FH-1	C-7	518456.40	1483743.63	49.53	Brand B	XJ7-B	
3	FH-2	C-9	518477.68	1483758.95	54.23	Brand B	XJ7-B	

General Info | Hydrant | Valve | Manhole | Meter | Fitting | Cleanout | Pipe

Valves Worksheet

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	A	C	D	E	F	G	H	I	J
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Valve Type	Main Type	Valve Size	Valve Manufacture
2	ARV-1	C301	518060.09	1483231.33	81.72	ARV - Combination	Water Main	2	Brand H
3	ARV-1	C303	518083.55	1483280.50	81.15	ARV - Vacuum	Force Main	4	Brand G
4	BFP-1	C303	518086.00	1483282.88	78.21	Backflow Preventer	Reclaimed Water Main	8	Brand F
5	BO-9	C405	518088.83	1483289.43	78.20	Blowoff	Water Main	2	Brand E
6	BFV-1	C405	518088.11	1483295.00	81.95	Butterfly	Water Main	30	Brand D
7	GV-3	C405	518132.54	1483372.75	81.23	Gate	Water Main	16	Brand C
8	LS-W1	C405	576779.36	1539706.97	64.30	Line Stop	Water Main	16	Brand B
9	PV-22	C405	576880.60	1539718.32	64.52	Plug	Force Main	12	Brand A

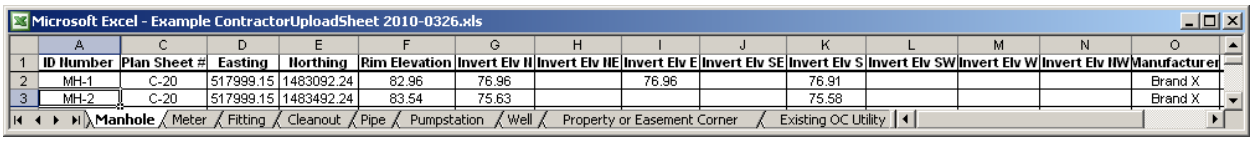
General Info | Hydrant | Valve | Manhole | Meter | Fitting | Cleanout | Pipe | Pumpstation | Well

Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	J	K	L	M	N	O	P	Q
1	Valve Manufacturer	Valve Model #	# of Turns to Close	Gear Actuator	Gear Ratio	Side Actuator	uator Manufact	Comments
2	Brand H	100XT						
3	Brand G	1000						
4	Brand F	2000 fgs						
5	Brand E	14 turbo						
6	Brand D	230 xls	200	Yes	3 to 1	Yes	Brand C	
7	Brand C	2225846	300	Yes	3 to 1	NO		
8	Brand B	7n6r44						
9	Brand A	Z100	200	Yes	3 to 1	Yes	Brand A	

General Info | Hydrant | Valve | Manhole | Meter | Fitting | Cleanout | Pipe | Pumpstation | Well

Manhole Worksheet

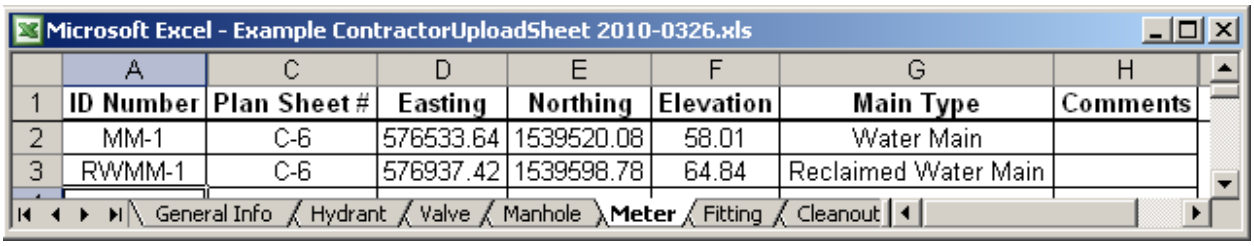


Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	A	C	D	E	F	G	H	I	J	K	L	M	N	O
1	ID Number	Plan Sheet #	Easting	Northing	Rim Elevation	Invert Elv N	Invert Elv NE	Invert Elv E	Invert Elv SE	Invert Elv S	Invert Elv SW	Invert Elv W	Invert Elv NW	Manufacturer
2	MH-1	C-20	517999.15	1483092.24	82.96	76.96		76.96		76.91				Brand X
3	MH-2	C-20	517999.15	1483492.24	83.54	75.63				75.58				Brand X

Manhole | Meter | Fitting | Cleanout | Pipe | Pumpstation | Well | Property or Easement Corner | Existing OC Utility

Meter Worksheet

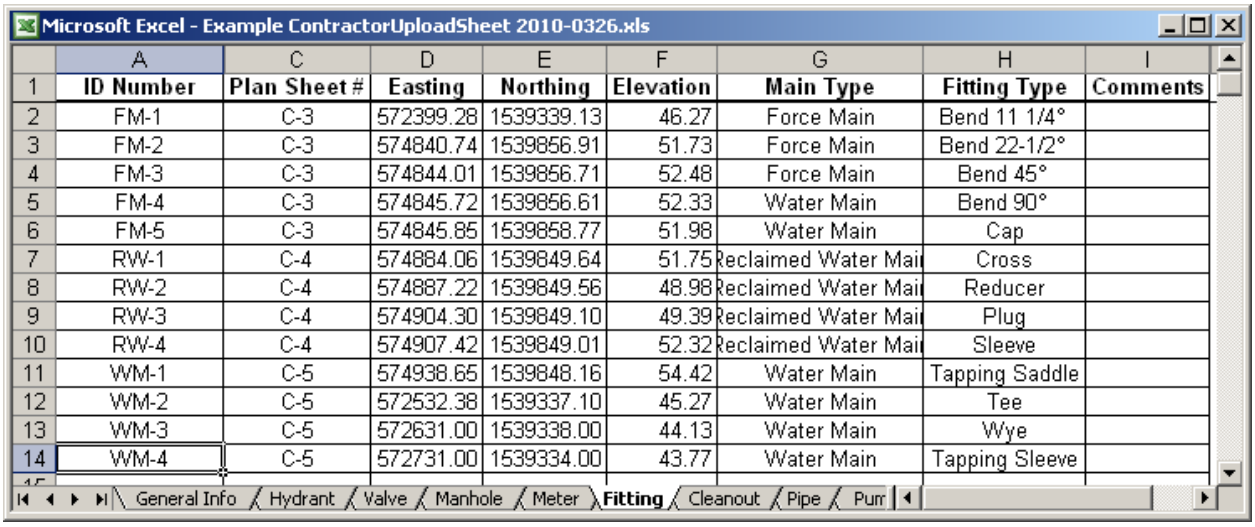


Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	A	C	D	E	F	G	H
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Comments
2	MM-1	C-6	576533.64	1539520.08	58.01	Water Main	
3	RWMM-1	C-6	576937.42	1539598.78	64.84	Reclaimed Water Main	

General Info | Hydrant | Valve | Manhole | Meter | Fitting | Cleanout

Fitting Worksheet

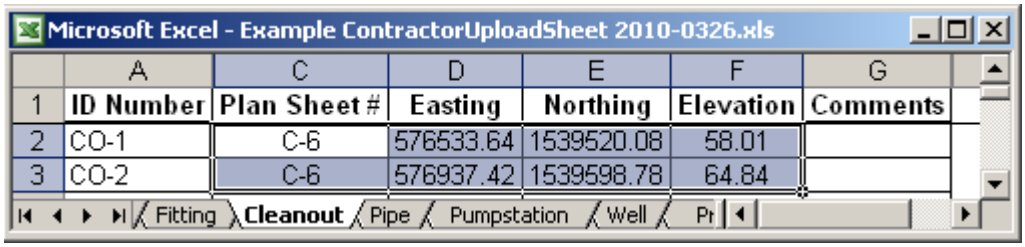


Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Fitting Type	Comments
2	FM-1	C-3	572399.28	1539339.13	46.27	Force Main	Bend 11 1/4°	
3	FM-2	C-3	574840.74	1539856.91	51.73	Force Main	Bend 22-1/2°	
4	FM-3	C-3	574844.01	1539856.71	52.48	Force Main	Bend 45°	
5	FM-4	C-3	574845.72	1539856.61	52.33	Water Main	Bend 90°	
6	FM-5	C-3	574845.85	1539858.77	51.98	Water Main	Cap	
7	RW-1	C-4	574884.06	1539849.64	51.75	Reclaimed Water Mai	Cross	
8	RW-2	C-4	574887.22	1539849.56	48.98	Reclaimed Water Mai	Reducer	
9	RW-3	C-4	574904.30	1539849.10	49.39	Reclaimed Water Mai	Plug	
10	RW-4	C-4	574907.42	1539849.01	52.32	Reclaimed Water Mai	Sleeve	
11	WM-1	C-5	574938.65	1539848.16	54.42	Water Main	Tapping Saddle	
12	WM-2	C-5	572532.38	1539337.10	45.27	Water Main	Tee	
13	WM-3	C-5	572631.00	1539338.00	44.13	Water Main	Wye	
14	WM-4	C-5	572731.00	1539334.00	43.77	Water Main	Tapping Sleeve	

General Info | Hydrant | Valve | Manhole | Meter | Fitting | Cleanout | Pipe | Pum

Cleanout Worksheet

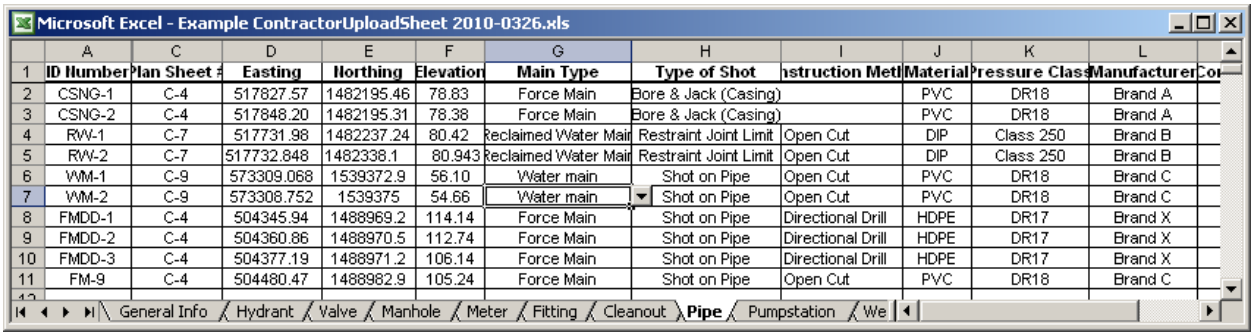


Microsoft Excel - Example ContractorUploadSheet 2010-0326.xls

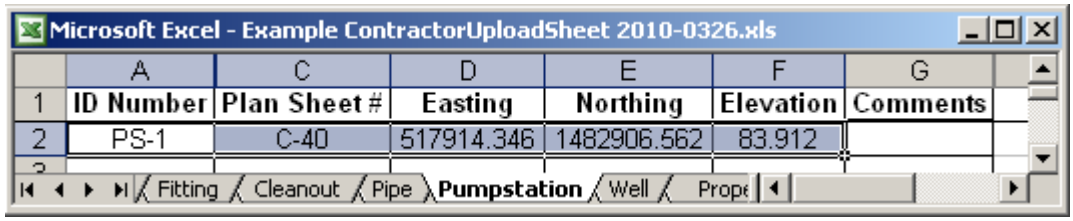
	A	C	D	E	F	G
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Comments
2	CO-1	C-6	576533.64	1539520.08	58.01	
3	CO-2	C-6	576937.42	1539598.78	64.84	

Fitting | Cleanout | Pipe | Pumpstation | Well | Pr

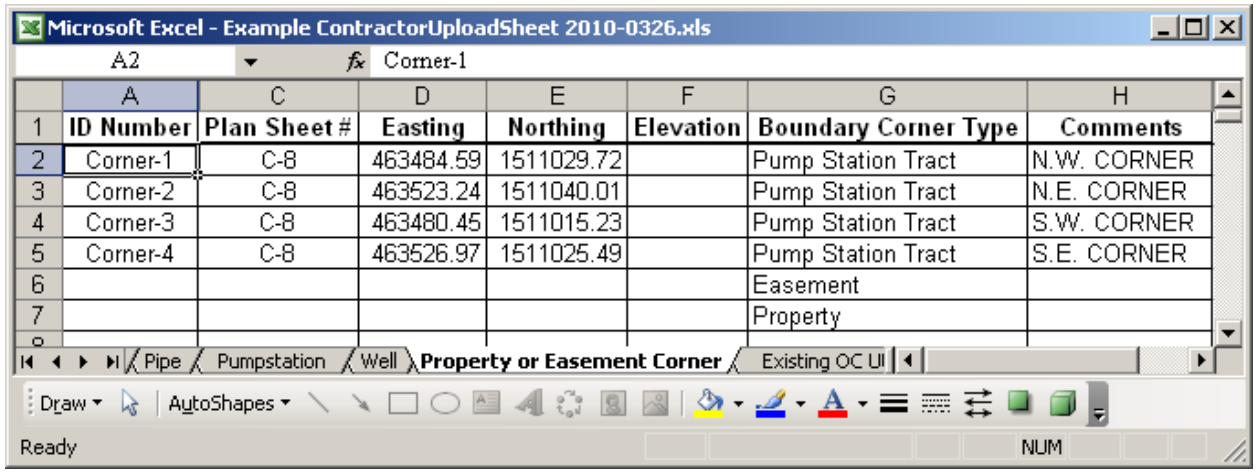
Pipes Worksheet



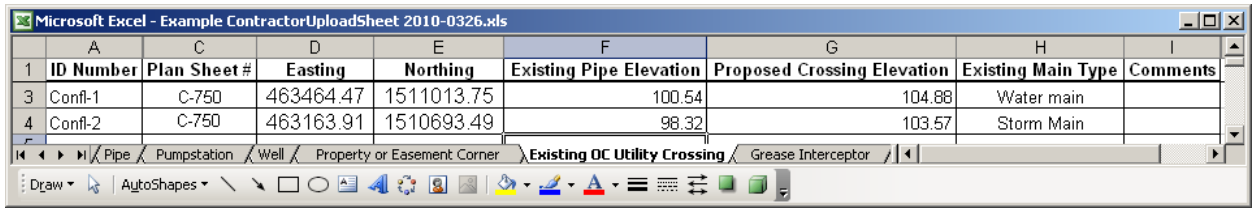
Well Worksheet



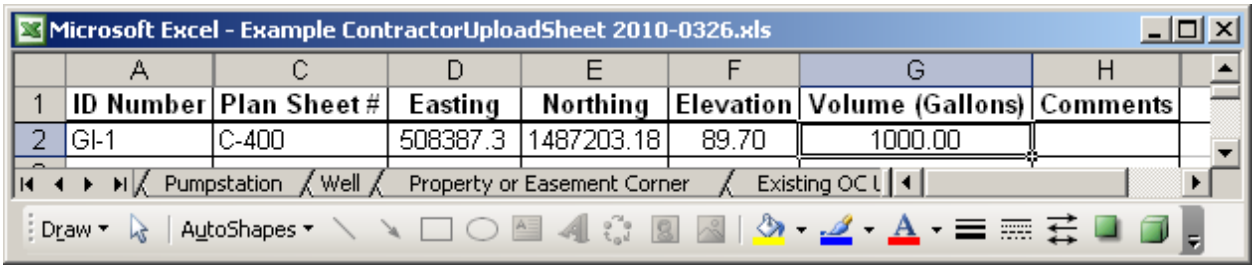
Easements Worksheet



Existing OC Utility Crossing



Grease Interceptor

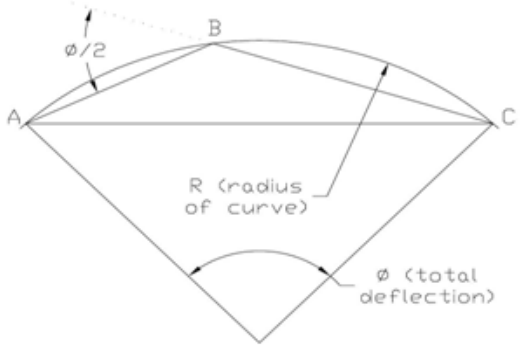


For ease of calculating pipe deflections in Table 01050-3, begin by providing a unique asset ID (top of pipe shots and fittings) for each utility and type, numbered sequentially along the pipe run (including changes in direction) from start to finish of the pipe in the Table 01050-2. Then branches and services of the same utility type can be numbered. It is recommended that each utility (water, wastewater or reclaimed water) numbering format be distinguishable from the other. This will allow organization and convenient sorting after the individual asset table worksheet tabs are combined in the spreadsheet program prior to copying and pasting to the deflection table spreadsheet.

TABLE 01050-3

PIPE DEFLECTION TABLE EXAMPLE

Project:			
Contractor:			
Progress Mtg Date:			
Contract #			
Dwg Sheet #			
Utility Type		FM	
Pipe Manufacturer		National Pipe	
Pipe size & material		16" PVC C905	
PVC Manufacturer Deflection		6	**inches**
County Allowable Deflection	75%	4.5	**inches**
Allowable Angle of Offset		1.5	**degrees**
Allowable Radius of Curvature		764	**feet**
Laying Length of Pipe		20	**feet**



ID	Size and Type	Northing	Easting	Elev.	Calculations Including Elevation (XYZ)						
					Distance between points AB	Distance between points BC	Distance between points AC	Total Deflection Ø'	Radius of Curve**	Average Offset Angle***	Average Offset****
					Length AB	Length BC	Length AC	XYZ (w/ elevation)	XYZ (w/ elevation)	per laying length	per laying length
					ft	ft	ft	degrees	ft	degrees	inches
14041	16" FM	1505131.50	468948.53	107.68	-	-	-	-	-	-	-
7000	16" FM	1505059.60	468932.08	108.15	73.76	38.93	112.66	5.48	1,178.35	0.97	4.07
2128	16" FM	1505022.11	468921.60	108.55	38.93	39.61	78.54	2.29	1,961.65	0.58	2.45
2127	16" FM	1504983.85	468911.35	108.29	39.61	38.35	77.96	1.78	2,505.50	0.46	1.92
2126	16" FM	1504946.67	468901.96	107.81	38.35	39.13	77.42	8.79	505.16	2.27	9.51
2125	16" FM	1504908.11	468895.31	107.48							

Data that has be inputted

Values in yelloware over spec

*Uses lawof cosines to determine angle ABC and Ø.
angle ABC = arccos((AB²+BC²-AC²)/(2*AB*BC))
180-Ø/2 = angle ABC
Calculate the total deflection Ø.
to the outer point (A or C) is equal in angle to
the approach from the next point along the

** Uses lawof sines, using the chord length AC and radius R.
Since sin((Ø/2)*(PI/180))=(Chord/2)/R and length AC=Chord
R=AC/(2*sin(Ø*PI/360)
This calculation assumes an average radius over the bend between three points.

*** Adds the lengths of AB + BC / 20ft to get an approximate number of bends over the span.
This value is divided by the total deflection
angle to calculate the average bend angle of
This assumes that the bend angle consistent across the entire length.

**** Uses average offset angle and laying length of pipe.

PART 3 - EXECUTION

A. Survey Field Work

1. Locate, reference, and preserve existing horizontal and vertical control points and property corners shown on the Drawings prior to starting any construction work. If the Surveyor performing the Work discovers any discrepancies that will affect the Project, the Contractor must immediately report these findings to the County. All survey work shall meet the requirements as defined in Florida Administrative Code 5J-17. Reference and preserve all survey points during Construction. If survey points are disturbed, it is the responsibility of the Contractor's Surveyor to reset the points at the Contractor's expense. Copies of the Surveyor's field notes and/or electronic files for point replacement shall be provided to the County.

   a. The Surveyor shall locate all improvements for the project As-Built Asset Attribute Data using State Plane Coordinates as the horizontal datum and the benchmark referenced on the Drawings as the vertical datum. The County will provide electronic files of the Drawings to be used by the Surveyor in complying with these specifications.

   b. The construction layout shall be established from the reference points shown or listed on the Drawings. The accuracy of any method of staking shall be the responsibility of the Contractor. All construction layout staking shall be done such as to provide for easy verification of the Work by the County.

2. Only a Surveyor licensed in the State of Florida shall be employed for this Work. All control points shall be protected by the Contractor from disturbance. If the monuments are disturbed, any Work that is governed by these monuments shall be held in abeyance until the monuments are reestablished by the Contractor and approved by the County. The accuracy of all the Contractor's stakes, alignments and grades is the responsibility of the Contractor. However, the County has the discretionary right to check the Contractor's stakes, alignments, and grades at any time.

3. Use survey control points to layout such work tasks

including but not limited to:

a. Clearing, grubbing, work limits, right-of-way lines and easements

b. Locations for pipelines and all associated structures and appurtenances

4. The Surveyor shall reference and replace any project control points, boundary corners, benchmarks, section corners, and right-of-way monuments that may be lost or destroyed, at no additional cost to the County. Establish replacement points based on the original survey control. Copies of all reference field notes and/or electronic files for point replacement shall be submitted to the County.

B. Surveying

1. Locate and protect existing horizontal and vertical control points shown on the construction Drawings prior to starting any work. If the Surveyor performing the Work finds differences that will effect the Work, the Contractor must immediately report the findings to the County. Establish control points, lines and levels by instrumentation and similar appropriate means. The location of these points should minimize the number of sightings necessary to control the Work and the likelihood of the points being disturbed. Preserve and reference all permanent reference points during Construction. If permanent reference points are disturbed, it is the responsibility of the Contractor’s Surveyor to reset the points at the Contractor’s expense. Copies of the Surveyor’s field notes shall be provided to the County.

a. Record locations, with horizontal and vertical data, on project As-Built survey.

b. Make no changes or relocations without prior written notice to the County or without receipt of written approval from the County.

c. Report to the County when any control point is lost or destroyed or requires relocation because of necessary changes in grades or locations.

2. Cover for water, reclaimed water and force mains shall vary to provide long uniform gradient or slope to pipe to minimize air pockets and air release valves. The locations shown on the Drawings for air and vacuum release valve assemblies are approximate and the Contractor shall field adjust these locations to locate these valves at the highest point in the pipeline installed.

3. To insure a uniform gradient for gravity pipe and pressure pipe, all lines shall be installed using the following control techniques as a minimum:

   a. Gravity lines: Continuous control, using laser beam technology,

   b. Pressure lines: Control stakes set at 50 ft. intervals using Surveyor’s level instrument.

C. Survey Documents

The Tables 01050-2 Asset Attribute Data, 01050-3 Pipe Deflection Table, and 01050-4 Gravity Main Table shall be signed, sealed and dated by the Surveyor with each pay request as specified in Section 01027 "Application for Payment" and the requirements of Section 01720 "Project Record Documents."

END OF SECTION

SECTION 01065 PERMITS AND FEES

A. General

The Contractor shall:

1. Obtain and pay for all permits and licenses as provided for in the General Conditions, except as otherwise provided herein.

2. Schedule all inspections and obtain all written approvals of the agencies required by the permits and licenses.

3. Comply with all conditions specified in each of the permits and licenses.

4. The Contractor shall, within 14 days of the date of the Notice-to-Proceed, prepare for and attend a meeting with representatives from the Owner and the Engineer to review requirements for preparation of a Florida Department of Environmental Protection (FDEP) Notice-of-Intent (NOI) application and Storm Water Pollution Prevention Plan (SWPPP) for compliance with the USEPA's NPDES General Permit for construction activities.

B. Permits by Contractor

Contractor shall apply and pay for at least the following permits and pay costs to keep permits active:

1. FDEP Notice of Intent to use the Generic Construction NPDES permit (See Section 02270).

2. St. John's River Water Management District Dewatering Permit. Refer to Section D below.

3. Orange County Division of Building Safety - Commercial Building Permit(s).

   a. General Commercial Building Permit – The County will pay all fees associated with the General Commercial Building Permit from the Orange County Division of Building Safety. Orange County Utilities Engineering will provide Resident Project Representatives for inspection services associated with the Utilities Engineering Division.

   b. Subtrade Commercial Building Permit(s) - The Contractor shall pay for and obtain all the Sub-trade Commercial Building Permits associated with the General Building Permit. The Contractor shall be

responsible for scheduling and paying for all inspection services associated with the Building Permit in order to obtain final approval.

c. Fire Alarm System – The Contractor is responsible for paying for and submitting fire alarm drawings signed and sealed by an electrical engineer registered in the State of Florida. These drawings shall be submitted to the Orange County Division of Building Safety within six (6) weeks of issuance of the Notice to Proceed for this project. The Contractor will be responsible for providing timely responses to any comments received from the Building Department to avoid delaying issuance of the Building Permit. The Contractor shall be responsible for scheduling and paying for all inspection services associated with the Fire Alarm System in order to obtain final approval.

d. Fence Permit - The Contractor shall pay for and obtain a permit for the chain link fence surrounding the proposed improvements

4. The Contractor shall pay for and obtain all other permits as required to perform the Work.

C. Permits by County

1. The County will apply and pay for the following permits:

a. Florida Department of Environmental Protection (FDEP) Domestic Wastewater Facility Permit.

b. Florida Department of Environmental Protection (FDEP) Environmental Resource Permit.

2. A copy of the FDEP permits obtained by the County will be furnished to the Contractor at the Preconstruction Conference.

3. The County will pay all fees associated with the General Commercial Building Permit from the Orange County Division of Building Safety. Orange County Utilities Engineering will provide Resident Project Representatives for inspection services associated with Utilities Engineering Division. The Contractor shall pay for and obtain all the Sub-trade Commercial Building Permits associated with the General Building Permit. The Contractor shall be responsible for scheduling and paying for all inspection services associated with the Building Permit in order to obtain final approval.

D. Dewatering Activities

If dewatering is required, the Contractor shall coordinate with the St. John’s River Water Management District regarding the applicable rules and regulations. If a dewatering permit is required, the Contractor shall prepare an application to the District and pay any fee.

END OF SECTION

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SECTION 01200 PROJECT MEETINGS

A. Preconstruction Conference

Pursuant to Article 5 of the General Conditions, a pre-construction conference will be held to discuss submittals as indicated in Section 01300 of this division and the Contractor’s responsibilities described in the General Conditions.

B. Monthly Progress Meetings

On days as mutually agreed upon in the pre-construction conference, monthly progress meetings shall be held at the County's office or Contractor's project office to review the progress of the work and required submittals.

C. Field Meetings

At strategic times during the construction process, as specified in the standard specifications and other locations in the Contract Documents, field inspection meetings shall be requested by the Contractor. Contractor shall coordinate such field inspection meetings as to fulfill requirements of these documents prior to the approval of progress pay requests for such items. The Contractor shall document the decisions and directives administered during Field Meetings within the Contractor’s Daily logs.

D. Project Close-Out Meeting

A project close-out meeting shall be held to finalize and secure the requirements as specified in Section 01700 of this division.

E. Attendance

The Contractor's relations with his subcontractors and material suppliers and discussions relative thereto are the Contractor's responsibility as described in the General Conditions and are not part of the project meetings content. Persons designated by the Contractor to attend and participate in project meetings shall have all required authority to commit the Contractor to solutions as agreed upon in the project meetings.

F. Minutes of Progress Meetings

The Engineer will compile a report of each progress meeting and will distribute copies to the Owner and the Contractor. The Contractor shall make and distribute other copies as necessary to subcontractors.

END OF SECTION

SECTION 01300 SUBMITTALS

A. General

1. This section includes the submissions of shop drawings, samples, operation and maintenance manuals and record drawings. There are other requirements in the Contract documents for submittals that are not addressed herein.

2. The submittal shall contain a copy of the pertinent specification Section(s) respective to that submittal, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. Accompanying a copy of the pertinent specification Section(s) as noted in Part A.2, the submittal shall contain a copy of the contract mechanical process, structural, electrical and instrumentation drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

4. Submittals shall be identified per the respective specification Sections which the elements are specified

within, e.g. 15100-001A for Manual, Check and Process Valves.

5. The Contractor shall group all elements specified within a respective specification Section into a singular submittal per that specification Section. For certain specification Sections with a large volume of content, the Contractor may provide no more than three (3) submittals for inclusive content within a singular specification Section.

6. Shop drawings and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at times convenient to the Engineer and at the Contractor's expense, based on the Engineer's then prevailing rates. The Contractor shall reimburse the Owner for all such fees invoiced to the Owner by the Engineer. Submittals are required until accepted. Any need for more than one (1) resubmission, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Time.

7. Partial submittals will not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor and will be considered "Not Accepted" until resubmitted. The Engineer may at his option provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

8. Identify submittals with the name of the project, date, and accompany each lot submitted with a letter of transmittal referring to the name of the project, the specification page number, and/or drawing number, and tag number for identification for each item. Submittals for each type of work shall be numbered per specification consecutively, and the numbering system shall be retained throughout all revisions.

9. In all submittals and schedules, allow 30 days for the Engineer's review of each shop drawing submittal or resubmittal.

10. Resubmittals will be handled in the same manner as first submittals. On resubmittals, the Contractor shall identify all revisions made to the submittals, either in writing on the letter of transmittal or on the shop drawing by use of revision triangles or other similar methods. The resubmittal shall clearly respond to each comment made by the Engineer on the previous submission. Additionally, the Contractor shall direct specific

attention to any revisions made other than the corrections requested by the Engineer on previous submissions.

B. Shop Drawings

1. Prepare shop drawings in accordance with Article 9 of the General Conditions and send to the Project Manager carriage prepaid. Submit shop drawings and product data for all materials and equipment to be incorporated into the Work.

2. The term "shop drawing" as used herein includes fabrication, erection and installation, layout, and setting drawings, manufacturer's drawings, descriptive literature, catalogs and brochures, performance and test data, mix design, wiring and control diagrams, all other drawings and descriptive data pertaining to materials, equipment, piping, duct and conduit systems, and methods of construction as may be required to show that the materials, equipment or systems, and the positions thereof conform to the Contract requirements. As used herein, the term "manufactured" applies to standard units usually mass-produced; and "fabricated" means items specifically assembled or made out of selected materials to meet individual design requirements.

3. Shop Drawings shall be prepared and submitted with identification per specification section wherein the elements are specified, e.g. 15100-001A for Manual, Check, and Process Valves.

4. Multiple shop drawings shall not be submitted for individual respective elements within a single specification section. One shop drawing shall be prepared per specification section in order to encompass all elements within that specification. For large specification sections, a group of no greater than three shop drawings shall be prepared for those sections.

5. Shop drawings shall establish the actual detail of all manufactured or fabricated items, indicate proper relation of adjoining work, amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure, and incorporate minor changes of design or construction to suit actual conditions. Shop drawings shall be drawn to scale and shall be completely dimensioned.

6. If shop drawings cover more than one piece of equipment or components, the shop drawing shall show the entire

assembly and the relationship and connections between all components.

7. Supply short and long term storage procedures on all equipment submitted.

8. Coordinate the shop drawings from different manufacturers and supplies so that all equipment and material will fit and work together.

9. The contract drawings are diagrammatic and are intended to indicate general arrangement of equipment, ducts, conduits, piping, and fixtures. The Contractor shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the materials/equipment he proposes to supply both as pertains to his own work and any work affected under other parts, headings, or divisions of drawings and specifications. Changes shall be reviewed in advance by the Engineer.

10. Shop drawings, including manufacturer's literature, catalog cuts, or other printed material shall be entitled with the name of the project on each sheet and shall otherwise be identified by listing the particular Division, Section, Article, or reference of the work pertaining thereto. Differing items shall not be submitted on the same sheet. For acceptance of differing items, any deviations shall be highlighted and annotated.

C. Samples

Submit physical examples to illustrate materials, equipment, or workmanship and to establish standards by which work is to be evaluated.

D. Equipment Operation and Maintenance Manuals

1. Provide installation, operation, and maintenance manuals from manufacturers and suppliers. Submit three (3) hard copies and one (1) electronic copy of manuals to the Project Manager within 30 days after review of shop drawings, product data, and samples and not later than the date of shipment of each item of equipment to the project site. Electronic copies shall be submitted in "PDF" format.

2. Provide manuals for each piece of equipment including individual components and subsystems of complete assemblies. Line out all non-applicable text and

illustrations. The section of the manual on operation shall describe the functions and limitations of each component and its relationship to the system of which it is a part. Where several models, options, or styles are described, the manual shall identify the items actually provided.

3. The manual shall contain the following:

   a. Manufacturer's identification, including order number, model, and serial number.

   b. Blue line prints or reviewed shop drawings and diagrams of all systems, including temperature control system.

   c. Certified equipment drawings or reviewed shop drawing data clearly marked for equipment furnished.

   d. Complete operating and maintenance instructions for each and every items of equipment, setting forth in detail and step-by-step the procedure for starting, stopping, operating and maintaining the entire system as installed. A schedule of recommended maintenance intervals shall also be included.

   e. Complete parts list of all replaceable parts, their part numbers, and the name and address of their nearest vendor.

   f. A complete valve tag list including the name and function of the pipe in which the valve is mounted.

   g. Any special emergency operating instruction and a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.

   h. All manufacturer's equipment guarantees and warranties.

4. Brochures shall be loose leaf with durable plastic or fiberboard covers. Each sheet shall be reinforced to prevent tearing from continued use, and each brochure shall have the following information clearly printed on its cover:

   a. Project name, name of County and address.

   b. Name and address of Engineers.

c. Name and addresses of Contractors and subcontractors and department to contact.

d. Telephone number of contractors, including night and emergency numbers.

e. Major equipment vendors' names and telephone numbers.

5. In addition to these written instructions, fully and carefully instruct the County or his selected representatives as to the proper care and maintenance of each system and its equipment, and provide signed statements from personnel receiving such instructions to the Engineer.

6. Submit complete manuals at least two weeks before the date of the instruction.

7. Operation and maintenance manuals specified herein are in addition to any operation, maintenance, or installation instructions required by the Contractor to install, test, and start up equipment.

E. Centrifuge Dewatering Operation and Maintenance Manual

1. The Contractor is required to retain an Engineer that is licensed in the State of Florida in order to prepare an Operations and Maintenance Manual for the new Centrifuge Dewatering Improvements. The Operations and Maintenance Manual shall meet the requirements and criteria noted within Rule 62-620 FAC and for preparation of Form 62-620.910(13) for the Notice of Availability of Record Drawings and Final Operations and Maintenance Manuals. The Engineer shall prepare a draft O&M Manual that will be submitted to Orange County Utilities for final review and acceptance.

F. Compilation of Manufacturer’s Warranties & Certification Letters

1. The Contractor shall provide and compile all documentation and pertinent information regarding all warranties on the Centrifuge Dewatering Improvements into compilation notebook(s). The warranties shall be collated in a series of notebooks that shall be indexed by equipment tag number, unit processes and/or other pertinent organizational method as directed by Orange County Utilities. The notebooks shall include a singular table which shall document the commencement and expiration dates of all warranties on the project. The table shall be electronically transmitted to Orange

County Utilities in MS Excel format. The information shall be formatted in a manner, as directed by the Orange County Utilities EWRF Operations staff, for input and incorporation into the County's Maximo Asset Management software. The warranties shall be accompanied by the manufacturer's certification letters that are supplied to the County for each respective piece of equipment furnished. The letters provide certification from the manufacturer that the equipment was properly installed in accordance with the contract documents, manufacturer's requirements and is operating properly at commencement of service. The letters shall be provided in the same divider as the warranty information.

G. Maximo Asset Management Software – Equipment Data

1. The Contractor shall prepare an MS Excel based spreadsheet in a format as provided or directed by the Orange County Utilities EWRF Operations staff, for pertinent specification data from all equipment furnished within the Project for input into the County's Maximo Asset Management software.

END OF SECTION

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SECTION 01310 PROGRESS SCHEDULES

PART 1 GENERAL

A. Requirement

1. The Contractor will submit precedence method cost-loaded Critical Path Method (CPM) Progress Schedules to the Project Manager depicting the approach to prosecution and completion of the Work. This requirement includes, but is not limited to the Contractor's approach to Activity cost-loading, recovering schedule and managing the effect of changes, substitutions and Delays on Work sequencing.

2. The Progress Schedule shall show how the Contractor's priorities and sequencing for the Work (or Work remaining) conform to the Contract requirements and the sequences of Work indicated in or required by the Contract Documents; reflect how the Contractor anticipates foreseeable events, site conditions and all other general, local and prevailing conditions that may affect cost, progress, schedule, furnishing and performance of the Work; and show how the Contractor's Means and Methods translate into Activities and logic.

3. The Progress Schedule will consist of the Initial Submittal, Payment Submittals and Revision Submittals. Upon acceptance by the Project Manager, the Initial submittal will become the As-Planned Schedule for the Work. Revision submittals upon acceptance will become the As-Planned Schedule for the Work remaining to be completed as of the submittal date for that Revision.

4. References to the Critical Path Method (CPM) are to CPM construction industry standards that are consistent with the requirements of this Section.

B. Glossary Of Terms

1. The following terms, whether or not already defined elsewhere in the Contract Documents, have the following intent and meanings within this Section:

a. Activity Value (Value) – That portion of the Contract Price representing an appropriate level of payment for the part of the Work designated by the Activity.

b. As-Planned Schedule – The first, complete Initial Progress Schedule submitted by the Contractor with the intent to depict the entire Work as awarded and

accepted by the Project Manager or returned as no resubmittal required.

c. Contract Float – Days between the Contractors anticipated date for completion of the Work, or of a specified portion of the Work, if any, and the corresponding Contract Time.

d. CPM Schedule – The Progress Schedule based on the Critical Path Method (CPM) of scheduling. The term Critical Path means any continuous sequence of Activities in the Progress Schedule controlling, because of their sum duration, the Early Date of a pertinent, specified Contract Time.

e. Early/Late Dates – Early/late times of performance, based on CPM calculations, for an Activity in the Progress Schedule. Early Dates will be based on proceeding with all or part of the Work on the date when the corresponding Contract Time commences to run. Late Dates will be based on completing all or part of the Work on the corresponding Contract Time, even if the Contractor plans early completion.

f. Milestones – Key, pre-determined points of progress in the completion of a facility, denoting interim targets in support of the Contract Times. Milestones may pinpoint targets for key excavation and substructure events, significant deliveries, critical path transition from superstructure to piping and electrical rough–in and building enclosure. Also, hook–up of mechanical and electrical equipment, availability of power for testing, equipment shakedown, training of County personnel, start–up, Substantial Completion and other events of like import.

g. Official Schedule – The Initial or most recent Revision Submittal accepted by the Project Manager or returned as no resubmittal required and the basis for Payment Submittals until another Revision Submittal is submitted and accepted. The accepted Initial Submittal is also the As-Planned Schedule.

h. Payment Submittal – A monthly Progress Schedule update reflecting progress and minor adjustments on the Activities, sequencing and restraints for Work remaining.

i. Total Float – Days by which an activity may slip from its Early Dates without necessarily extending a pertinent Contract Time. Total Float at least equals Contract Float. Total Float may also be calculated and reported in working Days. When an activity is delayed beyond Early Dates by its Total Float it becomes a Critical Path activity and if delayed further will impact a Contract Time.

C. Quality Assurance

1. The Contractor may self-perform the Work covered by this Section or employ a Subcontractor, subject to the Project Manager's consent. Employment of a scheduling Subcontractor shall not in any way alter or reduce the Contractor's obligations under the Contract Documents.

2. The Contractor will obtain a written interpretation from the Project Manager, if the Contractor believes that the selection of activities, logic ties and/or restraints requires a written interpretation of the Contract Documents. With each submission, the Contractor will point out by specific, written notation, any Progress Schedule feature that may reflect variations from any requirements of the Contract Documents.

3. It is the Contractor's responsibility to obtain information directly from each Subcontractor and Supplier when scoping their respective Activities, Values, logic ties and restraints.

4. Neither Acceptance nor Review of any Progress Schedule will relieve the Contractor from the obligation to comply with the Contract Times and any sequence of Work indicated in or required by the Contract Documents and to complete, within the Contract Times, any Work omitted from that Progress Schedule.

5. Neither Acceptance nor Review of any Progress Schedule will imply approval of any interpretation of or variation from the Contract Documents, unless expressly approved by the Project Manager through a written interpretation or by a separate, written notation on the returned Progress Schedule Submittal.

D. Allowances

1. Work covered by contractual allowances will be completed within the Contract Times. The Progress Schedule will incorporate the Contractor's best estimate of the activities, logic and restraints required, using the

information in the Contract Documents or as indicated by the Project Manager in writing.

E. "Or Equals" And Substitutions

1. Activities in the Initial Submittal will be based strictly on the products named or specified in the Contract Documents and will not reflect any "or equal" or substitute materials or equipment, even if the Contractor intends to pursue "or equal" and substitution proposals. This limitation also applies to Means and Methods indicated in or required by the Contract Documents.

F. Milestones And Schedule Recovery

1. The Project Manager will select Milestones and Milestone Dates on the basis of the As-Planned Schedule. As the Official Schedule is revised, Milestone Dates will be revised accordingly. Milestone Dates will serve as target dates.

2. Whenever any Activity slips by fourteen (14) or more Days from the Late Date for an activity in the Official Schedule, Milestone Dates selected by the Project Manger, or a pertinent Contract Time, the Contractor will deliver a Revision Submittal documenting the Contractor's schedule recovery plan and/or a properly supported request for an extension in the Contract Time. The narrative will identify the Delay and actions taken by the Contractor to recover schedule, whether by adding labor, Subcontractors or construction equipment, activity re-sequencing, expediting of submittals and/or deliveries, overtime or shift Work, and so forth. Activity shortening and overlapping shall be explained as to their basis (and be supported by increases in resources).

3. Upon evaluation of that Revision Submittal, if the Project Manager determines there is sufficient cause, the County may withhold liquidated damages or provide a notice of intent to do so, if schedule is indeed not recovered, and/or may give a notice of default.

G. Progress Schedule Software

1. The scheduling software employed by the Contractor to process the Progress Schedule will be the current version of Primavera P6® or Primavera® Contractor CPM scheduling software, no other software shall be allowed.

2. If the Contractor intends to use companion schedule reporting, analysis or graphics software tools, the

Contractor will furnish to the Project Manager descriptive materials and samples describing such software tools.

H. Non-Performance

1. The Project Manager may refuse to recommend all or any part of any payment, if the Contractor fails, refuses or neglects to provide the required Progress Schedule information on a timely basis. Partial payments without a properly updated Progress Schedule shall be returned to the Contractor as non-conforming.

2. If justified under the circumstances, the Owner also may prepare alternate Progress Schedules, as appropriate, and deduct from the Contract Amount all related costs by Change Order and/or take other action commensurate with the breach

I. Reports, Schedules And Plots

1. Schedule Reports will include Activity (ID) code and description, duration, calendar, Early Dates, Late Dates and Total Float. Separate Schedule Reports will tabulate, for each Activity, all preceding and succeeding logic types and lead times, whether CPM Plots displaying logic ties are appended or not.

2. CPM Schedule Plots will be plotted on a suitable time scale and identify the Contract Times, Critical Paths, phases and work areas on 24"x 36" or smaller sheets. Activities will be shown on the Early Dates with Total Floats noted by Late Date flags. For Payment and Revision Submittals plot a target comparison based on the current Official Schedule.

3. The Activity Value report will tabulate Activity code and description and Activity Value, percent complete and earned value as calculated by the scheduling software. Cash flow plots shall be provided showing the monthly and cumulative actual and planned earned values with curves shown for Early and Late Dates in the schedules. For Payment and Revision Schedule submittals, the cash flow curves shall also plot the most current Official Schedule planned earnings curves.

4. Each submittal shall include listings of all added and deleted activities, logic, constraints, Activity Value changes and update information vs. the previous Progress Schedule submittal. This list may be manually prepared or generated by accessory software that will generate such listings.

J. Narrative Requirements

1. The Initial Submittal narrative will describe the Contractor’s approach to prosecution of the Work and the basis for determination of activity durations, sequence and logic, including the Contractor's management of the site, e.g., lay down, staging, parking, etc.; Contractor’s phasing of the Work; use of crewing and construction equipment; identification of non-work Project Managers, shifts, weekend Work and multiple calendars applied to activities and an explanation of the basis for restraint dates

2. Revision and Payment Submittal narratives will explain any changes to the approach or planning referred to in Paragraph A above on account of any change, delay, schedule recovery, substitution and/or Contractor-initiated revision occurring since the previous submittal.

3. Each narrative will list the Critical Path Activities and compare Early and Late Dates against Contract Times and Milestone Dates. Narratives shall also recap progress and Days gained or lost vs. the current Official Schedule, and identify delays, their extent and causes.

4. The Initial Submittal narrative will describe all delays occurring since Contract Award and all pending and anticipated “or equal” and substitution proposals. Payment and Revision Submittals narratives will describe any new delays and shall certify that the Contractor has not been delayed, as of the cut-off date, by any acts or omissions of the County or Project Manager, except as otherwise specifically stated.

K. Activity Requirements

1. Separate activities will identify permits, design when included in the Work, construction, Submittal preparation and review (and resubmission and re-review), deliveries (site or storage), testing, start-up, commissioning and Punch List. Separate Activities will be used for County-furnished equipment, interfaces with other work and other responsibilities of the County, Project Manager and Professional.

2. Activities will be detailed to the extent required to show the transition of trade Work. Activities will delineate the progression of the Work through mass excavation, substructure, superstructure, equipment installation, start of piping and conduit rough-in, building enclosure, mechanical and electrical equipment hook–up phase, building mechanical, electrical and plumbing (MEP),

interior finishes, training of County personnel, equipment checkout & testing and start–up.

3. Submittal Activities will segregate long-lead items, any item requiring structural access and other procurements that, in the Contractor's judgment, may bear on the rate of progress. If the Contract Documents require MEP coordination drawings, separate MEP coordination drawing Activities will be used for each floor. Allow time for reviews per Section 01300 and the General Conditions, and revisions and re-submittals. Also include activities for or provide a separate tabular schedule of submittal dates for all shop drawings, product data, and samples including County furnished products and the dates reviewed submittals will be required from the Project Manager. Indicate decision dates for selection of finishes.

4. Activities will not combine separate or non-concurrent items of Unit Price or lump sum Work, Work in separate structures and Work in distinct areas, locations or floors within an area or structure; or rough-in and finish Work.

5. Activity durations will equal the work Days required to sufficiently complete the Work designated by the Activity, (i.e., when finish-to-start successors could start, even if the Activity is not quite 100% complete). Installation Activities will last from ten (10) to forty (40) workdays. Submittal review activity durations shall conform to specified timeframes.

6. Activities will be assigned consistent descriptions and identification codes. Sort codes will group Activities by building or structure, floor or area, Change Order and other meaningful schemes.

7. Activities will be assigned Activity Values as appropriate and needed to reasonably allocate the Contract Amount to the time periods that they will be earned and eligible for payment based on the Progress Schedule and Schedule of Values. Separate pay activities may be used to simplify cost-loading of the Progress Schedule. When used, pay activities shall be loaded with the cost of Work that is included, at no cost, in related (generally, concurrent) CPM activities. Pay activities shall not control the rate of progress; however, their start and finish dates shall be consistent with those of their related CPM activities to ensure accurate Early Date and Late Date cash-flow plots.

L. Float Tolerances And Float Ownership

1. Any Progress Schedule with Early Dates after a Contract Time will yield negative Total and Contract Floats, whether shown/calculated or not. Any Revision Submittal with less than negative twenty (20) Days of Float will be returned as “Revise and Resubmit,” unless a time extension is requested or the County assesses liquidated damages or gives notice of intent to do so, in the event schedule is not recovered.

2. Float calculated from the definitions given in this Section supersede any conflicting Float values in any early completion Progress Schedule.

3. Neither the County nor the Contractor own the Float time, the Project owns the Float time. Neither the County nor the Contractor use of positive Total Float will impact a Contract Completion Date or justify an extension of Contract Time.

M. Submittals

1. Each Progress Schedule Submittal will consist of a narrative, five (5) copies of the required reports and plots and an optical ROM data disk with the Contractor's corresponding schedule and schedule layout files in Primavera “.XER” format.

2. The Project Manager will review Progress Schedule Submittals and return a review copy within 14 Days after receipt and the Contractor shall, if required, resubmit within 7 Days after return of the review copy.

3. Requirements for a Preliminary Submittal:

   a. Within twenty (20) Days after receipt of Notice to Proceed and prior to commencing Work on the Project, prepare and submit to the Project Manager a Preliminary Submittal of the Progress Schedule for the Work. The Preliminary Submittal will show the Work as awarded, without delays, Change Orders or substitutions. The Preliminary Submittal shall be in CPM format and show general work planning and sequencing for the entire Contract Time and detailed planning for the first 90 days after Notice to Proceed.

   b. No cost or resource loading of activities is required for the Preliminary Submittal. The Project Manager may issue comments on the Preliminary Submittal. A narrative should be included if needed to clarify

planning and sequencing represented in the Preliminary Submittal. Any comments issued should be considered and incorporated as appropriate in the development of the full Progress Schedule Initial Submittal.

4. Requirements for the Initial Submittal:

   a. Within forty-five (45) Days after receipt of Notice to Proceed and prior to commencing Work on the Project, prepare and submit to the Project Manager the Initial Submittal of the Progress Schedule for the Work. The Initial Submittal will show the Work as awarded, without delays, Change Orders or substitutions.

      (1) Activity Values will prorate Schedule of Values costs and/or pay items through to Activities. Provide a cross-reference listing with two parts; a part that will list each activity with the respective amounts allocated from each Schedule of Values and Unit Price Item making up the total value of each activity and a second part that will list the Schedule of Values and Unit Price Items with the respective amounts allocated from each activity that make up the total value of each item.

   b. After the As-Planned Schedule is established, the Project Manager will select Milestones and record the Milestone Early and Late Dates. As the Official Schedule evolves, Milestone Dates will be revised accordingly.

   c. If the Project Manager refuses to endorse the Initial Submittal (or a resubmission) as "Resubmittal Not Required," the As-Planned Schedule will not be established. In that event, the Contractor will continue to submit Payment and Revision Submittals reflecting progress and the Contractor's approach to remaining Work. The Project Manager will rely on the available Payment and Revision Submittals, subject to whatever adjustments it determines appropriate.

5. Requirements for Payment Submittals:

   a. Payment Submittals with progress up to the closing date and updated Early Dates and Late Dates for progress and remaining Activities will be due with each Progress Payment. As-built data will consist of actual dates, percent complete, earned payment, changes, Delays and other significant events occurring before the closing date.

b. Activity percent complete and earned value should indicate a level of completion that corresponds to the Application for Progress Payment for the same period. The earned value should be calculated by the scheduling software as Activity Value time’s percent complete. Explanation should be provided whenever the cumulative earned value of activities in a Payment Submittal is not within 10% of the value of work completed as represented in the corresponding Application for Progress for Payment.

c. At the Contractor’s option, a Payment Submittal may overlay minor adjustments on activities and sequencing for Work remaining. This excludes Activity re-scoping to reflect Delays, changes, schedule recovery or substitutions.

6. Requirements for Revision Submittals:

a. Revision Submittals will be submitted when necessary because of major changes or delays affecting activities, sequencing or restraints for Work remaining and/or to put forth a schedule recovery plan. Revision Submittals may also be required because of Contractor-initiated re-planning, or when Contractor plans to perform Work ahead or out-of-sequence that will require additional testing or inspection personnel, or when requested by the Project Manger when Work is performed out-of-sequence from the current Official Schedule such that the number of Days gained or lost can not be determined or the scheduled dates of completion of the Work in a Payment Submittal are not viewed as reliable.

b. If requesting a time extension, the Revision Submittal should show the impact of the delay after incorporating reasonable mitigation to minimize the impact and illustrate how the number of Days requested time extension was determined. The delay should be determined as the change in the forecast Contract Completion Date(s) resulting solely from delays that entitle the Contractor to a time extension as provided in the General Conditions. Any and all Contractor slippage and delay occurring prior to and concurrent with the delay potentially entitling the Contractor to a time extension shall be incorporated in the Revision and explained such that the concurrent and non-concurrent periods of delay are indicated. If the Contractor does not follow the procedures contained in this Section or, if the Contractor's analysis is not verifiable by an independent, objective evaluation by the Project Manager using the electronic files and

data furnished by the Contractor, any such extension in Contract Time will not be granted.

7. Retrospective Delay Analysis.

   a. If the Project Manager refuses to endorse any Revision Submittal as “Resubmittal Not Required,” the Contractor and County will use the latest Official Schedule when evaluating the effect of Delays on Contract Time and/or Contract Price. The procedure to be used will consist of progressively updating the latest Official Schedule at key closing dates corresponding to starting and finishing dates of the delays and/or dates the delays became critical or dates the Critical Path may have changed for other reasons. For each Progress Schedule iteration, slippage between actual Milestone Dates and Initial Milestone Dates will be correlated to Delays occurring solely in that iteration.

   b. For each iteration, revisions in Activities, logic ties and restraints affecting Work after the closing date will be included in that Progress Schedule only if they meet any of the following conditions. First, they are Progress Schedule revisions that the Project Manager consented to contemporaneously (i.e., before the closing date) in writing. Second, they reflect comments or objections raised by or on behalf of the Project Manager and that were actually confirmed by the as-built progress. Lastly, they represent Contractor’s schedule recovery plans or other Progress Schedule revisions that were actually confirmed by the as-built progress.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01323 SCHEDULE OF VALUES

A. Preliminary Schedule of Values

The preliminary schedule of values listing shall include, at a minimum, the proposed value for the following major work components:

1. General Requirements / Mobilization / Demobilization. General Requirement Mobilization/Demobilization costs on the Schedule of Values shall not exceed 5% of the total Contract Amount. All Work included in the Schedule of Value that falls under this heading as described in this paragraph (including such Work by Subcontractors) will be added and checked for compliance with the 5% limitation. Any actual cost in excess of this amount shall be distributed proportionately to Schedule of Values items for direct Work items not covered by this heading. Work under this heading may be detailed on Schedule of Value line items identifying each as to whether it is mobilization or initial costs, maintenance or overhead cost or finalization or demobilization cost. The subdivision of this Work into Schedule of Values line items shall be done to support the payment process that shall be distributed as follows: 50% for the first progress payment, 10% for the final payment following demobilization and restoration, and 40% spread evenly over payments made in between.

2. The total value of miscellaneous site improvements inclusive of clearing and grubbing, stripping, excavation, fill construction, paving, road removal, site restoration, and all incidental work associated with miscellaneous site improvements. This total value shall be itemized into separate values for each item.

3. The total value of yard piping construction work inclusive of fabrication, excavation, pipe installation, pipe structures (air-release valves, blowoff valves, and vents), backfilling, testing, site restoration, and all incidental work associated with yard piping construction. The total value shall be broken down into separate values for each pipe section.

4. The total value of reinforced concrete work by structure and building inclusive of all excavation, dewatering, subgrade preparation, backfill, and incidental work for all new structures. Additionally, this total value shall be broken down into separate values for each new

structure constructed as a part of the work. Miscellaneous and minor concrete work may be listed as one item in this breakdown.

5. The total value of all mechanical work (HVAC and plumbing), including piping, valves, and equipment.

6. The total value of process piping, valves, and mechanical equipment (such as pumps).

7. The total value of electrical work.

8. The total value of instrumentation and control work including fiber-optic cable system.

9. Record Drawings/Operations and Maintenance (O&M) Manuals/Warranty and Certification Documentation. A minimum of 0.5% of the total Contract Amount shall be included within the Schedule of Values for the Contractor's preparation of Record Drawings, Operations and Maintenance Manuals and the Warranty and Certification Documentation.

10. The total value of all other work not specifically included in the above items.

11. The Contractor and Engineer shall meet and jointly review the preliminary schedule of values and make any adjustments in value allocations if, in the opinion of the Engineer, these are necessary to establish fair and reasonable allocation of values for the major work components. Front-end loading will not be permitted. The Engineer may require reallocation of major work components from items in the above listing if, in the opinion of the Engineer, such reallocation is necessary. This review and any necessary revisions shall be completed within 15 days from the date of the notification of the required reallocation.

B. Detailed Schedule of Values

1. Base the detailed schedule of values on the accepted preliminary schedule of values for major work components. Because the ultimate requirement is to develop a detailed schedule of values sufficient to determine appropriate monthly progress payment amounts through cost loading of the CPM schedule activities, provide sufficient detailed breakdown to meet this requirement. Provide breakdown of line item quantities when applicable: cubic yards, linear feet, pounds, etc.

The Engineer shall be the sole judge of acceptable numbers, details, and description of values established. If, in the opinion of the Engineer, a greater number of schedule of values items than proposed by the Contractor is necessary, the Contractor shall add the additional items so identified by the Engineer as a condition to processing the payment requests.

2. At a minimum the schedule of values shall be separated by unit process area and/or by building and the following general work elements. The minimum detail of breakdown of the major work components is indicated below.

   a. General Requirements/Mobilization/Demobilization. General Requirement Mobilization/Demobilization costs on the Schedule of Values shall not exceed 5% of the total Contract Amount. All Work included in the Schedule of Value that falls under this heading as described in this paragraph (including such Work by Subcontractors) will be added and checked for compliance with the 5% limitation. Any actual cost in excess of this amount shall be distributed proportionately to Schedule of Values items for direct Work items not covered by this heading. Work under this heading may be detailed on Schedule of Value line items identifying each as to whether it is mobilization or initial costs, maintenance or overhead cost or finalization or demobilization cost. The subdivision of this Work into Schedule of Values line items shall be done to support the payment process that shall be distributed as follows: 50% for the first progress payment, 10% for the final payment following demobilization and restoration, and 40% spread evenly over payments made in between.

   b. Miscellaneous site construction shall be broken down by clearing and grubbing, stripping, excavation, full construction, erosion control, paving, paving removal, site restoration, and any other items determined to be necessary for the establishment of pay and schedule activity items.

   c. Yard piping construction work shall be broken down separately by pipeline segment, which shall not exceed 500-foot-long sections of the pipeline. Each pipeline segment shall be broken down into excavation, pipe fabrication (by wall thickness),

pipe installation, pipe structures (air-release valves, blowoff valves, and vents), backfilling, testing, site restoration, and any other items determined to be necessary for the establishment of pay and schedule activity items.

d. Concrete structures and buildings shall be broken down by structure into excavation, subgrade preparation, and appurtenant prefoundation work; concrete foundation construction; slabs on grade; walls/columns; miscellaneous metalwork; and backfill.

e. Mechanical (HVAC and plumbing) work shall be broken down to identify individual piping and ductwork and equipment installation and equipment testing.

f. Piping, valve, and equipment work shall be broken down to identify individual piping systems, equipment installation by equipment (including valves, actuators, etc.), name and number, and equipment testing and checkout.

g. Electrical work shall be broken down by structure into conduit and raceway installation, cable and wire installation, electrical equipment installation, terminations, and lighting. Yard facilities shall be broken down by duct bank designation and substations.

h. Instrumentation and control work shall be broken down by pull boxes, duct, fiber-optic cable, and installation and testing.

i. Equipment testing and start-up broken down for completion milestones and substantial completions for each.

3. Other work not specifically included in the above items shall be broken down as necessary for establishment of pay and schedule activity items.

4. The Contractor, Engineer, and Resident Project Representative shall meet and jointly review the detailed schedule of values within 40 days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed to provide cost loading of the CPM schedule activities. Make any adjustments deemed

necessary to the value allocation or level of detail, and submit a revised detailed schedule of values within 10 days from the date of the review meeting.

5. Following acceptance of the detailed schedule of values, incorporate the values into the cost loading portion of the CPM schedule. The CPM activities and logic shall have been developed concurrent with development of the detailed schedule of values; however, it shall be necessary to adjust the detailed schedule of values to correlate to individual schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the schedule of values and the CPM schedule activities, where interfacing these two documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the schedule of values. Schedule of value items may need to be added to accommodate the detail of the CPM schedule activities. Where such instances arise, the Contractor shall propose changes to the schedule of values and to the CPM schedule activities to satisfy the CPM schedule cost loading requirements.

C. Incorporation of Schedule of Values into CPM Schedule

1. In conjunction with each submittal of the construction schedule, submit a cash flow projection indicating estimated earnings by month during the entire contract period and a schedule of values of the work using the "Schedule of Values" described above, including quantities and prices. The aggregate of these extended prices shall equal the contract price. Costs shall include all materials, labor, equipment, and appurtenant items necessary to accomplish the work in accordance with the contract documents. This schedule shall be satisfactory in form and substance to the Engineer and shall subdivide the work into the specified component parts. Upon review by the Engineer, incorporate the schedule into the form for Application for Payment. The Owner reserves the right to delete (or add) items of work from the contract and the total contract amount shall be reduced (or increased) by the total amount shown in the schedule of values.

2. Develop the schedule of values (lump-sum price breakdown) and incorporate into the cost loading function of the CPM schedule. Determine monthly progress payment amounts from the monthly progress updates of the

CPM schedule activities. Develop the schedule of values independent but simultaneous with the development of the CPM schedule activities and logic.

D. Cross-Reference Listing

1. To assist in the correlation of the schedule of values and the CPM schedule, provide a cross-reference listing, furnished in two parts. The first part shall list each scheduled activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective scheduled activity or activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the schedule of values), the total cost for each scheduled item should be indicated.

2. Update and submit these listings in conjunction with each CPM monthly submittal.

3. Incorporate executed change orders reflected in the CPM schedule into the schedule of values as a single unit identified by the change order number.

E. Changes to Schedule of Values

1. Changes to the CPM schedule which add activities not included in the original schedule but are included in the original work (schedule omissions) shall have values assigned as reviewed by the Engineer. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the Engineer.

2. In the event that the Contractor and Engineer agree to make adjustments to the original schedule of values because of inequities discovered in the original accepted detailed schedule of values, increases and equal decreases to values for activities may be made.

END OF SECTION

SECTION 01333 PRODUCT CODE COMPLIANCE CERTIFICATION

A. Description

This section describes the product code certification that the Florida Building Code (FBC) requires for certain items within the building envelope.

B. Code Compliance

1. Provide FBC product approval documentation for the following items in the project:

   a. Steel Doors and Frames: 08110.

   b. Overhead Coiling Doors: 08331.

   c. Door Hardware (Exterior Doors Only): 08710.

   d. Fiberglass Sandwich Panel Assemblies: 08952.

   e. Fixed Louvers: 10200.

   f. Prefabricated Metal Building: 13121.

2. If the products being proposed are changed between the submittal for the building permit and the shop drawing, document these changes with the building code authority having jurisdiction and document the reason for the change with the Owner’s Representative.

END OF SECTION

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SECTION 01380 CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

A. Quality Assurance

1. Aerial Photographer: Qualified as a commercial photographer, engaged as a professional in business for a period of not less than three years. Electronic ground level photos do not require a professional photographer.

2. Site photos may be submitted digitally as photographed by the Contractor.

B. Submittals

1. Submit sample photographs, aerial vantage points, monthly vantage points, file structure, etc…

2. Submit a proof of the final completion aerial.

PART 2 - PRODUCTS

A. Monthly Progress Photos – Digital

1. The Contractor may furnish monthly progress photos in digital format from typical monthly vantage points and site locations as mutually agreed upon with the County R.P.R.

2. Format and resolution shall be as mutually agreed upon with the County R.P.R.

3. Provide monthly photos within a CD or DVD. Furnish a file index that lists photo number or file name and description of view per respective date, unit process and/or vantage point within a file structure as mutually agreed upon with the County R.P.R.

B. Aerial Prints

1. Full color.

2. Finish: Matte finish.

3. Minimum Size: 15 inches x 21 inches.

4. Paper Weight: Single.

5. Mounting: In plastic sheets in loose leaf, three ring binders.

6. Provide a CD with electronic photo files. Furnish a file index that lists photo number or file name and description of view.

C. Aerials

1. Provide monthly aerials containing at least four (4) views of project site.

   a. At final completion, provide three (3) 24″ X 36″ framed aerials showing the progression sequencing of monthly aerials with the centered final aerial of one of the selected views. Include the respective logos of the Owner, Contractor and Engineer.

   b. The proof of the final completion aerial shall be submitted to the Owner and Engineer for review.

D. Identification:

1. Digital photographs shall be categorized and saved based upon the date which they were photographed.

2. Under the main folder in which the photographs were taken, photos are to be organized into categorized subfolders based upon unit process number, specific construction activity, recurring vantage point(s), or other means necessary to properly index them in coordination with respective areas of the Work.

PART 3 - EXECUTION

A. Technique

1. Factual presentation.

2. Correct exposure and focus.

   a. High resolution and sharpness

   b. Maximum depth-of-field

   c. Minimum distortion

B. Pre-Construction Photographs

See Section 01500.

C. Views Required

1. Consult with Engineer for instructions concerning views required at each specified visit to site. At a minimum provide four (4) views of each Process area included within the Work.

2. Photograph from locations to adequately illustrate state of project, or condition of construction.

3. Take photographs from as close to the same position for each period as practical.

4. Take a series of ground level photographs for each area under construction during the photographic visit, areas of construction completion from previous months "under construction views" and undisturbed areas where Contractor anticipates construction during the one month period prior to the next scheduled photographic visit.

5. Schedule and conduct photographic visits during the first work day of each month.

6. In addition, provide and conduct up to seven (7) additional photographic visits prior to, at critical stages of, and at the end of construction, when they do not coincide with scheduled photographic visit days. The timing of these additional photographic visits shall be subject to the prior approval of the Owner or Engineer.

D. Delivery of Prints

1. Deliver three (3) DVDs or CDs containing the copies of the monthly progress photos 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

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SECTION 01390 COLOR AUDIO-VIDEO CONSTRUCTION RECORDS

PART 1 - GENERAL

A. Scope

1. Prior to commencing work on the Project and after Final Completion of the Project, the CONTRACTOR shall provide a continuous color audio-video DVD recording of the entire construction area of the Project to serve as a record of the site's pre- and post-construction conditions. The entire length shall be defined as the entrances to the EWRF plant that are to be traveled by vehicles of the Contractor, subcontractors, suppliers, work areas, staging areas, etc. The CONTRACTOR shall submit one (1) copy of the pre-construction DVD to the ENGINEER prior to construction for approval. A copy of the pre-construction DVD shall be kept at the site by the CONTRACTOR until completion of the Project. As a condition of Final Completion, the CONTRACTOR shall have a continuous color-video DVD recording taken of the entire site to serve as a record of post-construction conditions and shall submit one (1) copy to the ENGINEER and two (2) copies to the COUNTY prior to the submittal of the Final Payment Application.

B. Approval

1. The DVD recording shall be made less than six (6) weeks prior to commencement of construction. The COUNTY and ENGINEER shall have the County to reject all or any portion of a DVD not conforming to this specification and require that it be redone at no additional cost to the COUNTY. The CONTRACTOR shall reschedule unacceptable coverage within five (5) days after being notified. All tapes and written records shall be well-maintained without any damage and shall become property of COUNTY. All videotaping shall be done in the presence of a COUNTY representative of the ENGINEER and who will designate areas to be covered by the DVD. The CONTRACTOR shall provide the COUNTY with a minimum of 48-hrs notice prior to filming. The COUNTY shall have the authority all or any portion of a DVD not conforming to specifications and order that it be redone at no additional charge to the COUNTY.

C. Professional Electrographers(Videographers)

1. The CONTRACTOR shall engage the services of a professional electrographer. The color audio-video tape recordings shall be prepared by a responsible commercial firm known to be skilled and regularly engaged in the business of preconstruction color audio-video DVD documentation. The electrographer through the CONTRACTOR shall furnish to the ENGINEER a list of all equipment to be used for the audio-video taping, i.e., supplier's (manufacturer's) name, model number, specifications and other pertinent information. Additional information to be furnished to the ENGINEER by the electrographer through the CONTRACTOR shall include the names and addresses of two (2) references for which the electrographer has performed color audio-video taping on projects of a similar nature within the last twelve (12) months.

PART 2 - PRODUCTS

A. General

1. The total audio-video recording system and the procedures employed in its use shall be such as to produce a finished product that will fulfill the technical requirements of the Project. The video portion of the recording shall produce bright, sharp, and clear pictures with accurate colors and shall be free from distortion, tearing, rolls, and any other form of picture imperfection. All video recordings shall, by electronic means, display on the screen the time of day, the month, day, and year of the recording. This date and time information shall be continuously and simultaneously generated with the actual recording. The audio portion of the recording shall produce the commentary of the camera operator with proper volume, clarity, and be free from distortion.

2. The recording system shall utilize AIA Standard Video and NTSC compatible color (American TV Standard).

PART 3 - EXECUTION

A. Equipment

1. Camera: the color video camera used in the recording system shall be of Industrial Grade and shall have EIA

standard NTSC type color – 1.0v 75 ohms. Video output from the camera(s) shall be capable of a horizontal resolution of 350 lines at center and utilize a minimum of 8:1 zoom with 2/3" Newvicon tube or CCD pick-up element for optimum color imagery plus minimum lag through one foot candle (10 LUX).

2. Recorder: the recording shall be made with an industrial grade DVD recorder. The recorder shall record the signal with a minimum horizontal resolution of 525 lines, 60 fields; NTSC color signal; RF modulated 72db. The construction documentation shall be recorded in SP mode.

3. Digital Video Disc: the DVDs used for the recordings shall be the 4.7GB industry standard dics.

4. DVD playback compatibility: the recorded DVD's shall be compatible for playback with any American TV standard DVD player.

B. Recorded Information – Video

1. All video recordings shall contain coverage of all surface features located within the construction zone of influence and shall include but not be limited to: all designated easements staking, all roadways, pavements, detention ponds, ditches, walls, railroad tracks, curbs, driveways, sidewalks, culverts, headwalls, retaining walls, treatment structures, pipe systems, pump stations, buildings, landscaping, trees, shrubbery, fences and CONTRACTOR staging areas. Of particular concern shall be pre-existing faults, fractures, or defects with existing infrastructure noted. Taped coverage shall be limited to one side of the site, street, easement or right of way at any one time. Tape coverage shall include all surface conditions located within the zone of influence of construction supported by appropriate audio description including the location relative to construction stations. Panning, zoom-in and zoom-out rates shall be sufficiently controlled to maintain a clear view of the object.

2. All video recordings shall, by electronic means, display continuously and simultaneously generated with the actual taping transparent digital information to include the date and time of recording and coordinate locations as shown on the Drawings. The date information shall contain the month, day and year. The time information shall contain the hour, minutes, and seconds. Additional

information shall be displayed periodically. Such information shall include, but not be limited to. Project Name, direction of travel and location. This transparent information shall appear on the extreme upper left hand third of the screen.

C. Recorded Information – Audio

1. Accompanying the video recording shall be a corresponding and simultaneously recorded audio recording. Each tape shall begin with the recording date and project name and COUNTY'S Project Number and be followed by the general location, i.e., structure or process. The audio track shall consist of an original live recording. The recording shall contain exclusively the narrative commentary of the electrographer, recorded simultaneously with the video record of the zone of influence of construction. The recording shall assist in viewer orientation and in any needed identification, differentiation, clarification, or objective description of the features being shown in the video portion of the recording, including location relative to construction stations. The audio recording shall be free from any conversations between the camera operator and any other production technicians.

2. The COUNTY and ENGINEER reserve the right to supplement the audio portion of the taping as deemed necessary.

D. DVD Indexing

1. DVD identification: All DVDs shall be permanently labeled and shall be properly identified by DVD number and Project Name.

2. DVD logs: Each DVD shall have a log of that DVD's contents. The log shall describe the various segments of coverage contained on that DVD in terms of the names of the streets or easements, coverage beginning and end, directions of coverage, video unit counter numbers, engineering station numbers, and date.

3. DVD index: The CONTRACTOR shall provide an index listing, in order by DVD number, each DVD, including DVD number and a brief description of coverage contained on that DVD, including engineering station numbers.

E. Time of Execution

1. All recording shall be performed during times of good visibility. No recording shall be done during period of significant precipitation, mist, or fog. The recording shall only be done when sufficient sunlight is present to properly illuminate the subject, and to produce bright, sharp video recordings of those subjects. No taping shall be performed when more than 10% of the area to be taped contains debris or obstructions unless otherwise authorized by the ENGINEER.

F. Continuity of Coverage

1. In order to increase the continuity of the coverage, the coverage shall consist of a single, continuous, unedited recording which begins at one end of a particular construction area and proceeds uninterrupted to the other end of the construction area. Such coverage shall consist of an organized, interrelated sequence of recordings at various positions within that proposed construction area (e.g., high service pump station). Such coverage shall be obtained by walking or special approval by the Engineer.

G. Camera Operation

1. Camera Height and Stability: If conventional wheeled vehicles are used as conveyances for the recording system, the vertical distance between the camera lens and the ground shall not exceed ten (10) feet. The camera shall be firmly mounted such that transport of the camera during the recording process will not cause an unsteady picture.

2. Camera Control: Camera pan, tilt, zoom-in, and zoom-out rates shall be sufficiently controlled such that recorded objects will be clearly viewed during DVD playback. In addition, all other camera and recording system controls such as lens focus and aperture, video level, pedestal, chroma, white balance, and electrical focus shall be properly controlled or adjusted to maximize picture quality.

3. Viewer Orientation Techniques: The audio and video portions of the recording shall maintain viewer orientation. In easements where the proposed construction location will not be readily apparent to the DVD viewer, highly visible yellow flags shall be

placed by the CONTRACTOR in such a fashion as to clearly indicate the proposed centerline of construction.

4. Electrographer Experience: The electrographer in charge shall have had previous experience with audio-video documenting preconstruction work.

H. DVD Viewer

The CONTRACTOR shall make available for use by the COUNTY and ENGINEER, at the site, one (1) DVD viewer system. The system shall be provided as requested by the ENGINEER, for the duration of the Project and be made available for on-site viewing until Final Completion. The system shall consist of the following components:

1. DVD Player: The DVD player shall be capable of playback standard DVD(s) as hereinafter specified and shall be powered by a standard 120 volt, 60 HZ service. Player features shall include resettable digital counter, and 10-foot uhf coaxial output connecting cable for connection to any conventional TV set. The player shall consist of a videocassette player/recorder or similar type as used for recording with corresponding digital counter number sequence so as to be compatible with the documentation. It shall be capable of speed search, clear still frame and frame-by-frame advance.

2. TV receiver: TV receiver shall be a color American TV Standard VHP 2-13 channel coverage. It shall have a viewing area, diagonally measured, of no less than fourteen (14) inches and shall have direct video and audio input. The cables for the video and audio connections shall also be supplied.

END OF SECTION

SECTION 01400 WEB BASED PROJECT CONTROLS SYSTEM

PART 1 GENERAL

A. Project Controls

The Project Controls on this project shall be performed through the use of web-based project controls software. In fulfilling this requirement the Contractor shall provide the following:

1. Utilization of Version 12.1 or the latest version of Primavera Contract Manager web-based software hosted and managed on the Orange County Utilities server. No other software shall be acceptable. The intended users on the individual license shall include the Owner (three (3) users), Construction Consultant (one user), Engineer (two (2) users), and Contractor (two (2) users). The software, owner's manuals, concurrent licensing and database shall be owned and retained by the County. If the Contractor requires additional users, additional user licenses shall be provided to the County by the Contractor at no cost to the County and those additional licenses may be retained by the Contractor at project final completion.

2. The Contractor shall access the Orange County Utilities server through the use of computer(s) provided by the contractor. The computer(s) shall be located at the EWRF Contractor's Temporary Field Offices and shall be dedicated to the sole use of Contract Manager. These computers will be put in service by the Orange County IT Department and shall be loaded with the appropriate Orange County parameters, software, Firewalls, etc. as needed, Computers shall be accessible at anytime throughout the entire duration of the project by the Orange County IT Department.

   The Contractor shall be responsible to install a single Mode Fiber Optic cable exterior and Multi-Mode interior, from the existing North Electrical Building to the Temporary Contractor's Field Offices. The Temporary Contractor's office is expected to be

located in general vicinity of Clarifier #11 and the Owner’s Field Office west of the Reclaimed Water Pumping Facility located approximately 3000-feet west of Clarifier #10, if a different location is desired and/or available, the contractor shall remain responsible for all that is necessary to provide the connections of the Temporary Contractor’s Field Offices.

3. All project correspondence and documentation including but not limited to Requests for information, Notices, Change Orders / Change Management, noncompliance notices, Notice of claims, requests for clarification, updates, meeting minutes, shop drawing transmittals, shop drawings in PDF format, shop drawing comments, letters, memo’s, etc. shall be created and managed in Primavera Contract Manager. **The use of emails as project correspondence and documentation is unacceptable and shall be considered to be noncompliance with this specification**.

4. Contractor shall attend a minimum one day joint training session for the Owner, owner construction consultant, Engineer and Contractor, for all components of the software in the manner detailed in Part 3.A of this specification.

5. Statement of capability and cooperation - The Contractor shall have the capability of preparing and utilizing the specified document control software, critical path scheduling techniques and specified software packages. A statement of capability shall be submitted in writing to the Engineer with the return of the executed Agreement to the Owner and will verify that either the Contractor’s organization has in-house capability qualified to use the technique or that the Contractor employs a consultant who is so qualified. The statement shall include the name of the individual on the Contractor's staff or qualified Consultant who will be responsible for the use of Primavera Contract Manager and associated reports and for providing the required updating information of same. The Contractor shall also submit a statement of cooperation with the specifications, including the elimination of emails as a form of communication on the specified project as well as acknowledgment that all documentation shall be created and maintained in Contract Manager.

B. Submittals

1. Provide a statement of Capability and Cooperation per Part 1.A.

2. Provide a digital list of all Contract Manager requested user's, contact information (first name, last name, middle initial, address, company name, email address, phone, title, etc.) and provide a list all companies or persons (Company, contact name, email address) that may be receiving direct correspondence out of Contract Manager.

PART 2 PRODUCTS

A. Web-based Project Controls Software

Primavera Contract Manager 12.1 or latest edition. Software. Collaboration by all parties on a single project database storing all project documentation during construction and through project final completion.

PART 3 EXECUTION

A. Requirements for Operation of Contract Manager

The Contractor, Owner and Engineer shall use the following functions of the Contract Manager Software:

1. Project Information Modules

a. Companies – All contact information for parties involved in this project will be entered by the County. Contractor shall provide a digital list of all contact information (Full Name with middle initial, Company Name, address, phone number, cell phone, email address, title, etc).

b. Issues – Issues shall be created as necessary to monitor potential problems on the project. Issues shall be assigned from items in requests for information, meeting minutes, or independently generated items. The project team shall be responsible for entering data and maintaining this list.

2. Communication Modules

a. Transmittal – All transmittals between the Contractor, Owner and Engineer shall be generated in the Contract Management software including but not limited to shop drawing transmittal cover letters, submittals and other project related packages or documentation.

b. Requests for Information - All requests for information shall be generated and performed through Contract Manager. Requests for Information shall be performed completely electronically. All requests shall be complete. If necessary, the Contractor shall attach electronic attachments of all sketches, photographs or other documentation as necessary to provide full details of the issue or concern. References to all pertinent details, drawings, schedule activities, and issues shall be noted in each request for information. All project participants shall be responsible for electronic updates for their action items. Contractor shall submit all RFI's with a ball in court (BIC) to the Engineer. The Engineer shall provide a response and submit the RFI with a ball in court to the County. RFI's shall not be considered answered and shall not be acted upon by the Contractor until the County has officially CLOSED the RFI.

c. Notices – All notices be performed in this module. Notices shall be comprised of all documentation previously written in the form of letters, memo's, emails, test requests, Notice of claim, general correspondence, clarification, schedule update, bulletin, etc. and shall be created in Contract Manager with the appropriate attachments as required.

d. Notices of Non-compliance – All notices of non-compliance shall be generated and performed through Contract Manager. Both the original notice from the Owner/Engineer and the proposed corrective action by the Contractor shall be completed in web-based software. Owner/Engineer shall submit all notices of non compliance with a ball in court (BIC) to the Contractor. The Contractor shall provide a response and submit the NCN with a ball in court to the Engineer. NCN's

shall not be considered answered and shall not be acted upon by the Contractor until the County has officially CLOSED the NCN.

e. Meeting Minutes – All meetings shall be documented in Contract Manager.

Business Items and Attendees will be documented, and attachments will be attached as appropriate. Recurring meetings shall be generated using delivered functionality within Contract Manager, and will be updated by the meeting organizer. Logs presented at the meetings including but not limited to Shop drawing logs, RFI logs, Change Order Logs, Test Request & Results logs, and correspondence logs shall be generated from Contract Manager, dispersed and attached to the meeting minutes module. Logs shall be downloaded as of the date of the meeting to provide the most current status of all logs.

3. Contract Information Modules

a. Change Management – Change Management shall be used to organize all related documents for each change to scope of work, schedule, or budget.

Related documents shall be linked via Issues and included in the CPM schedule. Estimates, proposals, and final change orders shall be linked as Attachments. The contractor shall input data and maintain this module.

The Change Management process shall only be initiated from a request for information in the RFI module.

b. Payment Requisition – The Contractor shall utilize the Payment Requisition module for the purpose of inputting the monthly pay applications into Contract Manager for the project record as well as for the required approval of the “pencil copy” or preliminary submittal for approval by the County inspector prior to submitting each month’s printed copy through normal means.

4. Logs Modules

a. Submittal Packages – Submittals will be combined into Submittal Packages as appropriate, when workflow is similar and using Packages increase efficiency.

b. Submittals – Contract Manager shall be used to create all transmittals between the Engineer, Owner and Contractor for all submittals. The printed copy of the submittals will be transmitted through normal means.

Contractor shall enter a complete list of all known submittals for the project at the start of the project. Submittals shall include required by dates so that all parties are aware of upcoming submittals, and will use industry standard specification codes to categorize the submittals and shall be included in the Primavera CPM schedule. Contractor shall provide and attach a digital copy of the shop drawing submittal including all revisions, in PDF format for a complete project record and access for all users. However, only hard copy shop drawings submittals shall be reviewed and approved by the Engineer.

c. Contractor Daily Reports – Daily Reports shall be inputted daily through Contract Manager by the Contractor. Daily Reports shall be complete and include electronic attachments, photographs, or other documentation as appropriate. Daily Reports shall be documented in accordance with the Standard Specifications for the project.

5. Other

a. Correspondence Sent – All correspondence sent shall be logged within Contract Manager by the originating party in the appropriate module.

Documents generated within Contract Manager shall be recorded via delivered functionality within Contract Manager. Documents generated external to Contract Manager shall be kept to an absolute minimum and shall be manually added to appropriate contract manager module. Digitally Attach

applicable documents as appropriate to Contract Manager.

b. Correspondence Received – All correspondence received from outside parties pertinent to the project shall be logged within Contract Manager by the receiving party. Receipt of submittals or other documents that originated out of Contract Manager shall be recorded by the contractor via delivered functionality within Contract Manager in the appropriate module. Digitally Attach applicable documents as appropriate to Contract Manager.

END OF SECTION

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SECTION 01420 GENERAL ABBREVIATIONS

PART 1 - GENERAL

A. General

Interpret abbreviations used on the drawings and in the specifications as tabulated below. If an abbreviation on a drawing is not explained below, it shall be as explained in ANSI Y1.1. The interpretation of abbreviations shall consider the context or discipline in which they are used, for example:

1. FF usually means "finish floor" when referring to a floor slab.

2. FF usually means "flat face" when referring to a pipe flange.

B. List of General Abbreviations

Abbreviation	**Term**
A	
A	Ampere/Area
AA	Aluminum Association
AABC	Associated Air Balance Council
AADF	Annual Average Daily Flow
AAMA	Architectural Aluminum Manufacturer's Association
AAS	Airport Advisory Service
AASHTO	American Association of State Highway and Transportation Officials
AB	Anchor Bolt/Aggregate Base
ABAN	Abandoned
ABC	Asphalt Base Course
ABT	About
AC	Acre/Asphaltic Concrete/Alternating Current/Air Conditioning
ACCU	Air Cooled Condensing Unit
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute

Abbreviation	Term
ACP	Asbestos-Cement Pipe
ACU	Air Conditioning Unit
AD	Access Door
ADDL	Additional
AE	Architect-Engineer
AF	Air Filter/Ampere Frame
AFB	Air Force Base
AFBMA	Anti-Friction Bearing Manufacturer's Association
AGA	American Gas Association
AGMA	American Gear Manufacturer's Association
AHD	Ahead
AHU	Air Handling Unit
AI	The Asphalt Institute
AIA	American Institute of Architects
AICS	Amperes Interrupting Capacity, Symmetrical
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AL	Aluminum
ALIGN	Alignment
ALM	Alarm
ALTN	Alternate
AMB	Ambient
AMCA	Air Movement and Control Association
AMP	Ampere
ANCH	Anchor
ANG	Angle
ANSI	American National Standards Institute
API	American Petroleum Institute
APPROX	Approximate
APWA	American Public Works Association
ARCH	Architecture/Architectural
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ARV	Air-Release Valve

Abbreviation	Term
ARVV	Air-Release/Vacuum Valve
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPH	Asphalt
ASSY	Assembly
ASTM	American Society of Testing and Materials
ATS	Automatic Transfer Switch
AVE	Avenue
AVG	Average
AWG	American Wire Gauge
AWPA	American Wood Preservers Association
AWPB	American Wood Preservers Bureau
AWS	American Welding Society
AWWA	American Water Works Association
B	
BB	Back-to-Back
BC	Beginning of Curve/Back of Curve/Bolt Circle
BCR	Begin Curb Return
BEG	Begin
BETW	Between
BF	Blind Flange
BFV	Butter Fly Valve
BHP	Brake Horsepower
BK	Back/Brake
BKR	Breaker
BL	Base Line
BLDG	Building
BLK	Block
BM	Bench Mark/Beam
BO	Blowoff
BOCA	Building Officials Code Administration International, Inc.
BOD	Biochemical Oxygen Demand
BOT	Bottom

Abbreviation	Term
BP	Baseplate
BR	Bronze/Branch
BRG	Bearing
BTN	Button
BTU	British Thermal Unit
BUR CBL	Buried Cable
BVC	Begin Vertical Curve
BW	Block Wall
C	
C	Conduit/Celsius
CAB	Crushed Aggregate Base
CANTIL	Cantilevered
CAP	Capacity
C.A.R.	Construction Assistance Request
CATV	Cable Television
CB	Catch Basin/Circuit Breaker
CC	Cooling Coil
C-C	Center-to-Center
CCB	Concrete Block
CCP	Concrete Cylinder Pipe
CCS	Central Control Station
CCT	Chlorine Contact Tank
CD	Cross Drain/Condensate Drain/Ceiling Diffuser
CEM	Cement
CF	Cubic Feet/Curb Face
CFH	Cubic Feet Per Hour
CFM	Cubic Feet Per Minute
CFS	Cubic Feet Per Second
CG	Ceiling Grill
C & G	Curb and Gutter
CH	Chiller
CHG	Change
CHKD PL	Checkered Plate
CI	Cast Iron
CIP	Cast in Place/Cast-Iron Pipe

Abbreviation	Term
CISP	Cast Iron Soil Pipe
CISPI	Cast-Iron Soil Pipe Institute
CJ	Construction Joint
CL	Centerline/Class/Clearance
CLR	Clear
CMAA	Crane Manufacturer's Association of America
CMC	Cement-Mortar Coated or Coating
CML	Cement-Mortar Lined or Lining
CMLCSP	Cement-Mortar Lined and Coated Steel Pipe
CMP	Corrugated Metal Pipe
CMPA	Corrugated Metal Pipe Arch
CMU	Concrete Masonry Unit
CO	Cleanout/Conduit Only
COL	Column
COMM	Communication
COMP	Composite
COMPL	Complete
CONC	Concrete
CONN	Connection
CONST	Construct or Construction
CONT	Continuous
CONTR	Contractor
COORD	Coordinate/Coordinated
COP	Copper
COR	Corner
CPLG	Coupling
CPU	Central Processing Unit
CPVC	Chlorinated Polyvinyl Chloride
CRES	Corrosion Resistant Steel
CRSI	Concrete Reinforcing Steel Institute
CS	Carbon Steel/Commercial Standard
CSP	Corrugated Steel Pipe
CT	Center Top/Current Transformer
CTG	Coating
CTR	Center

Abbreviation	Term
CTV	Cable Television
CULV	Culvert
CU YD, CY	Cubic Yard
CYL	Cylinder
D	
D	Degree of Curvature
DB	Direct Buried/Decibel
DBL	Double
DC	Direct Current
DEPT	Department
DET	Detail/Detour
DG	Decomposed Granite
DI	Drop Inlet/Ductile Iron
DIA	Diameter
DIAG	Diagonal
DIM	Dimension
DIMJ	Ductile-Iron Mechanical Joint
DIP	Ductile-Iron Pipe
DIPRA	Ductile-Iron Pipe Research Association
DISCH	Discharge
DIST	Distance
DIV	Divide/Division
DO	Dissolved Oxygen
DMH	Drop Manhole
DN	Down
DP	Differential Pressure
DPI	Differential Pressure Indicator
DPNL	Distribution Panel
DR	Drain/Door
DSL	Diesel
DWG	Drawing
DWY	Driveway
E	
E	East
EA	Each

Abbreviation	Term
EC	End of Curve
ECC	Eccentric
ECR	End of Curb Return
ED	External Distance
EDUC	Eductor
EE	Each End
EF	Each Face/Exhaust Fan
EFF	Efficiency
EFL	Effluent
EG	Exhaust Grill
EGL	Energy Grade Line
EL	Elevation/Each Layer
E/L	Easement Line
ELEC	Electric
ELEV	Elevation
ELP	Elliptical
EMB	Embankment
ENC	Encasement
ENCL	Enclosure
ENG	Engine
ENGR	Engineer
EOP	Edge of Pavement
EOS	Equivalent Opening Size
EOTW	Edge of Traveled Way
EP	Explosion Proof/Edge of Pavement
EPA	Environmental Protection Agency (Federal)
EPS	Effluent Pump Station
EQ	Equation
EQL	Equal
ESMT	Easement
EST	Estimate or Estimated
ETC	And so Forth
ETM	Elapsed Time Meter
EVAP	Evaporator
EVC	End Vertical Curve

Abbreviation	Term
EW	Each Way
EWC	Electric Water Cooler
EWRF	Eastern Water Reclamation Facility
EXC	Excavate or Excavation
EXP	Expansion
EXST	Existing
EXT	Exterior/Extension
F	
F	Fahrenheit/Floor
FAA	Federal Aviation Administration
FAB	Fabricate
FBC	Florida Building Code
FBRBD	Fiberboard
FC	Foot-Candle
FCC	Filter Control Console
FCO	Floor Cleanout
FCV	Flow Control Valve
FD	Floor Drain
FDEP	Florida Department of Environmental Protection
FDN	Foundation
FDOT	Florida Department of Transportation
FE	Flanged End
FF	Finished Floor/Flat Face
FG	Finished Grade
FHY	Fire Hydrant
F&I	Furnish and Install
FIG	Figure
FIN	Final
FIT	Fitting
FL	Floor/Flow Line
FLEX	Flexible/Flexure
FLG	Flange
FLT	Float
FLUOR	Fluorescent
FM	Force Main/Factory Mutual

Abbreviation	Term
FMH	Flexible Metal Hose
FNSH	Finish
FOC	Face of Concrete
FOS	Face of Stud
FPC	Flexible Pipe Coupling
FPM	Feet Per Minute
FPS	Feet Per Second
FPT	Female Pipe Thread
FS	Finished Surface/Floor Sink/Federal Specifications
FSTNR	Fastener
FT	Feet or Foot
FTG	Footing
FUT	Future
FWY	Freeway
G	
G	Gas
GA	Gauge
GAL	Gallon
GALV	Galvanized
GAS	Gasoline
GB	Grade Break
GDR	Guard Rail
GE	Grooved End
GEN	Generator
GENL	General
GFI	Ground Fault Interrupter
GM	Gas Main
GMT	Greenwich Mean Time
GND	Ground
GPD	Gallons Per Day
GPM	Gallons Per Minute
GR	Grade
GRTG	Grating
GSKT	Gasket
GUT	Gutter

Abbreviation	Term
GV	Gate Valve
GWB	Gypsum Wallboard
GWBX	Gypsum Wallboard, Fire Rated
GYP	Gypsum
H	
H	Humidistat
HARN	Harness
HB	Hose Bibb
HC	Heating Coil
HD	Heavy Duty
HDPE	High Density Polyethylene
HEPA	High Efficiency Particulate Air
HGL	Hydraulic Grade Line
HGT	Height
HID	High Intensity Discharge
HOA	Hand-Off-Automatic
HOR	Hand-Off-Remote
HORIZ	Horizontal
HP	Horsepower/High Pressure
HPS	High Pressure Sodium
HPT	High Point
HR	Hour/Handrail
HS	High Strength
HTG	Heating
HTR	Heater
HV	Hose Valve
HVAC	Heating, Ventilating, and Air Conditioning
HVY	Heavy
HW	Headwall/Hot Water
HWL	High Water Level
HWY	Highway
HYDR	Hydraulic
HZ	Hertz (cycles per second)
I	
I	Intersection Angle

Abbreviation	Term
ICBO	International Conference of Building Officials
ID	Inside Diameter
IE	Invert Elevation
IEEE	Institute of Electrical and Electronics Engineers
IN	Inches
INCAND	Incandescent
INCL	Include
INL	Inlet
INS	Insulating
INSTL	Install or Installation
INTR	Interior/Intersection
INV	Invert
IP	Iron Pipe
IPS	Iron Pipe Size
IPT	Iron Pipe Thread
IRR	Irrigation
ISA	Instrument Society of America
J	
J	Joist
JB	Junction Box
JCT	Junction
JN	Join
JT	Joint
K	
KG	Kilogram
KM	Kilometer
KIPS	Thousands of Pounds
KV	Kilovolt
KVA	Kilovolt-Ampere
KW	Kilowatt
KWH	Kilowatt-Hour
KWHM	Kilowatt-Hour Meter
L	
L	Length of Curve/Long/Left
LATL	Lateral

Abbreviation	Term
LAV	Lavatory
LB	Pound
LBR	Lumber
LCL	Local
LF	Linear Foot
LG	Long
LI	Level Indicator
LLO	Long Leg Outstanding
LOC	Location/Locate
LOS	Lockout Stop
LP	Light Pole
LPT	Low Point
LR	Long Radius
LS	Lift Station
LT	Left/Light
LTG	Lighting
LWC	Lightweight Concrete
LWIC	Lightweight Insulating Concrete
LWL	Low Water Level
M	
MA	Milliampere
MAG	Magnet/Magnetic
MATL	Material
MAX	Maximum
MB	Machine Bolt/Megabyte/Millibars
MBH	Thousand BTU Per Hour
MECH	Mechanical
MC	Metal Channel
MCC	Motor Control Center
MCM	Thousand Circular Mils
MCP	Motor Circuit Protector
MD	Motorized Damper
MFR	Manufacturer
MG	Million Gallons/Milligram
MGD	Million Gallons Per Day

Abbreviation	Term
MH	Manhole
MHZ	Megahertz
MI	Malleable Iron/Mile
MIL	Military Specifications
MIN	Minimum
MISC	Miscellaneous
MLSS	Mixed Liquor Suspended Solids
MLVSS	Mixed Liquor Volatile Suspended Solids
MJ	Mechanical Joint
MMA	Monorail Manufacturer's Association
MO	Motor Operator/Motor Operated/Masonry Opening
MOD	Modification
MON	Monument
MOT	Motor
MPT	Male Pipe Thread
MSL	Mean Sea Level
MSS	Manufacturer's Standardization Society
MTD	Mounted
N	
N	North/Neutral/Nitrogen
NA	Not Applicable
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
N & C	Nail and Cap
NC	Normally Closed
NE	Northeast
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFC	National Fire Code
NIC	Not in Contract
NIP	Nipple
NO	Number/Normally Open
NOM	Nominal
NPT	National Pipe Taper
NRS	Nonrising Stem

Abbreviation	Term
NTS	Not to Scale
NW	Northwest
NWL	Normal Water Level
O	
OA	Overall/Outside Air
OC	On Center/Overcurrent
OD	Outside Diameter
ODP	Open Dripproof
OE	Or Equal
OF	Outside Face
OPER	Operator
OPNG	Opening
OPP	Opposite
ORIG	Original
OSA	Outside Air
OSHA	Occupational Safety and Health Administration
O TO O	Out to Out
OVFL	Overflow
OVHD	Overhead
P	
P	Pole
PARA	Paragraph
PB	Push Button/Pull Box
PC	Point of Curvature/Programmable Controller
PCA	Portland Cement Association
PCC	Point of Compound Curvature/Portland Cement Concrete
PDI	Plumbing and Drainage Institute
PE	Plain End/Polyethylene/Professional Engineer
PEN	Penetration
PERF	Perforated
PF	Power Factor
PG	Pressure Gauge
PI	Point of Intersection
PJTN	Projection
PKWY	Parkway

Abbreviation	Term
PL	Plate/Property Line
PLATF	Platform
PLF	Pounds Per Lineal Foot
PNL	Panel
POB	Point of Beginning
POC	Point of Connection
POJ	Push-On Joint
PP	Power Pole/Polypropylene
PPB	Parts Per Billion
PPM	Parts Per Million
PR	Pair
PRC	Point of Reverse Curve
PRESS	Pressure
PRL	Parallel
PROV	Provisions
PRPSD	Proposed
PRVC	Point of Reverse Vertical Curve
PSI	Pounds Per Square Inch
PSIG	Pounds Per Square Inch Gauge
PSF	Pounds Per Square Foot
PT	Point of Tangency
PTS	Preliminary Treatment Structure
PV	Plug Valve
PVC	Polyvinyl Chloride
PVMT	Pavement
PWR	Power
Q	
Q	Flow Rate
QTY	Quantity
R	
R	Right/Radius
RAD	Radius/Radial
RAF	Return Air Fan
RAG	Return Air Grille
RC	Reinforced Concrete

Abbreviation	Term
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
RCPA	Reinforced Concrete Pipe Arch
RD	Road
RDC	Reduce
RDCR	Reducer
RDWY	Roadway
REF	Reference
REINF	Reinforce or Reinforced
RELOC	Relocated
REQ	Required/Requirement
REQD	Required
REV	Revise/Revision
RF	Raised Face
RH	Relative Humidity
RJ	Restrained Joint
RLG	Railing
RND	Round
RPM	Revolutions Per Minute
RR	Railroad
RST	Reinforcing Steel
RT	Right
RTD	Resistance Temperature Detector
R/W	Right-of-Way
S	
S	South/Slope in Feet Per Foot/Sewer
SAE	Society of Automotive Engineers
SAN	Sanitary
SAR	Supply Air Register
SBCCI	Southern Building Codes Congress International
SC	Seal Coat
SCFM	Standard Cubic Feet Per Minute
SCHED	Schedule
SCR	Silicon-Controlled Rectifier
SCRN	Screen

Abbreviation	Term
SD	Storm Drain
SDG	Siding
SDI	Steel Deck Institute
SDWK	Sidewalk
SE	Southeast
SECT	Section
SF	Square Feet
SGL	Single
SH	Sheet/Sheeting/Shielded
SIM	Similar
SLP	Slope
SLV	Sleeve
SM	Sheet Metal
SOL	Solenoid
SOV	Solenoid-Operated Valve
SP	Space/Steel Pipe/Static Pressure/Spare
SPCG	Spacing
SPEC	Specification
SPLC	Splice
SPRT	Support
SQ	Square
SQ FT	Square Feet
SR	Short Radius
SS	Sanitary Sewer
SSPC	Steel Structures Painting Council
SST	Stainless Steel
ST	Street
STA	Station
STBY	Standby
STD	Standard
STK	Stake
STL	Steel
STR	Straight
STRL	Structural
STRUCT	Structure

Abbreviation	Term
STS	Storm Sewer
STGR	Stringer
STWY	Stairway
SURF	Surface
SW	Southwest
SWG	Swing
SYMM	Symmetrical
SYS	System
T	
T	Ton/Tangent Length of Curve/Telephone
TAN	Tangent
T/B	Top of Beam
TB	Top of Bank/Terminal Board
T & B	Top and Bottom
TBG	Tubing
TBM	Temporary Bench Mark
TC	Top of Curb
TD	Time Delay
TDH	Total Dynamic Head
TDS	Total Dissolved Solids
TEFC	Totally Enclosed Fan Cooled
TEL	Telephone
TEMP	Temperature/Temporary
TENV	Totally Enclosed Nonventilated
THB	Thrust Block
THD	Thread or Threaded
THH	Thrust Harness
THK	Thick
TIR	Total Indicator Reading
TO	Turnout
T/O	Top of
TOC	Top of Concrete
TOS	Top of Slab
TOT	Total
TP	Telephone Pole

Abbreviation	Term
TRD	Tread
TRA	Tie Rod Assembly
TS	Tube Steel
TV	Television
TYP	Typical
U	
UBC	Uniform Building Code
UD	Underdrain
UG	Underground
UH	Unit Heater
UL	Underwriters' Laboratories, Inc.
ULT	Ultimate
UNO	Unless Noted Otherwise
UPS	Uninterruptible Power Supply
UR	Urinal
USGS	United States Geological Survey
UTC	Underground Telephone Cable
UTR	Up Through Roof
V	
V	Vent/Valve/Volt
VAC	Vacuum/Volts, Alternating Current
VC	Vertical Curve
VCP	Vitrified Clay Pipe
VEL	Velocity
VERT	Vertical
VFD	Variable Frequency Drive
VOL	Volume
VPC	Vertical Point of Curve
VPI	Vertical Point of Intersection
VPT	Vertical Point of Tangency
VSS	Volatile Suspended Solids
VTR	Vent Through Roof
W	
W	West/Watt/Wide/Water
W/	With

Abbreviation	Term
WC	Water Closet
WCO	Wall Cleanout
WG	Water Gauge
WH	Wall Hydrant
WL	Waterline
WLD	Welded
WM	Water Meter/Water Main
W/O	Without
WP	Waterproof/Working Point
WRF	Water Reclamation Facility
WRGWB	Water-Resistant Gypsum Wallboard
WSE	Water Surface Elevation
WSP	Water Stop
WT	Weight
WTR	Water
WWF	Welded Wire Fabric
WWM	Woven Wire Mesh
X	
XFMR	Transformer
XFR	Transfer
Y	
YCO	Yard Cleanout
YD	Yard
YP	Yield Point
YR	Year
YS	Yield Strength
Z	

PART 2 - MATERIALS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01500 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

A. Temporary Electric Power

Purchase electric power or provide portable electric power for the construction of the project. Provide for the extension of utility lines to the point of usage. The Contractor is responsible for the permitting and the provisions required in order to provide temporary power for construction facilities. There is no excess electrical power available at plant site.

B. Temporary Water

1. Make arrangements for developing water sources and supply all labor and equipment to collect, load, transport, and apply water as necessary for compaction of materials, concrete construction operations, testing, dust control, and other construction use.

2. Furnish potable drinking water in suitable dispensers and with cups for use of all employees at the job site during the entire construction period.

C. Temporary Sanitary Facilities

1. Provide temporary toilet facilities separate from the job office. Maintain these during the entire period of construction under this Contract for the use of all construction personnel on the job. Provide enough chemical toilets to conveniently serve the needs of all personnel.

2. Chemical toilets and their maintenance shall meet the requirements of the State and local health regulations and ordinances. Any facilities or maintenance methods failing to meet these requirements shall be corrected immediately.

D. Construction Staking

The Contractor shall provide all construction staking for the work.

E. Silt Barriers, Turbidity Curtains, and Screens

Install silt barriers, turbidity curtains and screens for capturing sediments-solids from erosion.

F. Site Administration and Security

1. Site Administration: The Contractor shall be responsible for all areas of the Site used by it and by all

Subcontractors in the performance of the Work. The Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to the County or others. The Contractor shall have the right to exclude from the Site all persons who have no purpose related to the Work or its inspection, and may require all persons on the Site (except County's employees) to observe the same regulations as the Contractor requires of its employees.

Access to the Site during construction will be limited to Contractor's and/or Subcontractor's employees, agents, and vendors (hereinafter "Representatives") for the sole purpose of performing the Work. All Representatives shall have photo identification issued by the Contractor. Contractor/Subcontractor Representative's identity and business purpose will be subject to verification by County's security representative. Access to the Site will be limited to the main gate off Alafaya Trail unless specific alternate arrangements are made with the County. Contractor will supply, and update, a list with the names, driver's license and license plate numbers of all personnel.

The County reserves the right to direct the Contractor to permanently remove any Contractor or subcontracted employee from the site for breach of security, policy, unsafe working practice, unprofessional behavior, or failure to comply with access restrictions.

2. Security: The Contractor shall be responsible for protection of the Site, and all Work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.

   The County is implementing special security measures to protect the public wastewater system and the Contractor shall provide the same level of security. The Contractor shall provide the following security measures:

   a. All personnel, employees, and/or subcontractors and suppliers that pass through the security perimeter shall wear Contractor issued photo identification badges.

   b. Contractor will supply, and update, a list with the names, driver's license and license plate numbers of all personnel.

c. All personnel passing through the security perimeter shall be subject to background checks to identify any historical crimes dealing with terrorism, sabotage, or other government related illegal activities.

d. All project deliveries shall be inspected prior to entering the security perimeter of the Facility in order to verify contents. All delivery personnel and delivery vehicles shall be under supervision while within the security perimeter of the Facility in lieu of issuance of photo identification badges.

e. If access other than the main gate off Alafaya Trail is utilized, a full time guard shall be provided at the construction gate during contractor working hours. All arrangements for alternative access shall be pre-arranged with the County. All alternative access must be secured and locked when not in use.

No Claim shall be made against the County by reason of any act of an employee or trespasser, and the Contractor shall make good all damage to the County's property resulting from the Contractor’s failure to provide security measures as specified.

G. Access Road and Parking Areas

1. Obtain access to project site through the existing gates from Alafaya Trail. Keep the existing gate accessible at all times so that the County’s vehicles have access to the site.

2. The Contractor and his employees will be permitted to park their vehicles on the County’s property. The County will designate a location for the Contractor and employee parking.

H. Drainage, Erosion, Dust, and Mud Control

1. Provide for the drainage of stormwater as may rain or flow onto or be discharged from the site in performance of the work. Drainage facilities shall be adequate to prevent damage to the work, the site, and adjacent property.

2. Existing drainage channels and conduits shall be cleaned, enlarged or supplemented as permitted by drainage control agencies to carry all runoff attributable to Contractor's operations. Dikes shall be constructed to divert runoff from entering adjacent property (except in natural channels), to protect

County's facilities and the Work, and to direct water to drainage channels or conduits. Ponding shall be provided to prevent downstream flooding and waterway contamination.

3. Prevent erosion of soil on the site and adjacent property resulting from the construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection. Install silt barriers or screens for capturing sediments/solids from erosion.

4. Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation preserved to the greatest extent practicable. Temporary storage and construction buildings shall be located, and construction traffic routed, to minimize erosion. Temporary fast growing vegetation or other suitable ground cover shall be provided as necessary to control runoff.

5. Perform dust and mud control operations to prevent construction operations from producing dust and mud in amounts harmful to persons or causing a nuisance to persons living nearby or occupying buildings in the vicinity of the work. Use water or dust preventative to control dust during dry weather. Take necessary steps to prevent the tracking of mud onto adjacent streets and highways.

I. Project Sign(s)

Provide and erect one sign near the project site in accordance with the drawings. Construct the sign of 3/4-inch exterior grade plywood with 4-inch by 4-inch posts. Brace each sign with at least 2-inch x 4-inch lumber. Paint the sign as indicated in the drawing.

J. Contractor's Field Office and Storage Sheds

Provide field office with parking spaces, a telephone and storage sheds for the performance of the work, and protection of materials and equipment. Provide personnel to answer the telephone during working hours. If the facilities are located off the project site, the Contractor shall indemnify and insure the owner of the land against claims for accident, theft, and other items in accordance with the General Conditions.

K. Owner’s Field Office

Furnish, equip, and maintain an office trailer for the sole use of the Owner, with secure entrance doors and one key per occupant. Provide entrance/exit steps at all exterior doors. Provide parking areas for County vehicles. No Contractor employees or equipment parking will be permitted on Owner parking areas. Contractor shall have Owner’s field office fully functional prior to any construction activities.

1. Area: 1,200 square feet minimum, with minimum dimensions 24 feet x 50 feet.

    a. Divide trailer into three (3) offices, one on each end, reception area, restroom, and conference hall.

    b. Obtain prior approval of Engineer of floor plan. Each room shall have doors with integral locks, keyed alike.

2. Windows:

    a. Minimum: 3, with a minimum total area of 10 percent of floor area.

    b. Operable sash and insect screens.

    c. Locate to provide view of construction areas.

    d. Provide operable Venetian blinds for all windows.

3. Flooring:

    a. Provide VTC flooring throughout interior of trailer.

4. Furniture:

    a. Two (2) conference tables 30 inches x 96 inches with conference chairs.

    b. Three (3) standard size desks, 3-foot x 5-foot with four drawers.

    c. Three (3) office chairs with armrest, high back, swivel and reclining.

    d. Two (2) plan tables: 36 inches x 60 inches.

    e. Two (2) plan table stools with cushion and high backs.

    f. One (1) plan rack to hold a minimum of six sets of project drawings.

g. One (1) standard four-drawer legal size metal filing cabinet with lock and keys (one key per occupant).

h. Two (2) wooden bookshelves with four shelves each.

i. Four (4) office chairs with armrest (2 per office).

j. Four (4) wastebaskets.

k. One (1) tack board, 30 inches x 48 inches.

l. One (1) dry erase board, 30 inches x 42 inches.

m. One (1) coat rack.

n. One (1) 5 cubic-foot refrigerator.

o. One (1) 1.5 cubic-foot microwave oven.

p. One (1) table for printer, copier, fax.

q. One (1) personal computer with minimum 19-inch flat screen monitor. It shall be equipped at a minimum with a Windows 7 operating system, 3rd Gen Intel® Core™ i5 Processor, 6 GB memory and 500 GB Hard Drive.

(1) Full size keyboard and mouse

(2) Network connectivity: 10/100BaseT Ethernet

(3) Wireless router

(4) Productivity Software:

(a) Microsoft Office Professional 2010 or higher

(b) Adobe Acrobat 9 Pro or higher

(c) Internet Security: Integrated software, providing software firewall, virus, spyware, phishing and spam protection in a combined application.

(d) Backup: External hard drive, minimum 2 TB with automated backup software providing daily backups.

5. Office Equipment and Supplies:

a. Two (2) fire extinguishers (per code).

b. One (1) plain paper facsimile (fax) machine with independent phone line.

c. One (1) water cooler dispenser with hot and cold-water valves, including water service for the duration of the Project.

d. One (1) copier machine (sorter, double side copying, letter, legal and 11 x 17) with software for O.C. computer to operate.

e. One (1) color printer EPSON WorkForce Pro WP-4020 or equal.

f. Provide paper for copies in all sizes for the duration of the Project.

g. Provide standard office supplies for the duration of the Project.

h. One (1) first-aid kit.

6. Office Communications:

a. One (1) telephone system with minimum 3 rotary lines and 3 receivers, caller ID.

b. One (1) telephone digital answering machine for 3 lines.

c. Three (3) fastest speed available internet connections, at a minimum DSL, Roadrunner, etc., including e-mail service with connections in each office for the duration of the Project.

d. Four (4) surge protector power strips.

e. The field office telephone numbers will **not** be published publicly.

7. Services (AOD):

a. Lighting: 50-foot-candles at desktop height.

b. Exterior lighting at entrance door.

c. Automatic heating and mechanical cooling equipment sufficient to maintain comfort conditions.

d. Minimum of four-110 volt duplex electrical convenience outlets, at least one on each wall.

e. Electric distribution panel: two circuits minimum, 110-volt, 60-hertz service.

f. Equip washroom with flush toilet, washbasin with two faucets, medicine cabinet with supplies, toilet tissue holder, 10-gallon capacity automatic electric water heater, and paper towel holder.

g. Provide potable water service to all trailer fixtures.

h. Provide a single waste discharge to sanitary disposal system.

i. Cleaning service for the duration of the Project (min. once per week).

j. Furnish, replace, and replenish light bulbs, fluorescent tubes, toilet paper, paper towels, soap, etc.

L. Removal of Temporary Construction When No Longer Needed

When temporary facilities, services, and controls are no longer needed and before the Work is completed, remove the various temporary facilities, services, and controls and legally dispose of them. Portions of the site used for temporary facilities shall be reconditioned and restored to their previous condition.

M. Construction Solid Waste Disposal

Provide a roll-off container for construction debris for the duration of the construction contract.

N. County’s Construction Inspector Work Hours

See Section 01015.

O. Overtime and Weekend Work Pay Rate

See Section 01015.

P. Method of Payment

See Section 01015.

Q. Emergency Wastewater Spill and Water Main Break Procedures

1. Excavate Cautiously: The Contractor shall exercise extreme caution when excavating in proximity of wastewater force mains and gravity sewers. Force main and sewer locations shown on the plans are not exact or

guaranteed. The Contractor is responsible for field verifying existing utility locations.

2. Telephone Notification: The Orange County dispatch operator and County R.P.R shall be notified immediately in the event of a force main, gravity sewer, or water main break or damage at 407-836-2777.

3. Repair Immediately: All damage to Orange County's mains shall be repaired immediately by the Contractor at the Contractor's expense, in accordance with the current edition of the Orange County Utilities Standards and Construction Specifications Manual. If the repair is not made in a timely manner, as determined by the Orange County Utilities Inspector, Orange County may perform repairs and the Contractor will be charged for the repairs.

4. Orange County Utilities Department General Telephone Numbers:

   a. Orange County Utilities Construction Inspection Section…407-836-5550

   b. Orange County Utilities Water Reclamation Division…407-254-9680

   c. Orange County Utilities Water Division…407-254-9850

   d. Orange County Utilities Engineering Division…407-254-9900

5. Advance Notification of Construction: The Orange County Utilities Construction Section (407-836-5550) shall be notified at least seven (7) days prior to any construction activity.

6. Operation of Orange County Valves: Water, wastewater, and reuse valves are to be operated only by Orange County Utilities Inspector (407-836-5550). All valves being installed are to remain closed during construction.

R. Construction Sequence Plan

In addition to the Progress Schedule required by Section 01323, the Contractor shall submit a detailed construction sequence plan to the Project Manager for review and coordination with the plant's operations staff. The construction sequence plan must be accepted by the County before the work is started. The construction sequence plan shall comply with the time limits in Section 01040.

S. Construction Photographs

Prior to starting construction, the Contractor shall photograph the existing facilities from locations to adequately illustrate the condition of the facilities. Deliver three (3) mounted sets of prints to the County. Prints shall be 5″ x 7″ minimum, mounted in plastic sheets in loose leaf, three ring binders. Identify each print on back with the name of the project, description of view, and the time and date of exposure.

END OF SECTION

SECTION 01600 MATERIAL AND EQUIPMENT

A. Transportation and Handling

Deliver manufactured materials and products to the project site as needed for installation, undamaged, in original packages, containers, or bundles, as packaged by the manufacturer with manufacturer's name, brand, seals, and labels intact. Materials other than those designated within the Specifications shall not be delivered to the project site. No deliveries will be accepted by OCU personnel, Contractor shall be on site for all deliveries.

B. Storage and Protection

1. Protect and preserve all materials until final acceptance of the Project. Store all materials in a manner to facilitate inspection and to prevent damage, contamination, or intermixing.

2. Miscellaneous metal, reinforcement bars, welded wire fabric, and masonry reinforcement materials shall be stored to prevent contact with the ground and from being damaged by its own weight or by other loads. Reinforcement that has become muddy shall be cleaned before use.

3. Store cementitious materials in weathertight sheds on elevated floors away from damp surfaces. Prevent freezing.

4. Do not use and dispose of materials that have been stored for longer than their maximum recommended shelf life or beyond their recommended shelf date.

5. Store and protect all material and equipment in accordance with manufacturer's recommendations.

6. Store mechanical equipment with moving parts (pumps, valves, operators, etc.) in weathertight sheds on elevated floors.

7. Store electrical and electronic control equipment (motor control centers, panelboards, switch gear, wiring devices, etc.) in weathertight sheds on elevated floors and in an environment similar to the one in their final location (ventilated, air conditioned, etc.). Store all other electrical material in a manner to prevent contact with the ground and from being damaged by its own weight or by other loads.

C. Protection of Equipment

1. During construction, protect all equipment from moisture absorption and metallic component corrosion by appropriate use of strip heaters, lamps, coverings, or other suitable means. Apply protection immediately on receiving the products and maintain continually.

2. Keep products clean by elevating above ground or floor and by using suitable coverings. Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.

3. Protect factory finish from damage during construction operations and until acceptance of the project. Satisfactorily restore any finishes that become stained or damaged.

D. Equipment Selection and Serviceability

1. Locate and install all equipment so that it may be serviced. Demonstrate that there is room to remove all fan shafts, bearings, filters, pumps and motors, and similar equipment.

2. Equipment that is too large or poorly located to permit servicing shall be replaced or repositioned at no additional cost to the County.

3. Where piping, control diagrams or sequencing differ from the recommended piping arrangements of the equipment manufacturer, and will directly affect the equipment performance, the manufacturer's recommendations shall be submitted in writing to the Engineer for review prior to purchasing the equipment involved. Obtain such recommendations from the manufacturers in order to effect correct and perfect operation of the equipment at the capacities and temperatures indicated.

E. Spare Parts

1. Spare parts shall be packaged in sealed, rotationally moulded LLDPE military grade storage containers that can be stacked. Storage containers shall have exterior metallic hinges, clasps and handles. The Contractor shall produce a construction submittal for type of containers intended to be supplied for review and acceptance by the Owner and Engineer.

2. Pertaining to general inventory of all containers, the Contractor shall provide a general ascending alpha-

numerical numbering convention to label all individual containers supplied. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

3. Pertaining to contents, the containers shall include exterior labeling that shall include the following at a minimum; Process description and Process number, equipment description, equipment tag, Manufacturer's information. Labeling shall be provided in consistent location on all bins such that inventory can be reviewed when stacked.

4. The Contractor shall provide an electronic log in MS Excel of all containers which include the following at a minimum; container alpha-numerical designation, content description, site storage location, O&M Manual volume subsection reference.

5. A copy of all inventory and manufactures product information data sheets shall be provided within a file pocket attached within the container.

6. Containers shall be positioned on site as designated by the Owner's Representative

END OF SECTION

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SECTION 01664 SYSTEM START-UP AND TESTING

PART 1 - GENERAL

A. Description

1. This section includes system start-up and testing. Substantial completion for various portions of the work will be required prior to starting work on other portions of the project. Refer to Section 01040 for specific construction sequencing requirements.

2. Prior to requesting issuance of the Certificate of Substantial Completion for any portion of work, complete system start-up and testing as specified herein, must be completed to the satisfaction of the Owner.

3. At least ninety (90) days prior to initiation of the start-up for each facility as described below, submit a detailed start-up plan and schedule of operational circumstances described below. It is the intent of this section that the entire system as described below be operated and tested under actual operating conditions prior to acceptance. The start-up plan must be accepted by Owner and Engineer prior to initiation of start-up.

4. For issuance of substantial completion for each major respective process, the Contractor is to perform system start-up and testing procedure for the following major facilities. Some of the major facilities are necessary to be tested prior to performing start-up and testing of other facilities. At a minimum the Contractor is required to perform an individual system start-up and testing procedure for the following major facilities:

   a. New Phase I/II WAS Booster Pump Station (Process 610) including but not limited to the following:

      (1) Existing Control Building (Process 140) Improvements

      (2) Process, Electrical, Instrumentation and Controls Equipment

      (3) Solids handling centrifugal pumps

      (4) Piping, isolation valves, air release valves and associated appurtenances

      (5) All electrical transformers, switchgear and starters.

(6) Instrumentation system & field instruments required to operate in its intended automatic and/or manual mode as a complete system.

b. Existing Waste Activated Sludge (WAS) Holding Tanks (Process 620) including but not limited to the following:

(1) Process, Electrical, Instrumentation and Controls Equipment

(2) WAS Thickening Mechanisms

(3) Piping, isolation valves, air release valves and associated appurtenances

(4) All electrical transformers, switchgear and starters.

(5) Instrumentation system & field instruments required to operate in its intended automatic and/or manual mode as a complete system.

c. Existing Biosolids Handling Building (Process 630) including but not limited to the following:

(1) Process, Electrical, Instrumentation and Controls Equipment

(2) Grinders

(3) Flow meters

(4) Polymer Metering Pumps

(5) Piping, isolation valves, air release valves and associated appurtenances

(6) All electrical transformers, switchgear and starters.

(7) Instrumentation system & field instruments required to operate in its intended automatic and/or manual mode as a complete system.

d. Centrifuge Dewatering Building (Process 650) including but not limited to the following:

(1) Existing North Electrical Building (Process 150) Improvements

(2) Process, Electrical, Instrumentation and Controls Equipment

(3) Centrifuges & all associated appurtenances

(4) Screw Conveyors, Knife Gates & all associated appurtenances

(5) Odor Control System

(6) Truck Scales

(7) Bridge Crane

(8) HVAC System

(9) Piping, isolation valves, air release valves and associated appurtenances

(10) All electrical transformers, switchgear and starters.

(11) Instrumentation system & field instruments required to operate in its intended automatic and/or manual mode as a complete system.

5. For those major facilities identified within Part 1.A.4 as designated for an independent facility System Start-up and Testing procedure, it is intended that each major facility be placed in operation by accomplishing the following three steps:

   a. Preliminary Matters - field testing of individual components and equipment during the Contract Time, which may be accomplished one at a time and is to be performed as specified per the individual respective components' specification.

   b. System Start-up - starting the facility under operational conditions and showing it will work for a specified length of time, which shall be accomplished before system testing. Unless otherwise noted, System Start-Up shall be conducted utilizing plant effluent, have a minimum duration of 48 consecutive hours, at that processes rated capacity and operate successfully to the acceptance of the Owner without instances including but not limited to overflows, problems or stoppages required to make corrective measures.

   c. System Testing - proving that the entire Work will function properly as a system, each individual component will operate within the system and that the system will function to meet the specified standards over a stated period of time. Unless

otherwise noted, shall be conducted utilizing the intended media to be processed, have a minimum duration of 7 consecutive days, at that processes rated capacity and operate successfully to the acceptance of the Owner without instances including but not limited to overflows, problems or stoppages required to make corrective measures.

6. For those facilities not identified within Part 1.A.4 as designated for an independent facility System Start-up and Testing procedure, the Contractor is perform System Start-Up and Testing following the procedure outlined herein.

B. Submittals

1. At least ninety (90) days prior to each facility's system start-up, submit a system start-up and testing program to the Engineer for review.

2. The plan shall be a comprehensive report that includes detailed activities and coordination required to implement the requirements of this specification. The report shall include at a minimum preliminary matters, system start-up and system testing for both the wastewater process equipment and the electrical equipment.

3. The report shall include a detailed schedule for the sequence of all operations that the Contractor will perform for the testing specified herein.

4. Identify the Owner's activities required for the system start-up and testing. Schedule a meeting with Owner and Engineer to review draft start-up plan at least 60 days prior to initiating start-up activities. Revise draft plan to incorporate comments from Owner and Engineer and re-issue start-up plan at least 30 days prior to initiating start-up activities.

PART 2 - PRODUCTS

A. Water, Fuel, Chemicals and Electricity

The Contractor is responsible to supply all potable water, fuel, chemicals and electricity as necessary to perform all the system start-up and testing. At no cost to the Contractor, the Owner will provide the supply for all reclaimed, effluent or non-potable water.

B. Polymer for Process 650

The Contractor is responsible to supply all polymer as required for start-up, system testing and as necessary for issuance of substantial completion for Process 650. The County will supply polymer for dewatering solids using the Process 640 belt filter presses. For Process 650, the Contractor will supply the same type and manufacturer of polymer as the County presently uses. The Contractor will supply the polymer into the Process 630 storage facilities presently in service. Following issuance of substantial completion for Process 650, the Contractor is required to fill all bulk storage tanks within Process 630 to capacity, 630-TK-1 and 630-TK-2.

C. Temporary Pumping and Piping Facilities

The Contractor is responsible to supply a complete pumping and piping system to convey all reclaimed water, effluent or non-potable water from the existing chlorine contact chambers to the various facilities being testing.

D. Laboratory Testing Services

The Contractor is responsible to supply all services related to sample collection and laboratory testing services. The Contractor shall utilize a laboratory certified in the State of Florida. The certified laboratory is responsible to perform all the laboratory testing and produce the laboratory testing reports as required herein.

E. Electrical Test Recorders

Install 24-hour test recorders to each motor starter for the purpose of the tests only and remove them after completion of testing.

PART 3 - EXECUTION

C. Preliminary Matters

1. Conduct all field inspections as defined in the individual specification sections, installation checks, hydrostatic tests, performance tests, and necessary corrections required, to demonstrate that individual components of the Work have been properly erected and found to operate in accordance with the Contract Documents, so that they can be utilized for their intended purposes.

2. Remove all electrical jumpers, bypasses or other items connected to the equipment, which are not intended to

remain in the facility and are not required by the specifications. Demonstrate that each component is operating under its own control as designated.

3. Confirm that all electrical circuits are energized in the automatic position, that valves and gates are set to their normal position and that the flow path through the Work is unobstructed.

4. Assure that the water supply to the seal water system is on. Until the plant service water becomes available, provide temporary seal water with backflow preventer.

5. Fill each hydrostatic structure in the process flow stream with effluent in accordance with Section 03800.

D. Start-Up Testing

1. Provide personnel and equipment except as stated in paragraph entitled "Interface Between Contractor and Owner" during the start-up testing period to perform the start-up testing tasks. Prior to commencing system start-up and by utilizing the C.A.R. procedure, coordinate system start-up activities with the Owner's operating personnel and the Engineer.

2. Initiate component start-up in accordance with the manufacturer's operation and maintenance manual.

3. Coordinate with Owner for any adjustments desired or operational problems requiring debugging.

4. Make adjustments as necessary.

5. During this start-up testing period, a representative of the manufacturer of each major piece of equipment shall visit the site for at least one (1) day to inspect the equipment and certify to the Engineer and Owner in writing that the equipment has been installed properly and is operating properly.

6. During the start-up testing period, operate the facilities in a manner to test alarms, controls, and interlocks. Repair or replace equipment that does not respond to the interlocks, alarms and controls designed. The work must operate successfully during this testing period in the manner intended. If the work does not operate successfully, correct the problem and start the test over.

7. Test all motors for vibration by measuring the vibration on the shaft adjacent to the bearings. If a vibration

level is specified in the technical specifications for a particular piece of equipment, assure that the equipment complies with the specified level. Repair, realign or replace equipment until the measured vibration is less than the specified maximum vibration level. Submit vibration test reports to Engineer for review.

8. The system start-up will be deemed to be completed after the respective conditions within the specific equipment specifications have been met and the following;

   a. New Phase I/II WAS Booster Pump Station (Process 610) –

      (1) Pumps 610-P-1 and 610-P-2 have performed satisfactorily, per the discretion of the Owner's R.P.R, over the range of service conditions as specified for at least seven (7) consecutive days without overflows, problems or stoppages to make corrective measures .

      (2) Operation shall include both conditions automatic and manual operation. Demonstrate that the control and/or monitoring signals are properly received or transmitted from/to the interface terminal blocks as shown on the drawings.

   b. Existing Waste Activated Sludge (WAS) Holding Tanks (Process 620) including but not limited to the following:

      (1) Thickening Mechanisms 620-TM-1 and 620-TM-2 have operated satisfactorily, per the discretion of the Owner's R.P.R, at least seven (7) consecutive days without overflows, problems or stoppages to make corrective measures. Operation shall include both conditions automatic and manual operation.

      (2) Operation shall include both conditions automatic and manual operation. Demonstrate that the control and/or monitoring signals are properly received or transmitted from/to the interface terminal blocks as shown on the drawings.

   c. Existing Biosolids Handling Building (Process 630) including but not limited to the following:

      (1) Pumps 630-P-6, 630-P-7 & 630-P-8 and Grinders 630-GD-3, 630-GD-4 630-GD-5 and have performed

satisfactorily, per the discretion of the Owner's R.P.R, over the range of service conditions as specified for at least two (2) consecutive days without overflows, problems or stoppages to make corrective measures. Operation shall include both conditions automatic and manual operation. The System Start-Up and System Testing for this process shall be performed coincident with the System Testing and System Start-Up phases of Process 650.

(2) Operation shall include both conditions automatic and manual operation. Demonstrate that the control and/or monitoring signals are properly received or transmitted from/to the interface terminal blocks as shown on the drawings.

d. New Centrifuge Dewatering Building (Process 650) including but not limited to the following;

(1) Centrifuges 650-CF-1, 650-CF-2 and 650-CF-3 have performed satisfactorily, per the discretion of the Owner's R.P.R, over the range of service conditions as specified for at least seven (7) consecutive days without overflows, problems or stoppages to make corrective measures. Reference Section 11371 for additional requirements for the Preliminary Matters, System Start-Up and System Testing phases associated with the Centrifuges. The System Testing and System Start-Up phases of Process 650 shall include operation of Processes 610, 620 and 630.

(2) Operation shall include both conditions automatic and manual operation. Demonstrate that the control and/or monitoring signals are properly received or transmitted from/to the interface terminal blocks as shown on the drawings.

E. System Testing

1. General System Testing requirements;

a. After completion of the start-up testing, perform the system testing of the Centrifuge Dewatering Improvements in the presence of the Engineer and Owner. A successful system test must be completed before substantial completion may be issued. Provide

all personnel and equipment except as stated in the paragraph entitled "Interface Between Contractor and Owner" as necessary during the system testing period to complete the tasks. The Owner will direct the Contractor relative to required unit operation and performance under the varying operating conditions.

b. During the system test period, operate the facilities in a manner to test alarms, controls, and interlocks. Repair or replace equipment that does not respond to the interlocks, alarms, and controls designed.

c. During the system testing, test the pumps:

(1) Operate the pumps for the duration of the test, during which time no repairs or adjustments shall be required. Assure that pumps operate as designed and specified in response to wet well level controls and variable speed controls, and that programmer operates without evidence of vibration in excess of that allowed by the Hydraulics Institute Standards (Figures 77-76 and 77-8), cavitation, and damage to impellers and shafts. Repair, replace, or realign motors, shafts, and impellers and retest.

(2) Where field tests are required for pumps and no meters are in the associated piping, provide temporary meters and flow recorders.

d. During the system testing, test all motors for vibration by measuring the vibration on the shaft adjacent to the bearings. If a vibration level is specified in the technical specifications for a particular piece of equipment, assure that the equipment complies with the specified level. Repair, realign, or replace equipment until the measured vibration is less than the specified maximum vibration level.

e. During the system testing period, operate the Work and cause various operational circumstances to occur, as instructed by designated plant operating personnel. At a minimum, these circumstances will include ranges in flow and polymer, random equipment failures and tank overflows, surcharges, and bypasses. Acceptability of the Work's performance will be based on the work performing as specified under these actual and simulated operating conditions and producing an effluent as defined in

the contract documents. The intent of the start-up testing is for the Contractor to demonstrate to the Owner and the Engineer that the work will function as a complete and operable system under normal as well as emergency operating conditions and is ready for acceptance.

f. If the work does not operate successfully, correct the problem(s) and start the test over from day one.

g. Unless otherwise noted, System Testing shall be conducted utilizing the intended media to be processed, have a minimum duration of seven (7) consecutive days, at that processes rated capacity and operate successfully to the acceptance of the Owner without instances including but not limited to overflows, problems or stoppages required to make corrective measures.

F. Interface Between Contractor and Owner

It is the intent of this section that, during Preliminary Matters, and the System Start-Up and System Testing:

1. The ownership of the project shall remain with the Contractor.

2. During system testing, the Contractor will assist the Owner by performing all work to test, operate and maintain the plant (turning on/off pumps, opening/closing valves, etc.), assuming a 16 hour working day, seven days a week, starting the date a system test is initiated on any respective process.

3. The Owner will furnish certified operators in compliance with FDEP rules.

4. The Contractor shall submit a C.A.R. for correspondence with the Owner and will not perform any activities without first consulting with Owner.

G. Instrumentation and Controls Testing

1. For those major facilities identified within Part 1.A.4 as designated for an independent facility System Start-up and Testing procedure, the Contractor is to perform the Operational Readiness Test (ORT), Functional Demonstration Test (FDT) and Performance Acceptance Test (PAT) in conjunction with the Preliminary Matters, System Start-Up and System Testing procedures, respectively.

2. For those facilities not identified within Part 1.A.4 as designated for an independent facility System Start-up and Testing procedure, the Contractor is to perform the Operational Readiness Test (ORT), Functional Demonstration Test (FDT) and Performance Acceptance Test (PAT) in conjunction with the Preliminary Matters, System Start-Up and System Testing procedures, respectively.

END OF SECTION

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SECTION 01700 CONTRACT CLOSEOUT

A. Clean-Up Operations

See Section 01740.

B. Closeout Submittals

1. At least 2 weeks prior to start-up, the following items shall be submitted:

   a. Service manuals, installation instructions, and operation and maintenance manuals.

   b. Spare parts and special tools ordered as part of this Contract.

   c. All keys to all doors, gates, and equipment.

   d. Statements from the manufacturer's representatives as called for in the Contract Documents.

2. Upon completion of the project, or portions thereof, and prior to final payment, the Contractor shall transfer to the County all applicable items accumulated throughout construction. These include, but are not limited to, the following items:

   a. Manufacturers' guarantees, bonds, and letters of coverage extending them beyond the time limitations of the Contractors' guarantee.

   b. Salvaged materials or materials and equipment borrowed from the County.

   c. Record documents of completed facilities.

   d. Releases of lien. General release from Contractor plus copies of releases from subcontractors and material suppliers.

3. The closeout requirements of this section are in addition to the requirements of the Standard General Conditions and Supplementary Conditions.

END OF SECTION

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SECTION 01720 PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

A. Description

1. The purpose of the Project Record Documents is to provide the County with factual information regarding all aspects of the Work, both concealed and visible, to enable future location, identification and modification of the Work without lengthy and expensive site measurement, investigation or examination.

2. These standards and procedures are for integration of digital engineering CAD drawings and attribute data into the database environments, while maintaining the integrity and positional accuracy of the data. The requirement for digital submittal of approved construction plans is to provide the County GIS with a parcel and utility base for field maintenance and operations.

3. The location of the constructed improvements as depicted in the Contract Drawings is required. To insure the Work was constructed in conformance with the Contract Drawings, the following survey documents are required to be prepared and certified by the Surveyor:

   a. As-Built Asset Attribute Data Table (see Table 01050-2)

   b. Pipe Deflection Table (see Table 01050-3)

   c. Gravity Main Table (see Table 01050-4)

   d. Boundary Survey and Survey Map Report for pump stations and easements with constructed improvements.

B. Definitions

Except where specific definitions are used within a specific section, the following terms, phrases, words and their derivation shall have the meaning given herein when consistent with the context in which they are used. Words used in the present tense include the future tense, words

in the plural number include the singular number and words in the singular number include the plural number.

1. As-Built Drawings: Drawings prepared by the Contractor's Surveyor shall depict the actual location of installed utilities for the completed Work in a full size hard copy and an electronic AutoCAD file (dwg) format.

2. Record Documents: All documents as required in subsections Part 1.D and Part 2.B in this specification section.

3. Boundary Survey: Boundary survey, map and report certified by a Surveyor shall be provided that meets the requirements of Chapter 5J-17 'Minimum Technical Standards', FAC.

4. Surveyor: Contractor's Surveyor that is licensed by the State of Florida as a Professional Surveyor and Mapper pursuant to Chapter 472, F.S.

5. Survey Map Report: As a minimum the Survey Map Report shall identify any corners that had to be reset, measurements and computations made, pump station and easement boundary issues, locations of constructed improvements outside boundaries, and accuracies obtained.

6. Specifications and Addenda: Legibly mark each section to record.

   a. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed; and

   b. Changes made by Field Order or by Change Order

C. Quality Assurance

1. Delegate the responsibility for maintenance of the Record Documents to one person on the Contractor's staff as approved by the County.

2. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each

page of specifications and each sheet of Drawings and other documents where such entry is required to show progress and changes properly.

3. Make entries within 24-hours after receipt of information has occurred.

D. Record Documents at Site

1. Maintain at the site and always available for County's use one (1) record copy of:

   a. Construction Contract, Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents

   b. Change Orders, Verbal Orders, and other modifications to Contract

   c. Written instructions by the County as well as correspondence related to Requests for Information (RFIs)

   d. Accepted Shop Drawings, Samples, product data, substitution and "or-equal" requests

   e. Field test records, inspection certificates, manufacturer certificates and construction photographs

   f. Progressive As-Built Drawings

   g. Current Surveyor's tables for the As-Built Assets Attribute Data, Pipe Deflection Data, and Gravity Main Data

2. Maintain the documents in an organized, clean, dry, legible condition and completely protected from deterioration and from loss and damage until completion of the Work, transfer of all record data to the final As-built Drawings for submittal to the County.

3. Store As-Built Documents and samples in Contractor's office apart from documents used for construction. Do not use As-Built document for construction purposes. Label each document "AS-BUILT" in neat large printed letters. File documents and samples in accordance with

CSI/CSC format.

4. Record information concurrently with construction progress. Do not conceal any Work until required information is recorded.

PART 2 - PRODUCTS

A. As-Built Drawings

1. Maintain the electronic As-Built Drawings to accurately record progress of Work and change orders throughout the duration of the Contract.

2. Date all entries. Enter RFI No., Change Order No., etc. when applicable.

3. Call attention to the entry by highlighting with a "cloud" drawn around the area affected.

4. In the event of overlapping changes, use different colors for entries of the overlapping changes.

5. Design call-outs shall have a thin strike line through the design call-out and all As-Built information must be labeled (or abbreviated "AB") and be shown in a bolder text that is completely legible.

6. Make entries in the pertinent other documents while coordinating with the County for validity.

7. Entries shall consist of graphical representations, plan view and profiles, written comments, dimensions, State Plane Coordinates, details and any other information as required to document field and other changes of the actual Work completed. As a minimum, make entries to also record:

   a. Depths of various elements of foundation in relation to finish floor datum and State Plane Coordinates and elevations.

   b. As-Built Asset Attribute Data Table shall be completed in the Drawings.

   c. When electrical boxes, or underground conduits and plumbing are involved as part of the Work, record

true elevations and locations, dimensions between boxes.

d. Actually installed pipe or other work materials, class, pressure-rating, diameter, size, specifications, etc. Similar information for other encountered underground utilities, not installed by Contractor, their owner and actual location if different than shown in the Contract Documents.

e. Details, not on original Contract Drawings, as needed to show the actual location of the Work completed in a manner that allows the County to find it in the future.

f. The Contractor shall mark all arrangements of conduits, circuits, piping, ducts and similar items shown schematically on the construction documents and show on the As-Built Drawings the actual horizontal and vertical alignments and locations.

g. Major architectural and structural changes including relocation of doors, windows, etc. Architectural schedule changes according to Contractor’s records and Shop Drawings.

8. As-Built Drawings shall include certifications from the Surveyor and the Contractor.

9. As-Built Drawings shall show location of all underground and above ground water, wastewater and reclaimed water piping and related appurtenances, based upon Record Survey information. All changes to piping location including horizontal and vertical locations of utilities and appurtenances shall be clearly shown and referenced to permanent surface improvements and road rights-of-way. Drawings shall also show actual installed pipe material, class, etc.

10. As-Built Drawings shall clearly show all details not on original contract drawings but constructed in the field. All equipment and piping relocation shall be clearly shown Drawings shall clearly show all details not on original contract drawings but constructed in the field. All equipment and piping relocation shall be clearly shown.

11. Dimensions between all manholes, slope of gravity mains, invert and top elevations shall be shown.

12. Each As-Built Drawing shall be signed, sealed and dated by the licensed Surveyor as being an As-Built Drawings.

B. Record Documents

1. Three (3) hard copy sets and three (3) digital media sets of the final Record Documents and shall include all of the documents described below under this subsection.

2. The following documents shall be signed and sealed by the Surveyor:

   a. As-Built Asset Attribute Data Table (see Specification Section 01050 "Surveying and Field Engineering," Table 01050-2 for an example)

   b. Boundary Survey of pump station and Survey Map Report

   c. Boundary Survey and Survey Map Report for the location of constructed pipes within any easements and right-of-way. As a minimum the Survey Map Report shall identify or describe the locations where the pipe centerline was constructed within 3- feet of the easement or right-of-way boundary, where the pipe was constructed outside the easement or right-of-way boundary, any corners that had to be reset, measurements and computations made, pump station boundary issues, and accuracies obtained. Survey map report shall be dated after the Work within the right-of-ways or easements have been completed.

   d. Gravity Main Table (see Specification Section 01050 "Surveying and Field Engineering", Table 01050-4 for an example)

   e. Pipe Deflection Table (see Specification Section 01050 "Surveying and Field Engineering" Table 01050-3 for an example). An electronic blank table will be supplied by the County.

3. Digital sets of the final Record Documents including but not limited to:

    a. Scanned digital copies of the final As-Built Drawings

    b. Electronic Survey documents electronically sealed by the Surveyor

    c. Final Record Documents information

    d. Digital As-Built Drawing in the Engineer’s current version of AutoCAD file (dwg) format for the Contract Drawings, updated to match the final Record Drawing information

4. Pump station site Boundary Survey and Map Report.

5. New Boundary Survey to re-establish easement corners, right-of-way monuments, or pump station site corners with monuments if destroyed by the Work.

6. Scanned Documents: Scan the Survey Documents and other Record Documents reflecting changes from the Bid Documents.

7. The scanned "As-Built" Drawing sets shall be complete and include the title sheet, plan/profile sheets, cross-sections, and details. Each individual sheet contained in the printed set of the As-Built Drawings shall be included in the electronic drawings, with each sheet being converted into an individual tif (tagged image file). The plan sheets shall be scanned in tif format Group 4 at minimum of 400 dpi resolution to maintain legibility of each drawing. Then, the tif images shall be embedded into a single pdf (Adobe Acrobat) file representing the complete plan set. Review all Record Documents to ensure a complete record of the Project.

8. Provide an encompassing digital AutoCAD file that includes all the information of the As-Built Drawings and any other graphical information in the As-Built Drawings. It shall include the overall Work, utility system layout and associated parcel boundaries and easements. Feature point, line and polygon information for new or altered Work and all accompanying geodetic control and survey data shall be included. The

surveyor's certified As-Built Asset Attribute Data shall be added to the As-Built Drawings and Surveyor shall electronically seal the data in a comma-delineated ASCII format (txt).

C. Digital Record Drawing Submittal

A Record Drawing of the affected construction area shall be submitted in an encompassing digital CAD file that includes the overall utility system layout and the associated parcel features. Feature point, line and polygon information for new or altered structures in the work area and all accompanying geodetic control and survey data shall be included. The minimum requirements are as follows:

a. State Plane Coordinate System

(1) The drawing shall be submitted using state plane coordinate system with at least two points referenced to the County's geodetic control network with a horizontal accuracy of plus/minus three centimeters relative to the County's geodetic control network points used as reference. The points shall be certified by a surveyor registered in the state of Florida.

(2) Features in drawing files that are stored in drawing units will be translated to real world locations. The geodetic control chosen shall correspond to existing monuments in the County control network.

(3) The new structures and features shall be geographically registered to the geodetic control. State plane coordinates exist for most quarter section corners in Orange County. Control assistance can be obtained from the survey section of Public Works.

(4) If the geodetic control point is located within the project limits, it shall be symbolically indicated and annotated in the design file. If the nearest geodetic control is located well outside of the project area then it shall be tied to one of the other geodetic control points used,

and a reference tie annotated and indicated in the design file. The two geodetic control points described above are the least survey grade geo-referencing information a developer can use to create the plan view drawing. Please refer to the subsection, “Conventional and GPS Survey Standards” to understand the type of structures and survey grade needed for the additional geodetic information contained in this drawing. This document describes which structures need to be surveyed and created within the drawing according to its corresponding horizontal coordinates and vertical elevation.

(5) All drawings need to be geographically registered in the Florida State Plane Coordinate System. A licensed Surveyor shall set the vertical and horizontal control at the project site.

(a) Horizontal Datum: State Plane, Florida East Zone, Transverse Mercator Projection, National NGS Datum NAD of 1983, Re-adjustment of 1990 using the HARN (High Accuracy Reference Network) correction;

(b) Vertical Datum: Vertically corrected to the North American Vertical Datum of 1929.

b. The spatial accuracy of the feature data contained in the digital Record Drawing shall be equal to or better than the graphical data contained in the plan/profile sheets.

c. Pressure piping is to be entered as a single line between tees, wyes, and reducers. Pipe sections should be continuous through structures such as valves and other fittings. Pipes should be broken and joined by a suitable fitting when a line changes its diameter or material properties. For wastewater force mains, the line feature(s) shall be input using the same direction from point to point as the proposed or existing flow. Therefore, the starting point of force main line

segments within these layers shall be the upstream point and the downstream point shall be the endpoint of that segment. This procedure is required to indicate the continuity of flow and connectivity within the wastewater layers.

d. Gravity lines shall be entered as a single line, digitized in the direction of the design flow, and broken at manholes. The beginning point of the line would the upstream end and the ending point would be the downstream end.

e. Text identifying piping shall be aligned with the piping. Point and linear feature attribute text shall be visible on the drawing in a standard font and the lower left-hand corner of the text shall be just clear of the linear or point feature to which it corresponds, unless legibility requires that the label be moved and accompanied by a leader arrow. The labels shall be placed onto a separate layer and not to be placed in the feature layer. For reading from the bottom or right side of the plan sheet, the rotation angle shall be between -90 degrees and 90 degrees.

f. Features shall be placed on their appropriate layers and assigned colors by layer for consistency. Features shown in the AutoCAD files shall be in model space and be contained in the AutoCAD files as opposed to being linked to externally referenced files. CAD systems which use a numbering system for layers instead of names shall also include a conversion chart explaining which layer number corresponds with which layer name.

g. The GIS plan view layer shall be reviewed for duplicate objects, short objects, crossing objects, undershoots, clustered nodes, pseudo nodes, dangling objects or overshoots, and zero-length objects. Lines shall be continuous from structure to structure. Topology is provided by the end points of pipelines snapped to the end points of connecting lines, with a structure node being snapped to the end point. A point feature will be used to represent a structure such as a manhole or valve. The point feature shall be a

symbol block with its block insertion point at the point of intersection or end point of a line.

h. For preparation of the Record Drawings, the County will provide the Contractor the specific language to be utilized on each Drawing for the Record Drawing stamp. At a minimum the Record Dorawing will contain the following language: **"This document is a compiled representation of the constructed project, as prepared by the General Contractor: _____. The source and basis of information used in the preparation of the document, upon which the Engineer reviewed, was the General Contractor: _____. The Engineer did not confirm the accuracy or completeness of the information provided by the General Contractor:_____. This document is believed to be representative of the constructed condition in the opinion of the Engineer, however the accuracy and completeness of the information cannot be guaranteed. The Engineer shall not be held responsible for the accuracy of the material represented or the reuse of the material by others. These statements are required by rule 61G15-30, FAC for record documents that include information provided by others."** The County will provide the Contractor with the final specific wording to be contained within the Record Drawing stamp when project substantial completion is issued.

i. File format shall be AutoCAD (current edition utilized by the County) (dwg) or drawing interchange file (dxf). Dxf files can be created from all major CAD and GIS packages. Standard transfer media will be accepted. This media includes CD, DVD, and Iomega zip disks.

PART 3 - EXECUTION

A. Pre-Construction Meeting

Pre-construction Meeting: It is recommended that the Surveyor attend the Pre-construction meeting. At the pre-construction meeting the Contractor shall be provided with a blank electronic version of the spreadsheet for the tables: Asset Attribute Data and Pipe Deflection. The

Contractor's surveyor shall use these tables to input the data and shall not alter the table format or formulas.

B. Construction Progress Meetings

Contractor shall provide progressive Record Documents described below:

1. Construction Contract, As-Built Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents.

2. Specifications and Addenda: Record manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed as well as any changes made by Field Order, Change Order or other.

3. Change orders, verbal orders, and other modifications to Contract.

4. Written instructions by the County as well as correspondence related to Requests for Information (RFIs).

5. Accepted Shop Drawings, samples, product data, substitution and "or-equal" requests.

6. Field test records, inspection certificates, manufacturer certificates and construction photographs.

7. As-Built Asset Attribute Data Table: Surveyor shall obtain field measurements of vertical and horizontal dimensions of constructed improvements. The monthly submittal shall include the Surveyor’s certified statement regarding the constructed improvements being within the specified accuracies as described in Specification Section 01050 "Surveying and Field Engineering", Table 01050-1 Minimum Survey Accuracies or if not, indicating the variances.

8. Gravity Main Table: Surveyor shall prepare and update a Gravity Main Table to include as a minimum the pipe segment identification, pipe lengths, manhole inverts and tops, and slopes for gravity mains. Surveyor shall certify the data entered are correct and indicate if the minimum slopes have not been met.

9. Pipe Deflection Table: Surveyor shall input the type of pipe, pipe manufacturer, PVC manufacturer deflection allowance, allowable angle of offset and radius of curvature, laying length of pipe, and coordinates. Surveyor shall certify the data entered are correct and indicate if the deflection allowance, offset or radius of curvature exceeds the manufacturer's recommendations.

C. Final Record Documents Submittal

Submit the Final Record Documents within 20-days after Substantial Completion.

1. Participate in review meetings as required and make required changes and promptly deliver the Final Record Documents to the County.

D. Storage and Preservation

1. Store Record Documents and samples at a protected location in the project field office apart from documents used for construction.

   a. Provide files and racks for storage of documents

   b. Provide locked cabinet or secure space for storage of samples

2. File documents and samples in accordance with CSI format with section numbers matching those in the Contract Documents.

3. In the event of loss of recorded data, use means necessary to again secure the data to the County's approval.

   a. Such means shall include, if necessary in the opinion of the County, removal and replacement of concealing materials.

   b. In such cases, provide replacements of the concealing materials to the standards originally required by the Contract Documents.

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SECTION 01740 CLEANING DURING CONSTRUCTION AND FINAL CLEANING

PART 1 - GENERAL

A. General

1. This section includes cleaning during construction and final cleaning on completion of the work.

2. At all times maintain areas covered by the Contract and adjacent properties and public access roads free from accumulations of waste, debris, and rubbish caused by construction operations.

3. Conduct cleaning and disposal operations to comply with local ordinances and antipollution laws. Do not burn or bury rubbish or waste materials on project site. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains. Do not dispose of wastes into streams or waterways.

4. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

B. Cleaning During Construction

1. During execution of work, clean site, adjacent properties, and public access roads and dispose of waste materials, debris, and rubbish to assure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish.

2. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

3. Provide containers for collection and disposal of waste materials, debris, and rubbish.

4. Cover or wet excavated material leaving and arriving at the site to prevent blowing dust. Clean the public access roads to the site of any material falling from the haul trucks.

C. Site Cleaning Prior to Landscaping

Remove concrete, concrete wash, stucco splatter, gunite overspray, and all other wastes and debris prior to final grading and landscaping.

D. Final Cleaning

1. At the completion of work and immediately prior to final inspection, clean the entire project site as follows.

2. Clean, sweep, wash, and polish all work and equipment including finishes.

3. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces; polish surfaces.

4. Repair, patch, and touch up marred surfaces to match adjacent surfaces.

5. Broom clean paved surfaces; rake clean landscaped areas.

6. Remove from the site all temporary structures and all materials, equipment, and appurtenances not required as a part of, or appurtenant to, the completed work.

END OF SECTION

DIVISION 2 – SITEWORK

02050	Equipment, Piping, and Materials Demolition
02110	Clearing, Grubbing, and Stripping
02160	Temporary Excavation Support Systems
02200	Earthwork
02222	Protecting Existing Underground Utilities
02223	Trenching, Backfilling, and Compacting
02231	Soil-Cement Base Course
02232	Limerock Base Course
02270	Erosion and Sedimentation Control
02276	Gravel and Crushed Rock Base for Structures
02282	Connections to Existing Buried Pipelines
02530	Leakage and Infiltration Testing
02534	PVC Gravity Sewer Pipe
02551	Prime and Tack Coats
02576	Asphalt Pavement
02610	Stabilized Sub-Base
02630	Culverts and Storm Sewers
02778	Concrete Curbs, Gutters, and Sidewalks
02810	Sodding
02834	Steel Chain Link Fences and Gates

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SECTION 02050 EQUIPMENT, PIPING, AND MATERIALS DEMOLITION

PART 1 - GENERAL

A. Description

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

PART 2 - MATERIALS

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

PART 3 - EXECUTION

A. General

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

Remove equipment indicated in the drawings.

C. Replacement

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

D. Salvage

Equipment salvaged from the premises is the property of the County. Clean and prepare the equipment for storage as designated by the County RPR, 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 County RPR to protect it. Tag, label or identify the equipment in a manner as designated by the County RPR. Unload the equipment within a storage location as designated by the County RPR. 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 County RPR.

1. The following are major equipment elements that shall be salvaged as part of the Centrifuge Dewatering Improvements. 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
1. Air Handlers and Condensing Units (Process 150)
2. Unit Substations 1 & 2 Breaker and Transformer Subsections (Process 150)
3. Polymer Injection Pumps (Process 630)
4. Remote I/O Panels (Process 640)

E. Existing Piping and Electrical Utilities

Shut off or disconnect utilities affecting demolition work. Schedule shutdowns with the County by processing a C.A.R form; notify the County seven (7) working days in advance of any shutdown that is required to perform the work. The County 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. Reference the Construction Drawings for the elements within the Work to be demolished.

2. 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.

3. 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 02200.

4. 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 County. If, in the opinion of the County's Representative, 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 County's Representative. No blasting will be permitted.

5. All equipment, material, and piping, except as specified to be salvaged for the County, 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.

6. Do not reuse material salvaged from demolition work on this project, except as specifically shown.

END OF SECTION

SECTION 02110 CLEARING, GRUBBING, AND STRIPPING

PART 1 - GENERAL

A. Description

This section describes the work included in clearing, grubbing, stripping, and preparing the project site for construction operations.

B. Clearing

Remove and dispose of trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth. Remove all evidence of their presence from the surface including sticks and branches greater than 1 inch in diameter or thickness. Remove and dispose of trash piles and rubbish. Protect structures and piping above and below ground, trees, shrubs, and vegetative growth which are not designated for removal.

C. Grubbing

After clearing, remove and dispose of wood or root matter, including stumps, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a depth of 12 inches below the ground surface.

D. Stripping

1. Remove and dispose of all organic sod, topsoil, grass and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped.

2. Retain topsoil material onsite for dressing backfill areas before planting.

PART 2 - MATERIALS

A. Trees and Shrubbery

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. Preserve in place trees that are specifically shown in the drawings and designated to be preserved.

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 to affect the work to provide a balanced appearance of any tree. Treat cuts with a tree sealant.

PART 3 - EXECUTION

A. Clearing and Grubbing Limits

Clear and grub excavation and embankment areas associated with new structures, slabs, and roadways.

B. Disposal of Clearing and Grubbing Debris

Do not burn combustible materials. Remove cleared and grubbed material from the worksite and dispose.

C. Areas to be Stripped

Strip excavation and embankment areas associated with new structures, slabs, walks, and roadways. Strip stockpile areas.

D. Disposal of Strippings

Remove stripped material and dispose offsite, except topsoil.

END OF SECTION

SECTION 02160 TEMPORARY EXCAVATION SUPPORT SYSTEMS

PART 1 - GENERAL

A. Description

1. 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.

2. 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.

3. 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.

4. 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.

5. 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.

6. 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.

7. 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.

8. 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.

B. References

1. American Society for Testing and Materials (ASTM):

   a. A36: Standard Specification for Structural Steel

   b. A416: Standard Specification for Strand Steel, Uncoated Seven-Wire for Prestressed Concrete

   c. A572: Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel

   d. A722: Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete

   e. A615: Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

2. American Wood-Preserves Association (AWPA) Standards.

3. American Welding Society (AWS) Code: D1.1.

4. Federal Standard, FS TT-W-571: Wood Preservation and Treating Practices.

5. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29: Subpart P - Excavations, Trenching and Shoring.

6. American Concrete Institute (ACI)

7. ACI 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

8. Florida Trench Safety Act

C. Submittals

1. Submit the following in accordance with the General Conditions, Section 01300, and the following:

   a. Submit the following qualifications four (4) weeks prior to the construction:

(1) 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.

(2) Qualifications of Contractor's temporary excavation support system installer as specified in Paragraph D.8.

(3) Qualifications of Contractor's independent tieback testing laboratory as specified in Paragraph D.9, if a tieback system is utilized.

(4) Qualifications of Contractor's temporary excavation support system installation supervisor as specified in Paragraph D.10.

(5) 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 four (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: Submit three (3) paper copies of form 02160-1, 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 one (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.

D. Quality Assurance

1. 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.

2. 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.

3. Construction operations to conform to noise regulations provided in the Noise Control Plan and this Section.

4. Retain the services of an independent vibration consulting firm with the following in-house personnel to conduct the following vibration monitoring requirements:

    a. 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:

        (1) Be a Registered Professional Structural Engineer in the State of Florida.

        (2) Have a minimum of five (5) years experience in the vibration consulting field.

        (3) Have successfully completed at least five (5) projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.

    b. Assist Contractor in selecting pile driving equipment which will generate the lowest vibration and noise levels.

    c. Installation, monitoring and interpretation of monitoring equipment shall be performed by personnel with the following qualifications:

        (1) Have at least three (3) years of experience in the operation of monitoring equipment proposed for use and interpretation of records produced by such equipment.

        (2) Have installed, operated, monitored and interpreted equipment and records on at least three (3) projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more complex than those to be encountered.

5. 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

6. If utilizing deformation monitoring points (DMPs) for utilities, vacuum excavation shall be performed by subcontractor having five (5) years of experience in non-destructive vacuum excavation methods for utilities.

7. Prepare design, including calculations and drawings, under the direction of a Professional Structural Engineer licensed in the State of Florida having the following qualifications:

   a. Not less than ten (10) years experience in the design of specific temporary excavation support systems to be used.

   b. Completed not less than five (5) successful temporary excavation support system projects of equal type, size, and complexity within the last five (5) years.

8. Temporary Excavation Support System Installer's Qualifications:

   a. Not less than three (3) year experience in the installation of similar types and equal complexity as the proposed system.

   b. Completed not less than three (3) successful excavation support systems of similar type and equal complexity as the proposed system.

9. If utilizing a tieback system, employ an independent testing laboratory to test the tieback system with the following qualifications:

    a. Be accredited by the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program.

    b. 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.

    c. Have not less than five (5) years experience in testing of tieback systems of similar type and equal complexity as the proposed system.

    d. Have successfully tested at least three (3) tieback systems of similar type and equal complexity as the proposed system.

10. Install all temporary excavation support systems under the supervision of a supervisor having the following qualifications:

    a. Not less than five (5) years experience in installation of systems of similar type and equal complexity as the proposed system.

    b. Completed at least five (5) successful temporary excavation support systems of similar type and equal complexity as the proposed system.

11. All welding shall be performed in accordance with AWS D1.1.

E. 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.

i. Conformance to criteria and requirements of the Florida Trench Safety Act.

F. Delivery, Storage and Handling

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.

G. Project/Site Conditions

Subsurface Conditions: Refer to Appendix B. The geotechnical criteria provided in Appendix B 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

A. Materials

1. Structural Steel: All soldier piles, wales, rakers, struts, wedges, plates, waterstop and accessory steel shapes shall conform to ASTM A36.

2. Steel Sheet Piling: ASTM A572, continuous interlocking type.

3. Timber Lagging Left in Place: Pressured treated per appropriate AWPA standards.

4. 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.

5. Raker Ties: ASTM A615 Grade 60.

6. 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.

7. Concrete: Section 03300.

8. Tamping tools adapted for backfilling voids after removal of the excavation support system.

9. 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.

B. Equipment

A vibratory hammer shall be utilized for driving the temporary sheet piling providing that such operations do not exceed vibration/noise requirements of the specifications. Impact hammer shall be utilized when vibratory hammer is unable to drive temporary sheet piling to required depth and/or unable to meet vibration requirements. Impact hammer shall also meet noise requirement.

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. Submit Construction Administration Request (CAR) to the Owners Representative a minimum of seven (7) calendar days in advance of the work.

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 seven (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.

B. Ground Deformation Adjacent to Excavation Support Systems

1. 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.

2. 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.

3. 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.

4. Notify the Owner’s Representative immediately when the allowable ground deformation is exceeded.

5. Implement Construction Contingency Plan under direction of Structural Engineer who is in Responsible Charge for the temporary excavation support system.

C. Removal Of Earth Retention System:

1. Unless required to perform the work in accordance with the Contract Documents, the sheeting shall be left in place.

2. 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.

3. 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.

4. 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.

5. Conduct survey of the locations and final cut-off elevations of the excavation support systems left in place.

D. Contract Closeout

Provide in accordance with Section 01700.

Form 02610-1
CERTIFICATE OF DELEGATED DESIGN SERVICES

The undersigned hereby certifies that he/she is a Professional Engineer registered in the state of _____ and that he/she has been employed by (Name of Contractor) _____ to design _____ in accordance with Specifications Section _____ for the (Name of Project) _____ The undersigned further certifies that he/she has performed similar designs previously and has performed the design of the _____; that said design is in conformance with all applicable local, state, and federal codes, rules, and regulations and professional practice standards; that his/her signature and Professional Engineer (P.E.) Stamp have been affixed to all calculations and drawings used in, and resulting from, the design; and that the use of that stamp signifies the responsibility of the undersigned for that design.

The undersigned hereby certifies that he/she has Professional Liability Insurance with limits of $1,000,000.00 and a Certificate of Insurance is attached.

The undersigned hereby agrees to make all original design drawings and calculations available to the Town/City of _____ or Owner's representative within seven (7) days following written request therefore by the Owner.

_____	_____
P.E. Name	Contractor's Name
_____	_____
Signature	Signature
_____	_____
Title	Title
_____	_____
Address	Address

END OF SECTION

SECTION 02200 EARTHWORK

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of earthwork for excavations, fills, and embankments for roadways, structures, and sites.

B. Submittals

Submit six copies of a report from a testing laboratory verifying that the material contains less than 1% asbestos by weight or volume and conforms to the gradation specified.

C. Testing for Compaction

1. The Owner will test for compaction and relative density as described below.

2. Determine the density of soil in place by the sand cone method, ASTM D 1556. Compaction tests will be performed for each lift or layer.

3. Determine laboratory moisture-density relations of soils per ASTM D 698.

4. Determine the relative density of cohesionless soils per ASTM D 4253 and D 4254.

5. Sample backfill materials per ASTM D 75.

6. "Relative compaction" is the ratio, expressed as a percentage, of the in-place dry density to the laboratory maximum dry density.

D. Disposal of Excess Materials

Excess site excavated or wasted material shall be disposed of offsite by the Contractor at his expense. No prearranged disposal site or related permits have been determined or secured by the Owner.

E. Material Availability

Sufficient earthwork material to complete the work is not available at the site. Secure source of material and permits to complete the project requirements.

PART 2 - MATERIALS

A. Structural Fill & Backfill

1. Structural backfill shall consist of clean, fine to medium sand, contain less than 1% 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
3/4 inch	100
1/2 inch	95 - 100
3/8 inch	50 - 100
No. 4	20 - 65
No. 8	10 - 40
No. 40	0 - 20
No. 200	0 - 5

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

B. Sand, Including Imported Sand for Pipe Zone and Pipe Bedding in Pipe Trenches

1. Granular material free from clay balls, organic matter, and other deleterious substances and conforming to the following gradations:

Sieve Size	Percent Passing By Weight
3/8 inch	100
No. 4	75 - 100
No. 30	12 - 50
No. 100	5 - 20
No. 200	0 - 10

2. Sand shall have a coefficient of permeability greater than 0.014 cm/s 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.

C. Sand-Cement Slurry Backfill

Sand-cement slurry backfill shall consist of one sack (94 pounds of Type I or II portland cement added per cubic yard of imported sand and sufficient water for workability.

D. Water for Compaction

Water shall be free of organic materials and shall have a pH of 7.0 to 9.0, a maximum chloride concentration of 500 mg/l, and a maximum sulfate concentration of 500 mg/l. Provide all water needed for earthwork. Provide temporary piping and valves to convey water from the source to the point of use. Provide any meters if the water is taken from a County pipeline.

E. Aggregate Base for Hydraulic Structures

Aggregate base shall be No. 57 stone in accordance with the requirements of Section 901 of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, 2010 edition.

F. Drain Material

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

G. Filter Fabric

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

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

   b. Equivalent open sizes (UFGS-02373)

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

H. Drainpipe

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

PART 3 - EXECUTION

A. Dewatering

Provide and operate equipment adequate to keep excavations and trenches free of water. Dewater subgrade to a minimum of 2 feet below bottom of excavation. Remove water during period when concrete is being deposited, when pipe is being laid, and during the placing of backfill. Avoid settlement or damage to adjacent property. Dispose of water in a manner that will not damage adjacent property. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation. Obtain (if necessary) and comply with discharge permit from St. John's River Water Management District.

B. Excavation

1. 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.

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

3. 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.

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

C. Limits of Foundation Excavation

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.

D. Preparation of Foundation Subgrade

1. The existing location shall be cleared, stripped and grubbed as specified within Section 02110.

2. 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.

3. Scarify the final subgrade surface and compact the top 24 inches of the subgrade to a minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557) to a depth of 24-inches below the bottom elevation of the foundation.

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

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

E. Preparation for Placing Structural Fill and Backfill

1. 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% of the maximum modified Proctor dry density (ASTM D-1557).

2. Remove foreign materials and trash from the excavation before placing any fill material. Obtain the specified compressive strength and finish of concrete work per Sections 03300 before backfilling.

F. Placing and Compacting Fill and Structural Fill

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

2. Place backfill in maximum 8-inch lifts and compact each lift to a minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

3. 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% into the slope and shall be of a width at least equal to the height of fill lift.

G. Placing and Compacting Structural Backfill

1. 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.

2. Limits of Structural Backfill: Limits of structural backfill shall be a minimum of 5.0 feet from edge of foundation and shall extend at a 1:1 slope to the finish grade.

3. Compact each lift to a minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557). Stop structural backfill at least 6 inches below finished grade in all areas where topsoil is to be replaced.

4. 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.

5. 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.

6. 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.

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

H. Moisture Control of Backfills and Embankments

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.

I. Site Grading

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.

J. Vapor Barrier Installation

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

2. 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.

END OF SECTION

SECTION 02222 PROTECTING EXISTING UNDERGROUND UTILITIES

PART 1 - GENERAL

A. Description

This section includes materials and procedures for protecting existing underground utilities.

PART 2 - MATERIALS

A. Replacement in Kind

Except as indicated below or as specifically authorized by the County's Representative, reconstruct utilities with new material of the same size, type, and quality as that removed.

PART 3 - EXECUTION

A. General

1. 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.

2. 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.

3. 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.

B. Procedures

1. 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.

2. 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.

3. Remove and Reconstruct: Where so indicated in the drawings or as required by the County's Representative, remove the utility and, after passage, reconstruct it with new materials. Provide temporary service for the disconnected utility.

C. Compaction

1. Utilities Protected in Place: Backfill and compact under and around the utility so that no voids are left.

2. 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.

3. 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 County's Representative prior to construction.

D. Special Construction

1. Reinforced Concrete Beam: Where indicated in the drawings or as determined by the County'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.

2. Concrete Support Wall: Where indicated in the drawings or as determined by the County'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.

E. Thrust Blocks on Waterlines

1. 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 County. Protect thrust blocks in place or shore to resist the thrust by a means accepted by the County's Representative and reconstruct. If the thrust blocks are exposed or rendered to be ineffective in the opinion of the County's Representative, reconstruct them to bear against firm unexcavated or backfill material or restrain pipe mechanically.

2. 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:

   a. Sand-cement slurry (94 pounds of cement per cubic yard).

   b. The native material compacted to a relative compaction of 95%.

3. Then excavate the backfill material for construction of the thrust block.

4. Test compaction of the backfill material before pouring any concrete thrust block. Use Class A concrete per Section 03300 for reconstruction.

END OF SECTION

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SECTION 02223 TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation for pipeline trench excavation, backfilling, and compacting.

B. Submittals

1. Submit six copies of a report from a testing laboratory verifying that material conforms to the specified gradations or characteristics for pea gravel, granular material, imported sand, rock refill for foundation stabilization, and water.

2. Submit method of compaction in pipe zone including removal sequence of shoring where used.

C. Testing for Compaction

The County will test for compaction as described in Section 02200.

D. Pavement Zone

The pavement zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.

E. Street Zone

The street zone is the top 30 inches of the trench immediately below the pavement zone in paved areas.

F. Trench Zone

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.

G. Pipe Zone

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. 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. 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.

Pipe Diameter	Thickness of Pipe Zone Above Top of Pipe
6 inches or smaller	6 inches
8 inches and larger	10 inches

H. Pipe Base or Bedding

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. 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.

Pipe Diameter	Thickness of Pipe Base
16 inches or smaller	4 inches
18 inches and larger	6 inches

PART 2 - MATERIALS

A. Pea Gravel

Pea gravel shall be rounded gravel, graded with less than 10% passing a No. 200 sieve, less than 50% passing a No. 4 sieve, and having a maximum particle size as follows:

Type of Pipe	Maximum Particle Size (inches)
Ductile iron	¾

B. Granular Material for Backfill--Street and Trench Zones

Granular material or granular soil for backfill used above the pipe zone shall be lean bank-run or pit-run gravel, or

native soil. The maximum particle size shall be 2 inches. A maximum of 10% shall pass a No. 200 sieve.

C. Common Fill

1. Native earth backfill used above the pipe zone shall be excavated fine-grained materials free from roots, debris, rocks larger than 3 inches, asbestos, organic matter, clods, clay balls, broken pavement, and other deleterious materials. Less than 50% shall pass a No. 200 sieve. At least 40% shall pass a No. 4 sieve. The coarser materials shall be well distributed throughout the finer material.

2. Backfill materials that are obtained from trench excavated materials to the extent such material is available shall be either screened directly into the trench or screened during the trenching operation. If screened during trenching, the material shall be maintained free of unscreened material during the handling and backfilling process. Hand selecting of rocks from earth as it is placed into the trench will not be permitted in lieu of the specified screening. Under no circumstances will native earth backfill be allowed or used in the pipe base or pipe zone areas. Backfill shall be moisture conditioned to within approximately 2% of the optimum moisture content prior to being placed in trench.

D. Imported Sand--Pipe Zone and Pipe Base

See Section 02200.

E. Gravel and Crushed Rock--Pipe Zone and Pipe Base

Gravel or crushed rock material shall conform to the Florida DOT Section 901, "Coarse Aggregate," Grade 357.

F. Permeable Material for Underdrains--Pipe Zone and Pipe Base

1. Permeable material shall consist of hard, durable, clean sand, gravel, or crushed stone and shall be free of organic material, clay balls or other deleterious substances. Gradation shall be:

Sieve Size	Percent Passing By Weight
3/4 inch	100
1/2 inch	95 - 100
3/8 inch	70 - 100
No. 4	0 - 55
No. 8	0 - 10
No. 200	0 - 3

2. Durability Index shall be at least 40 per ASTM D 3744.

G. Sand-Cement Slurry--Pipe Zone

Sand-cement slurry backfill shall consist of one sack (94 pounds) of Type I or II portland cement added per cubic yard of imported sand and sufficient water for workability.

H. Rock Refill for Foundation Stabilization

Rock refill shall be crushed or natural rock containing less than 1% asbestos by weight or volume, having the following gradation:

Sieve Size	Percent Passing By Weight
3 inches	100
1-1/2 inches	70 - 100
3/4 inch	60 - 100
No. 4	25 - 55
No. 30	10 - 30
No. 200	0 - 10

I. Water for Compaction

See Section 02200. Water shall be free of organic materials injurious to the pipe coatings.

J. Underground Plastic Warning Tape for Metal Pipe

See Section 15075.

K. Underground Detectable Metallic Pipe Warning Tape

See Section 15075.

PART 3 - EXECUTION

A. Compaction Requirements

Unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:

1. Pipe Zone: minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

2. Backfill in Trench Zone Not Beneath Paving: minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

3. Backfill in Trench Zone to Street Zone in Paved Areas: minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

4. Backfill in Street Zone in Paved Areas: minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

5. Refill for Overexcavation: minimum density equivalent to 98% of the maximum modified Proctor dry density (ASTM D-1557).

B. Sidewalk, Pavement, and Curb Removal

Cut bituminous and concrete pavements regardless of the thickness and curbs and sidewalks prior to excavation of the trenches with a pavement saw or pavement cutter. Width of the pavement cut shall be at least equal to the required width of the trench at ground surface. Haul pavement and concrete materials from the site. Do not use for trench backfill.

C. Material Replacement

Remove and replace any trenching and backfilling material which does not meet the specifications, at the Contractor's expense.

D. Trench Widths

Trench widths in the pipe zone shall be as shown in the drawings. If no details are shown, maximum width shall be 18 inches greater than the pipe outside diameter. Comply with

29CFR Part 1926 Subpart P--Excavations. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. 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.

E. Trench Excavation

Excavate the trench to the lines and grades shown in the drawings with allowance for pipe thickness, sheeting and shoring if used, and for pipe base or special bedding. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade at no additional cost to the County with imported sand. Place the refilling material over the full width of trench in compacted layers not exceeding 6 inches deep to the established grade with allowance for the pipe base or special bedding.

F. 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. Do not obstruct any roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

2. Remove and store excavated topsoil separately. 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. Do not operate cranes and other equipment on the same side of the trench as the spoil piles.

G. 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.

2. Excavate trench in the compacted backfill or embankment. Place pipe base material, install pipe or conduit, and backfill with pipe zone material. Compact backfill above the pipe zone to the same relative compaction as the adjacent embankment as specified in Section 02200.

H. Foundation Stabilization

1. After the required excavation has been completed, the County will inspect 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 pipeline where unacceptable materials exist at the exposed subgrade. 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.

2. Backfill the trench to subgrade of pipe base with rock refill material for foundation stabilization. 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. Foundation stabilization work shall be executed in accordance with a change order.

3. Rock refill used by the Contractor for his convenience will not receive any additional payment.

I. Installing Buried Piping

1. Backfill per the detailed piping specification for the particular type of pipe and per the following.

2. Handle pipe in such a manner as to avoid damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

3. Inspect each pipe and fitting before lowering the buried pipe or fitting into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field with material recommended by the protective coating manufacturer. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.

4. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of bedding. Place the specified thickness of pipe base material over the full width of trench. 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. Before laying each section of the pipe, check the grade and correct any irregularities.

5. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Fill the area excavated for the joints with the bedding material specified or indicated in the drawings for use in the pipe zone. If no bedding material is specified or indicated, use imported sand.

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. If no pipe zone material is specified or indicated, use imported sand. 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. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.

7. Compact each lift to the relative compaction specified herein.

8. Push the backfill material carefully onto the backfill previously placed in the pipe zone. If no backfill material is specified or indicated, use native earth backfill. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe. Do not operate heavy equipment over the pipe until at least 3 feet of backfill has been placed and compacted over the pipe.

J. Backfill Compaction

1. Compact per the detailed piping specification for the particular type of pipe and per the following.

2. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction or hand tamping. Do not use high impact hammer-type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

3. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.

4. Do not use any axle-driven or tractor-drawn compaction equipment within 3 feet of building walls, foundations, and other structures.

END OF SECTION

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SECTION 02231 SOIL-CEMENT BASE COURSE

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing to construct a compacted base course composed of a combination of soil, Portland Cement and water.

PART 2 - PRODUCTS

A. Portland Cement

1. Except where a particular type of cement might be specifically called for on the plans, the cement used in the work may be of any one of the following AASHTO designated Types:

   Type I, II, or III (AASHTO M 85) or Type IS (AASHTO M 240).

   For all types specified the cement shall be subject to either the compressive or the tensile strength test. The air content test will be made at the option of the Engineer.

2. The cement used shall conform to the requirements of the AASHTO Designations shown therefore, with additional requirements as shown below.

3. Different brands of cement, cement of the same brand from different mills, or different types of cement, shall not be mixed during any continuous pour. Different brands or types of cement shall be stored separately.

4. Only portland cements containing less than 0.6 percent alkali, calculated as Na_2O (percent Na_2O plus 0.658 percent K_2O), shall be used in combination with coarse or fine aggregates from the Montgomery, Alabama, area, the Tuscaloosa formation or any other alkali reactive aggregate.

5. The cement may be delivered in bags or in bulk. The storage building, bin or silo shall be weatherproof and shall be located convenient to the work to be performed. On small jobs, storage in the open may be permitted by the Engineer, in which case a raised platform and adequate waterproof covering shall be provided.

If conditions warrant, a competent storekeeper may be required who shall have charge of the cement storehouse and shall keep suitable records of the delivery and use of all cement. Copies of such records shall be delivered to the Engineer at the close of each day's work or eight-hour run, showing in such details as he may reasonably require, the quantity used during the day or run, at each part of the work.

6. Cement varying more than five percent from designated weights (94 pounds per sack) shall be rejected (1) in carload lots if the average of 50 sacks taken at random is less than the designated weights, and (2) in individual sacks, if tests disclose that sacks vary more than five percent from designated weights and still the average of 50 sacks is greater than the designated weight. In the second instance, the cement may be used provided the proper adjustment per sack is made; such adjustment to be made by weight only.

   Cement which has been damaged, which is partially set, or which is lumpy or caked, shall not be used, and the entire contents of the sack of cement or the container of bulk cement, which contains damaged, partially set, or lumps of caked cement, will be rejected for use. Cement salvaged from discarded or used sacks shall not be used.

7. When, under the provisions of these specifications, it becomes necessary to transport loose cement, it shall be kept in a weatherproof compartment, separate from other aggregates.

B. Water

1. Water for use with cement shall be clean and practically free of oil, acid, alkali, chlorides, organic matter, and other deleterious substances.

   Water supplies which are approved by a public health department may be accepted without being tested. Water from all other sources shall be tested and approved by a public health department before use and shall not contain impurities in excess of the following limits:

Acidity or alkalinity calculated in Terms of calcium carbonate	0.05%
Total organic solids	0.05%
Total inorganic solids	0.08%
Total chlorides as sodium chloride	0.05%

C. Material

Use local or hauled-in clean sand or sand and clay.

D. Concrete

All concrete for base repair will be Class 1 concrete, minimum 28-day compressive strength of 2,500 psi as specified in Section 03300.

E. Curing Material

1. Rapid-curing, cut-back asphalt shall conform to the requirements of AASHTO M 81 except that the penetration range shall be from 60-120 instead of 80-120.

2. Cut-Back Asphalt, Grade RC-70 shall not be more than 15 units deficient in viscosity requirements. (The designation, "deficient," shall be considered as any variation, either under or over, from the minimum and maximum limitations for the viscosity, in the number of units by which the viscosity is measured.)

PART 3 - EXECUTION

A. Composition and Proportioning

1. Submit the name of an independent testing laboratory for review by the Engineer. Submit a design mix prepared by the testing laboratory for review by the Engineer.

2. Do not process the base until all tests of the soil to be used have been completed and the exact proportion of cement required for the particular soil has been determined according to "Expanded Short-Cut Test Methods for Determining Cement Factors for Sandy Soils", Highway Research Bulletin 61, 1952, and/or, when applicable, methods of "Wetting and Drying Test of Compacted Soil-Cement Mixtures", ASTM D559 (AASHTO T-135).

3. The quantity of water required will be the amount necessary for optimum moisture content in the compacted mixture. This quantity will vary with the nature of the soil and shall have been determined according to "Methods of Test for Moisture-Density Relation of Soil-Cement Mixtures", ASTM D558 (AASHTO T-134).

B. Preparation of Soil Aggregate

Remove unsuitable material and add suitable material as necessary prior to the application of cement. Pulverize the soil to be treated for sufficient width and depth to give

the compacted cross section shown on the plans. Pulverizing shall continue until 80 percent of the soil, by dry weight, exclusive of gravel, shell or stone larger than 3/4 inch, will pass a No. 4 sieve. Manipulate the pulverized soil until the moisture in the soil does not exceed the percentage of the optimum moisture specified for the soil-cement mixture.

C. Application of Cement

Shape the soil to the approximate cross section shown on the plans, and spread the designated quantity of cement uniformly over the surface in one operation.

D. Mixed-In-Place Method

Immediately after the cement has been distributed, mix it with the loose soil with a machine that will produce the proper homogeneous mixture. Shape the mixture to the approximate lines and grades shown on the plans.

E. Central Plant Mixed Method (Optional)

1. Mix the soil, cement and water in a pugmill either of the batch of continuous flow type. Equip the plant with feeding and metering devices which will add the soil, cement and water into the mixer in the specified quantities. Mix soil and cement sufficiently to prevent cement balls from forming when water is added, and continue until a uniform and intimate mixture of soil, cement and water is obtained.

2. Haul the mixture to the roadway in trucks equipped with protective covers. Place the mixture on the moistened subgrade in a uniform layer by an approved spreader and in such quantity that the completed base will conform to the required grade and cross section. Do not permit dumping of the mixture in piles or windrows upon the subgrade.

F. Compacting and Finishing

1. Compact the base to a density of 95 percent of the maximum density as determined by AASHTO T-180 to the line, grade and thickness shown in the plans.

2. After the mixture is compacted, reshape the surface of the base to the required lines, grades and cross section, and then lightly scarify to loosen imprints left by the compacting or shaping equipment until a uniform, even surface mulch of approximately 1 inch in

thickness is obtained. Then thoroughly roll and compact the surface.

3. Complete all of the above mixing, compacting and finishing within six (6) hours.

G. Construction Joints

1. At the end of each day's construction, form a straight transverse joint by cutting back into the completed work to form a true vertical face. This joint shall be located such as to exclude all that part of the base at the end of the run which does not have full depth, is not thoroughly compacted, not properly proportioned, or not properly mixed.

2. Build soil-cement for large, wide areas in a series of parallel lanes of convenient length and width meeting the approval of the Engineer. Form straight longitudinal joints at the edge of each day's construction by cutting back into the completed work to form a true vertical face free of loose or shattered material.

H. Weather Limitations

During seasons of probability of freezing temperature, do not apply cement unless the temperature is at least $40^{O}F$ in the shade and rising.

I. Surface Requirements (Scalping or Hardplaning)

After compacting and finishing have been completed, and not later than the beginning of the next calendar day after the construction of any section of base, test the surface with a template cut to the required crown and/or with a 10-foot straight-edge laid parallel to the centerline. Correct all irregularities greater than 1/4 inch. Additional wetting before, during and after this final shaping operation shall be required to keep the base continuously moist until the cure coat is applied.

J. Protecting and Curing

Within not more than three daylight hours after the hardplaning operations have been completed, the base shall be covered and protected against rapid drying by curing.

K. Opening to Traffic

Completed sections may be opened to all traffic after seven days.

L. Maintenance

Maintain the base to a true and satisfactory surface until the wearing surface is constructed. Should any repairs or patching be necessary, they shall extend to the full depth of the base and shall be made in a manner that will assure restoration of a uniform base course conforming to the requirements of these specifications. In lieu of repairing with soil-cement, Class 1 concrete may be used.

M. Testing

1. Monitor the construction procedure with the same independent testing laboratory that prepared the reviewed design mix and perform the following tests during placement:

   a. Determine cement content, moisture content, "inplace" density and thickness (maximum spacing of test holes 300 feet). Notify the Engineer immediately of any deviation from the design mix.

   b. Perform a laboratory density test and prepare two 4 inch-diameter by 4.6-inch-high compression test cylinders for each 300 feet of roadway. Moist cure by 7 days and test for compressive strength. Minimum acceptance standards are as follows:

      Thickness: Average in 1,000 ft.-1/4 inch variation
      Maximum variation in one hole-1/2 inch

      Compressive Strength: 300 psi in 7 days
      (molded laboratory specimens)
      350 psi in 14 days
      430 psi in 28 days

2. Send two copies of all field and laboratory test results to the Engineer within 10 days of completion of said tests. Include the cost of mix design and testing in the unit price bid for the soil-cement base.

END OF SECTION

SECTION 02232 LIMEROCK BASE COURSE

PART 1 - GENERAL

A. Description

The work specified in this section consists of the construction of a base course composed of limerock constructed on the prepared subbase in accordance with these specifications and in conformity with the lines, grades, notes, and typical cross sections shown on the plans.

B. Submittals

Submit copies of a certification from a testing laboratory that the material used for the base meets the specified criteria and contains less than 1% by weight asbestos.

PART 2 - PRODUCTS

A. Materials

1. Use limerock having a minimum percentage of carbonates of calcium and magnesium of 70, a maximum percentage of water-sensitive clay mineral of 3, and a liquid limit not exceeding 35. The material shall be non-plastic and contain less than 1% by weight asbestos.

2. Limerock material shall not contain cherty or other extremely hard pieces, or lumps, balls or pockets of sand or clay size material in sufficient quantity as to be detrimental to the proper bonding, finishing, or strength of the limerock base.

3. At least 97 percent (by weight) of the material shall pass a 3-1/2 inch sieve and the material shall be graded uniformly down to dust. The fine material shall consist entirely of dust of fracture. All 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.

4. Limerock material used in construction of limerock base shall have an average LBR value of not less than 100.

PART 3 - EXECUTION

A. Transporting Limerock

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” minimum outside of asphalt width.

2. Construct base in courses between 4 inches and 6 inches in thickness.

3. For double-course base, spread rock in two 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

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 sq. ft. in area paving. The average thickness of three consecutive holes must be equal to at least the specified thickness. 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 sq. ft. 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 THREE DENSITY DETERMINATIONS ON EACH DAY'S FINAL COMPACTION OPERATIONS ON EACH COURSE. The density determinations shall be made at more frequent intervals if deemed necessary by the Engineer.

END OF SECTION

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SECTION 02270 EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

A. Description

The work specified in this Section consists of measures required to control erosion on the project, right-of-way, and in areas outside the project area where work is accomplished in conjunction with the project, so as to prevent pollution of water, detrimental effects of public or private property adjacent to the project area and damage to work on the project. These measures will consist of construction and maintenance of temporary erosion control features or, where practical, the construction and maintenance of permanent erosion control features.

Effective May 1, 2003 construction sites that will result in a disturbance of one acre or more are required to seek coverage from FDEP under the Generic Permit for Stormwater Discharge from Large and Small Construction Activities - DEP document 62-621.300(4)(a). Accordingly, the Contractor shall be required to submit a Notice of Intent (NOI) along with the application fee to the FDEP Stormwater Notices Center to use the Generic Construction NPDES permit. This will also require the Contractor to develop and implement a Stormwater Pollution Prevention Plan (SWPPP) for this project; the requirements of which shall be followed by the Contractor for the duration of the project.

B. Control of Contractor's Operations Which May Result in Water Pollution

1. In addition to the erosion control measures specified herein, the Contractor shall comply with all requirements of the final approved Stormwater Pollution Prevention Plan (SWPPP) for the project.

2. Take sufficient precautions to prevent pollution of streams, canals, lakes, reservoirs, and other water impoundments, with fuels, oils, bitumens, calcium chloride, or other harmful materials. Conduct and schedule operations so as to avoid or otherwise minimize pollution or siltation of such streams, etc. Do not dump the residue from dust collectors or washers into any water body.

3. Construction operations in stormwater ponds and other impoundments shall be restricted to those areas where it is necessary to perform filling or excavation to

accomplish the work shown in the Contract Documents and to those areas which must be entered to construct temporary or permanent structures. As soon as conditions permit, promptly clear impoundments of all obstructions placed therein or caused by construction operations.

4. Except as necessary for construction, do not deposit excavated material in rivers, streams, canals, or impoundments, or in a position close enough thereto, to be washed away by high water or runoff.

C. Start of Work

Do not start work until erosion control measures are in place.

PART 2 - PRODUCTS

A. General

1. No testing of materials used in construction of temporary erosion control features will be required.

2. Materials used for the construction of the temporary erosion and sedimentation control measures not to be incorporated into the completed project may be new or used.

3. Coordinate with the conditions of the FDEP NOI permit.

PART 3 - EXECUTION

A. General

1. Temporary erosion control features shall consist of, but not be limited to, temporary grassing, temporary sodding, temporary mulching, sandbagging, slope drains, sediment basins, artificial coverings, berms, baled hay or straw, floating silt barriers, staked silt barriers and staked silt fences. Design details for some of these items may be found in the Water Quality Section of the applicable edition of the FDOT Roadway and Traffic Design Standards.

2. Incorporate permanent erosion control features into the project at the earliest practical time. Correct conditions, using temporary measures, that develop during construction to control erosion prior to the time it is practical to construct permanent control features.

3. Construct temporary and permanent erosion and sediment control measures to prevent the pollution of adjacent water ways in conformance with the laws, rules and regulations of Federal, State and local agencies.

B. Installation

1. Temporary Sod: This work shall consist of furnishing and placing sod in accordance with the Contract Documents.

2. Temporary Mulching: This work shall consist of furnishing and applying a two-inch to four-inch thick blanket of straw or hay mulch and then mixing or forcing the mulch into the top two inches of the soil in order to temporarily control erosion. Only undecayed straw or hay, which can readily be cut into the soil, shall be used. Other measures for temporary erosion control such as hydromulching, chemical adhesive soil stabilizers, etc., may be substituted for mulching with straw or hay. When permanent grassing operations begin, temporary mulch materials shall be plowed under in conjunction with preparation of the ground.

3. Sandbagging: This work shall consist of furnishing and placing sandbags in configurations, so as to control erosion and siltation.

4. Slope Drains: This work shall consist of constructing slope drains, utilizing pipe, fiber mats, rubble, cement concrete, asphaltic concrete plastic sheeting, or other acceptable materials, in accordance with the details shown in FDOT's Roadway and Traffic Design Standards or as may be approved as suitable to adequately perform the intended function.

5. Sediment Basins: Sediment basins shall be constructed in accordance with the details shown in FDOT's Roadway and Traffic Design Standards or as suitable to adequately perform the intended function. Sediment basins shall be cleaned out as necessary.

6. Artificial Coverings: This work shall consist of furnishing and applying fiber mats, netting, plastic sheeting, or other approved covering to the earth surfaces.

7. Berms: This work shall consist of construction of temporary earth berms to divert the flow of water from an erodible surface.

8. Baled Hay or Straw:

a. This work shall consist of construction of baled hay or straw dams to protect against downstream accumulations of silt. The baled hay or straw dams shall be constructed in accordance with the details shown in FDOT's Roadway and Traffic Design Standards.

b. The dam shall be placed so as to effectively control silt dispersion under conditions present on this project. Alternate solutions and usage of materials may be used if approved.

9. Temporary Silt Fences and Staked Silt Barriers: This work shall consist of furnishing, installing, maintaining and removing staked turbidity barriers in accordance with the manufacturer's directions, these specifications and the details as shown in FDOT's Roadway and Traffic Design Standards.

C. Removal of Temporary Erosion Control Features

In general, remove or incorporate into the soil any temporary erosion control features existing at the time of construction of the permanent erosion control features in such a manner that there will be no detrimental effect.

D. Maintenance of Erosion Control Features

General: Provide routine maintenance of permanent and temporary erosion control features until the project is completed and accepted.

E. Protection During Suspension of Contract Time

In the event that it is necessary that the construction operations be suspended for any appreciable length of time, shape the top of the earthwork in such a manner as to permit runoff of rainwater and construct earth berms along the top edges of embankments to intercept runoff water. Provide temporary slope drains to carry runoff from cuts and embankments which are located in the vicinity of rivers, streams, canals, lakes, and impoundments. Should such preventive measures fail, immediately take such other action as necessary to effectively prevent erosion and siltation.

END OF SECTION

SECTION 02276 GRAVEL AND CRUSHED ROCK BASE FOR STRUCTURES

PART 1 - GENERAL

A. Description

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

B. Submittals

Submit six copies of a report from a testing laboratory verifying that material contains less than 1% asbestos by weight or volume and conforms to the specified gradations or characteristics.

C. Testing for Compaction

1. The Owner will test for compaction or relative density as described below.

2. Determine the density of gravel and rock in place by the sand cone method, ASTM D 1556 or 2167.

3. Determine the relative density of gravel and rock per ASTM D 4253 and D 4254.

4. Sample backfill materials per ASTM D 75.

5. 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.

PART 2 - MATERIALS

A. Crushed Rock and Gravel

1. Crushed rock base and gravel are defined as natural or crushed rock, free from organic matter and containing less than 1% asbestos by weight or volume, and meeting the following gradation:

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. Durability Index shall be at least 40 per ASTM D 3744.

B. Crushed Rock

Crushed rock base shall be No. 57 stone conforming to Section 901, "Coarse Aggregate" of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

PART 3 - EXECUTION

A. Placement of Crushed Rock or Gravel

1. 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.

2. Compact base as follows unless otherwise indicated:

   a. Lower Lift: 80% relative density.

   b. Upper Lifts: 85% relative density.

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

END OF SECTION

SECTION 02282 CONNECTIONS TO EXISTING BURIED PIPELINES

PART 1 - GENERAL

A. Description

This section includes materials and installation of connections to existing buried utilities; including connections by hot tap and line stop.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following;

2. Submit appropriate reference material and documentation as specified herein.

3. 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

4. Submit confirmation of field investigation of the existing pipeline material, size and condition, as specified herein and illustrated in the Drawings.

5. Submit the qualifications and reference material of the Contractor, or Subcontractor, who will be performing the hot taps and line stops on the Project.

6. 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.

7. 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.

8. 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.

C. Qualifications

1. The Contractor, or Subcontractor, performing the line stop and hot taps shall meet the following minimum experience requirements:

a. Completed not less than twenty-five (25) successful hot taps and/or line stops of similar type, size, and complexity performed within the last ten (10) years, from the date that Bids are opened, and located within the United States of America.

b. Submit references for projects of equal type, size, and complexity to demonstrate experience. Include Work type, size, and contact information for Owner four (4) weeks prior to the construction.

2. 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;

   a. Designed not less than ten (10) hot taps and/or line stops of similar type, size, and complexity which were constructed within the last five (5) years, from the date that Bids are opened, and located within the United States of America.

PART 2 - MATERIALS

A. Utility Exploration and Materials Verification:

1. 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 02160.

B. Verification of Pipe O.D. and Condition

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.

C. Tapping Sleeves for Ductile-Iron, and PVC (Cast-Iron O.D.) Pipes

1. Tapping sleeves shall comply with MSS SP-60, and MSS SP-113.

2. Tapping Sleeves shall be furnished and installed as specified per the respective existing utility and the Orange County Approved Product List, see Attachment A, unless otherwise noted (i.e. tapping sleeves greater than 24 inches)

3. Pressure rating shall be at least 200 psi for piping 12 inches and smaller and at least 150 psi for piping 14 through 24 inches. For piping larger than 24 inches up to 42 inches pressure rating shall be at least 100 psi.

4. For potable water service, tapping sleeve shall be NSF 61 certified.

D. Test Plug

Test plug shall be ¾-inch NPT Type 304 stainless steel. Coat threads to prevent galling.

E. Gaskets for Water Service

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 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Style 19 or equal.

F. Gaskets in Other than Potable Water

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 psi at a temperature of 250°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Provide Garlock Style 9122 or equal.

G. Coating for Tapping Sleeves

Coat with fusion-bonded epoxy per Section 09961.

H. Tapping Gate Valves

Type V137 per Section 15100 unless otherwise noted.

I. Bolts and Nuts

Bolts and nuts shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

J. Rubber Stopper for Line Stop

Fully expandable rubber, minimum 100 psi pressure rating or carbon steel pivoting head with Buna-N sealing element, minimum 100 psi pressure rating.

PART 3 - EXECUTION

A. Owner RPR Notification

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 fourteen (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 five (5) days prior to performing the Work.

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.

B. General Procedure – Hot Taps

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 PSI).

3. Support the pipeline in a manner that will not damage the pipe.

4. Provide Temporary Excavation Support Systems per Section 02160.

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 PSI).

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.

C. General Procedure – Line Stops

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 PSI).

3. Support the pipeline in a manner that will not damage the pipe.

4. Provide Temporary Excavation Support Systems per Section 02160.

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 PSI).

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 02530 LEAKAGE AND INFILTRATION TESTING

PART 1 - GENERAL

A. Description

1. These specifications cover the testing and inspection for acceptance of gravity pipelines, sewers, culverts, drains, and manholes not intended to be pressurized in excess of 5 psi or 12 feet head of water. Testing and inspection shall comply with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) requirements as defined herein.

2. Gravity Mains:

Shall be inspected with CCTV for alignment, grade variations, separated pipes, leaks, deflection, cracked, broken or otherwise defective pipe to ensure overall pipe integrity. An approved CCTV inspection contractor shall perform the CCTV inspection(s) and submit the report(s) to the Owner as required.

3. Pressure Mains:

Hydrostatic tests shall be conducted for pressure pipes, joints and valves for allowable limits of pressure and leakage. Air testing of pressure pipes will not be permitted under any circumstance.

PART 2 - MATERIALS

A. Approved List of CCTV Contractors

1. The current “List of Approved CCTV Inspection Contractors for Wastewater Gravity Systems” can be found on our website at www.ocfl.net/utilities/. For more information, please contact a Standards Committee representative at 407-254-9900.

B. CCTV Inspection Equipment

1. Closed Circuit Television Camera:

The television camera used for the inspection shall be one specifically designed and constructed for sanitary sewer inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100 percent humidity/submerged conditions. The CCTV camera equipment will provide a view of the pipe ahead of the equipment and of features to the side of the equipment through turning and rotation of the lens. The camera shall be capable of tilting at right angles along the axis of the pipe while panning the camera lens through a full circle about the circumference of the pipe. The lights on the camera shall also be capable of panning 90-degrees to the axis of the pipe.

If the equipment proves to be unsatisfactory, it shall be replaced with adequate equipment. The camera unit shall have sufficient quantities of line and video cable to inspect two complete, consecutive sewer reaches with access approximately 750 feet apart.

The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Owner. The television camera, electronic systems and monitor shall provide an image that meets the following specifications, or approved equal.

a. The gray scale shall show equal changes in brightness ranging from black to white with a minimum of five stages.

b. With the monitor control correctly adjusted, the six colors - Yellow, Cyan, Green, Magenta, Red, and Blue, plus black and white shall be clearly resolved with the primary colors in order of decreasing luminance. The gray scale shall appear in contrasting shades of gray with no color tint.

c. The picture shall show no convergence or divergence over the whole of the picture. The monitor shall be at least 13 inches diagonally across the picture tube.

d. The live picture on the CCTV monitor shall be capable of registering a minimum of 470 lines horizontal resolution and be a clear, stable image with no interference.

e. Lighting intensity shall be remote controlled and shall be adjusted to minimize reflective glare. Lighting and camera quality shall provide a clear, in-focus picture of the entire inside periphery of the sewers and laterals for all conditions except submergence. Under ideal conditions (no fog in the sewer) the camera lighting shall allow a clear picture up to five pipe diameter lengths away for the entire periphery of the sewer. The lighting shall provide uniform light free from shadows or hot spots.

f. Camera focal distance shall be remotely adjustable through a range of 6 inches to infinity.

g. The monitor and software shall also be able to capture and save screen images of typical sewer details and all defects. Screen images shall be embedded into the pipe inspection report document submitted with the inspection video. The video camera shall be capable of displaying on screen data.

2. Lateral Video Camera

Lateral cameras may be push type or launched from the sewer main line. Lateral cameras shall be color, shall be self-leveling, and equipped with a footage counter to provide on screen display of footage measurement. Monitor resolution shall be as specified above in paragraph 2.A A Close Circuit Television Camera, or approved equal.

3. Video Capture System:

The video recordings of the sewer inspections shall be made using digital video equipment. A video enhancer may be used in conjunction with, but not in lieu of, the required equipment. The digital recording equipment shall capture sewer inspection on DVD disks or hard drive, with each sewer reach inspection recorded as an individual movie file (.MPEG, .MPG, or .WMV) or approved equal.

a. The video file names will be referenced in the inspection database and in an inspection report generated in PDF format. The pipeline collection and

real time video capture and data acquisition systems shall be provided.

b. The system shall use the most current PACP compliant application software and shall be fully object oriented or approved equal. It shall be capable of printing pipeline inspection reports with captured images of defects or other related significant visual information on a standard color printer.

c. The imaging capture system shall store digitized color picture images and be saved in digital format on a DVD, hard drive or approved equal. Also, this system shall have the capability to supply the Owner with inspection data reports for each line segment.

d. The Contractor shall have the ability to store the compressed video files in industry standard and approved Owner’s format and be transferable with the PACP compliant inspection database.

e. The contractor's equipment shall have the ability to "Link". “Linking” is defined as storing the video time frame code with each observation or defect with the ability to navigate from/to any previously recorded observation or defect instantaneously.

f. The system shall be able to produce data reports to include, at a minimum, all observation points and pertinent data. All data reports shall match the defect severity codes in accordance with PACP naming conventions

g. The data-sorting program shall be capable of sorting all data stored using generic sort key and user defined sort fields.

h. Camera footage, date & manhole numbers shall be maintained in real time and shall be displayed on the video monitor as well as the video character generators illuminated footage display at the control console.

i. Depth gage: The camera shall have a depth gage or approved method to measure deflection in the pipe and joint separation approved by the Owner.

C. Gravity Main Inspection CCTV Data

1. CCTV data shall be recorded and saved in MPEG format or Windows Media video format.

2. CCTV inspections shall use unique identification numbers established and provided by the Owner in pipe segment reference, upstream manhole number and the downstream manhole number fields.

3. The video files will be named in accordance with the Owner file naming convention: Upstream MH ID _ Downstream MH ID _ Inspection Date (year_month_day).wmv. Example: 39540008_39540007_2009_08_05.wmv

4. Reports shall be submitted in an electronic version (.pdf) generated by the computer software shall be consistent with PACP requirements, observation report with still images; and CCTV inspection results.

   a. PACP export pipe inspection database (.mdb) saved on CD-R's, DVD, or portable hard drives

   b. Inspection digital photographs in JPEG format saved on CD-Rs, DVD or portable hard drives

   c. QA/QC report

5. The video file names will be referenced in the inspection database and in an inspection report generated in PDF format. The pipeline collection and real time video capture and data acquisition systems shall be provided

6. The system shall use the most current PACP compliant application software and shall be fully object oriented or approved equal. It shall be capable of printing pipeline inspection reports with captured images of defects or other related significant visual information on a standard color printer.

7. The imaging capture system shall store digitized color picture images and be saved in digital format on a DVD, hard drive or approved equal. Also, this system shall have the capability to supply the UTILITIES with inspection data reports for each line segment.

8. The Contractor shall have the ability to store the compressed video files in industry standard and approved Owners format and be transferable with the PACP compliant inspection database.

9. The Contractor's equipment shall have the ability to "Link". “Linking” is defined as storing the video time frame code with each observation or defect with the ability to navigate from/to any previously recorded observation or defect instantaneously.

10. The system shall be able to produce data reports to include, at a minimum, all observation points and pertinent data. All data reports shall match the defect severity codes in accordance with PACP naming conventions

11. The data-sorting program shall be capable of sorting all data stored using generic sort key and user defined sort fields.

12. Camera footage, date and manhole numbers shall be maintained in real time and shall be displayed on the video monitor as well as the video character generators illuminated footage display at the control console.

D. Test Plugs

Inflatable and expandable type, braced to contain 5 psi over the pipe cross-section area.

E. Pressure-Relief Valve

Set to limit the internal pipe test pressure to 5 psi.

PART 3 - EXECUTION

A. Leakage Testing Of Gravity Mains

1. The Contractor, with the Owners representation present, shall perform the leakage testing. The Contractor shall be responsible for furnishing all necessary labor and equipment to conduct such testing.

    a. Leakage tests shall be by a low-pressure air test. Each test section shall not exceed 400 feet in length and shall be tested between adjacent manholes. Leakage testing shall be conducted in

accordance with the procedure for "Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe" as established by the Uni-Bell PVC Pipe Association. The pipe shall pass the current most stringent UNI-B-6 Uni-Bell standards for testing gravity sewers and shall have no evidence of leaks in the pipe or connections.

B. Gravity Main Requirements Before CCTV Inspection

1. All manhole flow channels and benching per specifications shall be constructed and coated (if applicable) prior to CCTV inspection.

2. CCTV inspections shall be received, reviewed and approved by the Owner prior to installation of pavement.

3. The Contractor shall clean gravity mains to remove debris and stains from the pipe prior to televising. Flushing water or debris will not be allowed to enter pump station wet wells. Water will be pumped from the sewer system during flushing to an acceptable discharge location. A visual inspection shall be made and all obstructions removed.

4. Gravity Mains/Pipes that are dirty (dirty walls and/or debris in the inverts) shall be re-flushed and cleaned before rescheduling a CCTV inspection. If necessary, swabbing may be required of specific sections of pipe.

5. The Contractor shall pass a mandrel through the PVC pipe to confirm ring deflection in excess of five percent (5%). The base inside diameter shall be used to determine mandrel size as per ASTM D 3034.

6. Dewatering system shall not be operated within 48 hours prior to CCTV inspection.

7. Backfill from the gravity main to the subgrade shall be compacted and stabilized for inspection and cleaning vehicle access prior to CCTV.

C. Notification

1. Contractor shall notify the Owner a minimum of 48 hours prior to performing any CCTV gravity main inspection work.

D. Televising Of Gravity Mains

1. Wherever possible, gravity mains shall be televised in the downstream direction.

2. Sufficient water shall be run through each section of main until water runs through each downstream manhole no more than 24 hours prior to televising. Lines that are dry or that enough water has not run through to reach the downstream manhole shall not be televised.

3. Gravity mains shall be televised from manhole to manhole utilizing a 360-degree pan and tilt color camera driven through at a moderate rate of speed not more than 30 feet per min. The camera shall be of the self-propelled tractor type with a measuring device mounted to the front capable of being read as the tractor moves and capable of accurately measuring depth of standing water up to, and including, three inches.

4. Begin video recording at the top of the manhole to see the condition of the manhole and any pipe that is connected to the manhole. Record going down into the manhole all the way to the preset footage with continuous recording until the downstream manhole.

5. Lighting should be set to allow for clear visibility without excessive reflection and should allow realistic colors to be visible.

6. The iris of the camera should be adjusted to allow for a sharp focused image and the lens should be kept clean and free of obstructions.

7. The operator should follow the manufacturer’s instructions to achieve the proper color correction.

8. All notes or coded references shall have footages recorded with them .

9. The camera should be centered within the pipe.

10. The distance between manhole centers shall be accurate within 0.5 percent.

11. The camera shall be stopped at all laterals adjusted for a clear picture and an orbital scan of the lateral taken

pausing at the invert at the service lateral to detect dirt or infiltration.

12. All laterals shall be televised when reaching the lateral if a launch type camera is utilized.

13. The camera shall also be stopped at any suspected or confirmed defects, the focus properly adjusted and a clear digital video taken.

14. Areas suspected of leaking shall be paused long enough to determine if a leak exists currently or if deposits have occurred.

15. A digital photo shall be taken of all areas noted on the report including laterals and any confirmed or suspected defects.

16. Manholes upstream and downstream shall be measured from rim to invert and the depth recorded on the inspection header in feet and inches.

17. Manhole material and defects shall be noted.

18. Manholes that have laterals tied into them shall have sufficient water ran through them and a CCTV inspection to the property line will be conducted.

E. CCTV QA/QC Inspection Procedures And Causes For Rejection Of CCTV Work

1. The Contractor shall submit their Quality Assurance Plan and Quality Control procedures to the Owner. The Contractor shall ensure data quality and submit the results of the internal quality control checks performed on submitted data.

2. The Owner will perform quality control checks on submitted inspection data. Failure to meet the minimum accuracy noted below will be cause for rejection of submitted data. The following is the QC procedure to be employed by the Owner and serves as the minimum requirements for the Contractor.

   a. The Contractor shall review of a minimum of 5% of the total inspections by each PACP certified operator entering the field CCTV data. The

Contractor shall number the inspection reports in the order they were inspected.

b. The Contractor shall number the inspection reports in the order they were inspected.

c. Each inspection report that corresponds to the random numbers will be marked for review, the inspection report printed and the video copied to the QA/QC directory.

d. Each selected inspection report will be reviewed in detail against the inspection digital video.

e. Each field that is populated and those that should have been populated will be counted to produce a "number of fields checked" for the required header information and detailed inspection information. The fields with errors, or missing data, regardless of the error will be totaled to determine the "error count". The accuracy level will then be calculated as follows: 100-((error count/number of fields checked)*100) = accuracy percentage

f. Utilities will review contractor's quality control report and review an additional 5% or more inspections to insure contractor's quality of work has been met.

g. The accuracy of each PACP certified operator entering the field CCTV data shall meet or exceed 90%. Submittals where the accuracy level falls below 90% will be returned in their entirety for re-inspection and/or resubmittal.

F. Gravity Main Inspection CCTV Report

a. A. The Contractor will be required to submit the following deliverables on a weekly basis.

(1) Inspection Reports to include:

(a) Inspection session header information (see required fields above)

(b) Defect log report including photo captures from CCTV video

(c) Schematic drawing of pipe showing defects

(d) Format: Adobe Acrobat PDF files – 1 report PDF per pipe

File name: <upstream MH ID>_<downstream MH ID>_<Date(year_mo_day format)>.PDF Example:30060002_30060001_2010_02_16.pdf

(2) The Contractor shall submit quality control forms that include a hard copy print out of the inspection reports checked with errors and omissions clearly marked.

(3) Inspection video files on DVD or portable hard drive, labeled as follows: DVD/Hard drive Labels - Typed labels shall be attached to the face of each DVD. The typed index labels shall include the following information:

(a) Content (CCTV)

(b) Contractor name

(c) Purpose of Survey

(d) Tributary Pump station number

(e) Reaches included (from Manhole Number ## to Manhole Number ##)

(f) Date of survey

(g) Contract Number / Delivery Order Number (if applicable)

- Electronic Inspection Data stored and exported in a NASSCO Pipeline Assessment and Certification Program (PACP) compliant Microsoft Access database (.MDB) version 4.4 delivered on DVD or portable hard drive.

- Inspection photograph digital files (jpeg) indexed to NASSCO PACP compliant database.

G. Causes For Rejection Of Gravity Mains

1. The Contractor shall be required to replace the pipeline if the acceptance or bond CCTV inspection reveals cracked, broken or defective pipe, and/or in the case of PVC pipe a ring deflection in excess of five percent (5%).

2. Joint separation shall be no greater than two inches between the spigot and bell of the pipe.

3. No evidence of leakage will be acceptable for private gravity mains connecting to Owners' collection system.

4. The following NASSCO PACP codes or notes shall be cause for rejection of gravity sewer systems

   a. PACP coding of "Line" (L) shall be accompanied by a measurement of the line, grade or angular deviation. Variance of established line and grade at any point along the length of the pipe shall not be greater than 1 inch, provided such variation does not result in a level or reverse sloping invert. An approved method shall be used to determine this deviation. A PACP coding of MWLS with a percentage of pipe greater than 12.5% on 8-inch sewer, 15% on 10-inch sewer etc. will be corrected by excavation and repair.

   b. PACP coding of "Infiltration" (I) for pipe joints shall be replaced or the pipe joint shall be reseated at the joint. Grouting shall not be considered a method of repair and will not be accepted. Replace the leaking gravity main segment if there is visible infiltration at any point other than the pipe joint.

   c. Any PACP coding in the category of "Structural Family".

   d. PVC pipe having ID tears will be rejected.

   e. PACP condition grading of "OB" (obstruction) in pipe shall be rejected, the obstruction shall be removed and the line cleaned and re-televised.

H. Acceptance

1. Successful passage of both the leakage test and CCTV inspection is required before acceptance by the Owner.

2. Prior to repair or replacement of failed sewer pipe, the method of repair or replacement shall be submitted to the Owner for approval. Pressure grouting of pipe or manholes shall not be considered as an acceptable method of repair.

I. Testing And Inspection Of Manholes

1. Leakage Test:

   There shall be no visible leakage through the walls or pipe connections.

2. Vacuum Test:

   All manholes shall be required to meet the requirements of the vacuum test as per the current ASTM C 1244 “Standard Test Method for Concrete Sewer Manholes by the negative Air Pressure (Vacuum) Test” prior to acceptance. Manholes that fail the vacuum test or that develop a leak during the one year warranty period shall be rejected, removed and replaced with new material at no cost to the Owner. No field repair shall be approved.

3. Manhole Inspections:

   a. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Owner. Such inspection may be made at the place of manufacture and/or at the site after delivery, or at both places. The sections shall be subject to rejection at any time due to failure to meet any of the specification requirements; even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be immediately removed from the job. All sections or joints, which have been damaged, will be rejected, removed from the site and replaced with new material. If already installed, rejected section shall be removed and replaced entirely at the Contractor’s expense.

b. At the time of inspection, the sections will be carefully examined for compliance with the specified ASTM 478 “Standard Specification for Precast Reinforced Concrete Manhole Sections”, and with the approved manufacturer's drawings. All sections shall be inspected for general appearance, dimension, “scratch-strength” blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured. Installed manholes shall be inspected for proper filling and coating of the lifting holes and proper installation of any liner, coating or shrink-wrap.

J. Testing Of Wastewater Force Mains

Pressure testing of wastewater force mains shall be in accordance with Specification Section 15144.

END OF SECTION

SECTION 02534 PVC GRAVITY SEWER PIPE

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of PVC gravity sewer pipe conforming to ASTM D3034 or ASTM F789.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit reports on testing per ASTM D3034 or ASTM F789 ASTM D3212, and ASTM F477.

3. Submit cut sheets showing invert elevations, ground elevations, and cuts every 25 feet. Show lateral locations.

PART 2 - MATERIALS

A. PVC Material

Additives and fillers, including stabilizers, antioxidants, lubricants, colorants, etc., shall not exceed 10 parts by weight per 100 of PVC resin in the compound.

B. Pipe

Pipe shall conform to ASTM D3034, SDR 35, or ASTM F789.

C. Joints

Provide elastomeric gasket joints of the push-on type, conforming to ASTM D3212.

D. Gaskets

Gaskets for push-on joints shall conform to ASTM F477.

E. Fittings

Fittings shall conform to ASTM D3034, SDR 35, or ASTM F789.

F. Mandrel for Field Testing of Pipe Deflection

The mandrel shall:

1. Be a rigid, nonadjustable, odd-numbering-leg (nine legs minimum) mandrel having an effective length not less than its nominal diameter.

2. Have a minimum diameter at any point along the full length as follows:

Pipe Material	Nominal Size (inches)	Minimum Mandrel Diameter (inches)
PVC-ASTM D3034 (SDR 35)	6	5.619
	8	7.524
	10	9.405
	12	11.191
	15	13.849

3. Be fabricated of steel; be fitted with pulling rings at each end; be stamped or engraved on some segment other than a runner indicating the pipe material specification, nominal size, and mandrel outside diameter (e.g., PVC, D 3034-8"-7.524"); and be furnished in a carrying case labeled with the same data as stamped or engraved on the mandrel.

4. All costs incurred by the Contractor attributable to mandrel and deflection testing, including any delays, shall be borne by the Contractor at no cost to the Owner.

PART 3 - EXECUTION

A. Laboratory Testing

1. Conduct tests required in ASTM D3034 or F789, D3212, and F477.

2. The acceptable rates of failure for quality control tests shall be as follows:

   a. Outer Diameter: 0%.

   b. Minimum Wall Thickness: 0%.

c. Other Dimensions: 0%.

d. Flattening: 0%.

e. Impact: Six of six samples must pass; if one fails, test six more; all six must pass.

B. Installing PVC Sewer Pipe

1. Install in accordance with Section 02223, ASTM D2321, and as described below.

2. Pipe shall not deviate more than 1 inch from line or 1/4 inch from grade. Measure for grade at the pipe invert.

3. Minimum bedding thickness shall be 4 inches.

4. Lay pipe without break, upgrade from structure to structure, with the socket ends of the pipe upgrade.

5. Do not use the pipe as a drain for removing water that has infiltrated into the trench.

6. After joint assembly, bring the bedding material up to pipe spring line. Bedding material shall be imported sand per Section 02223. Place the bedding material on each side of the pipe. Tamp the bedding material into final position at pipe spring line and continue to the top of the pipe. Relative compaction shall be in conformance with Section 02223.

7. Then place bedding material to 1 foot above the top of the pipe and compact to the same relative compaction as in the pipe zone per Section 02223. The remainder of the trench backfill shall be native material, installed per Section 02223.

8. Do not use hydro-hammers to compact bedding or backfill.

C. Installing Pipe at Manholes and Structures

1. Place a 2-foot PVC length of pipe of the same inside diameter as the adjoining pipe at the inlet and outlet to each manhole or structure. Use one of the following methods:

a. Directly cast a manhole coupling into the manhole base. Provide rubber-ring gasket in the coupling.

b. Stretch a rubber-ring gasket around the pipe to serve as a water stop when cast into the structure wall.

2. Do not cast pipe bells into manholes or structures. Cut off the bell so that no recess or offset appears on the exposed face from the inside wall of the pipe to the outside wall of the pipe. The pipe shall have a plain end, flush with the inside wall of the manhole or structure, or as shown in the drawings.

D. Testing for Defects of Installed Pipe

Following placement and compaction of backfill and prior to placing permanent pavement, ball and mandrel the pipe to measure for obstructions (excessive deflections, joint offsets, and lateral pipe intrusions).

E. Field Testing for Pipe Deflection

1. Test installed pipe to ensure that vertical deflections for plastic pipe do not exceed the maximum allowable deflection. Maximum allowable deflections shall be governed by the mandrel requirements stated herein and shall nominally be:

Nominal Pipe Size	Percentage
Up to and including 12 inches	5.0
Over 12 to and including 15 inches	4.0

2. The maximum average inside diameter shall be equal to the average outside diameter per applicable ASTM standard minus two minimum wall thicknesses per applicable ASTM standards. Manufacturing and other tolerances shall not be considered for determining maximum allowable deflections.

3. Perform deflection tests not sooner than 30 days after completion of placement and compaction of backfill. Clean and inspect the pipe for offsets and obstructions prior to testing.

4. Pull a mandrel through the pipe by hand to verify that maximum allowable deflections have not been exceeded. Prior to use, the mandrel shall be certified by an independent testing laboratory. Use of an uncertified mandrel or a mandrel altered or modified after certification will invalidate test. If the mandrel fails to pass, the pipe will be deemed to be overdeflected.

5. Uncover any overdeflected pipe and, if not damaged, reinstall. Remove damaged pipe from the site. Any pipe subjected to any method or process other than removal, which attempts, even successfully, to reduce or cure any overdeflection, shall be uncovered, removed from the site, and replaced with new pipe.

F. Leakage Test

See Section 02530.

G. Testing for Alignment and Grade

After the pipe has been installed, tested for leakage, backfilled to existing grade, and manholes raised to grade and resurfaced, "ball" the pipe from manhole to manhole with a sewer scrubbing ball. After balling the pipe, perform the following:

1. Provide television inspection. Make a videotape or DVD and defects requiring correction shall be noted. Upon completing the corrective work, notify the Owner; the affected portion of the pipeline system will be retelevised at no additional cost to the Owner.

END OF SECTION

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SECTION 02551 PRIME AND TACK COATS

PART 1 - GENERAL

A. Description

This section includes materials, testing and application of bituminous material on a previously prepared base and on an existing pavement surface.

B. Submittals

Submit shop drawings in accordance with the General Conditions and Section 01300 showing the materials to be used and manufacturer's certificates showing compliance with the specifications.

PART 2 - PRODUCTS

A. Prime Coat

The material used for prime coat shall be:

1. Cut-back Asphalt Grade RC-70 or RC-250 meeting the requirements of AASHTO M81 except that the penetration range shall be from 60-120 instead of 80-120.

   For Grade RC-3000, in addition to the requirements shown in Table I of AASHTO M81 the following values shall be added to the requirements for Distillation Test:

Distillate, percentage by volume of total distillate to 680 deg. F.	Grade RC-3000 Max.
to 320 deg. F	0
to 374 deg. F	10
to 437 deg. F	40

   All other requirements for the distillation test (and for other properties included in the table) shall be as shown in Table I of AASHTO M81.

2. Emulsified Asphalt Grades SS-1 or CCS-1, SS-1H or CCS-1H diluted in equal proportion with water; asphalt emulsified asphalt grade AE-60, AE-90, AE-150 or AE-200 diluted at the ratio of 6 parts emulsified asphalt to 4 parts water; special MS-Emulsion diluted at the ratio of 6 parts emulsified asphalt to 4 parts water; Asphalt Emulsion Prime (AEP) meeting the following:

a. Anionic Emulsified Asphalt shall meet the requirements of AASHTO M140 with the exception that the cement mix test will be waived when the asphalt is used in non-mix application, such as tack coats and primes.

b. Cationic Emulsified Asphalt shall meet the requirements of AASHTO M208.

c. Emulsified Asphalt Grades AE-60, AE-90, AE-150 and AE-200 shall meet the following requirements:

HIGH FLOAT EMULSIONS

	Asphalt Emulsion Grade			
	AE-60		AE-90	
	Min	Max	Min	Max
Tests on Emulsion:				
Saybolt Furol Viscosity at 122°F, sec.	75	400	75	400
Settlement 5 days, %		5		5
Storage Stability 24 Hr., %		1		1
Sieve Test, %		0.10		0.10
Demulsibility, 50 ml CaC12 0.10N, %	75		75	
Residue by Distillation, %	65		65	
Oil Portion, % by Volume (500°F Dist)		1		2
Tests on Residue:				
Penetration 77°F 100 g 5 sec	40		70	
Absolute Viscosity, poise 140°F	3200		1600	
Ductility 77°F 5 cm/min, cm	40		40	
Float Test 140°F, sec	1200		1200	
Solubility in Trichloroethylene, %	97.5		97.5	

	AE-150		AE-200	
	Min	Max	Min	Max
Tests on Emulsion:				
Saybolt Furol Viscosity at 122°F, sec.	75	400	75	
Settlement 5 days, %		5		5
Storage Stability 24 Hr., %		1		1
Sieve Test, %		0.10		0.10
Demulsibility, 50 ml CaC12 0.10N, %	75			
Residue by Distillation, %	65		62	
Oil Portion, % by Volume (500°F Dist)		3		8
Tests on Residue:				
Penetration 77°F 100 g 5 sec	125		150	
Absolute Viscosity, poise 140°F	800		400	
Ductility 77°F 5 cm/min, cm	40			
Float Test 140°F, sec	1200		1200	
Solubility in Trichloroethylene, %	97.5		97.5	

d. Special MS-Emulsion shall meet the following requirements with a minimum application temperature of 170°F:

SPECIAL MS-EMULSION

	Min	Max
Tests on Emulsion:		
Saybolt Furol Viscosity at 77°F, sec.	45	--
Storage Stability 24 Hr., %	--	1
Sieve Test, %	--	0.10
Demulsibility, 50 ml CaC12 0.10N, %	65	--
Residue by Distillation, %	62	--
Oil Portion, % by Volume (500°F Dist)	--	8
Tests on Residue:		
Penetration 77°F 100 g 5 sec	60	--
Ductility 77°F 5 cm/min, cm	40	--
Absolute Viscosity, poise 140°F	800	--
Solubility in Trichloroethylene, %	97.5	

e. Emulsified Asphalt Grade CRS-2H shall meet the following requirements:

EMULSIFIED ASPHALT GRADE CRS-2H

	Min	Max
Tests on Emulsion:		
Saybolt Furol Viscosity at 122°F, sec.	100	400
Settlement 5 days, %	--	5
Storage Stability 24 Hr., %	--	1
Demulsibility, 35 ml 0.8% Sodium dioctyl Sulfosaccinate, %	40	
Particle Charge	Positive	
Sieve Test, %	--	0.1
Residue, %	65	--
Tests on Residue:		
Penetration 77°F 100 g 5 sec	80	140
Ductility 77°F 5 cm/min, cm	40	--
Solubility in Trichloroethylene, %	97.5	--

f. Asphalt Emulsion Prime shall meet the following requirements:

ASPHALT EMULSION PRIME (AEP)

	Min	Max
Tests on Emulsion:		
Saybolt Furol Viscosity at 77°F, sec.	20	150
Settlement 5 days, %	--	5
Storage Stability 24 Hr., %	--	1
Sieve Test, %	--	0.1
Demulsibility, 50 ml CaC12 0.10N, %	65	--
Residue, %	55	--
Oil Portion, % by Volume (500°F Dist)	--	12
Tests on Residue:		
Penetration 77°F 100 g 5 sec	40	200
Ductility 77°F 5 cm/min, cm	40	--
Solubility in Trichloroethylene, %	97.5	--

Where Emulsified Asphalt is deficient from the minimum percentage of residue required in the applicable specifications, payment for such material will be made at reduced rates as shown in the following table:

Deficiency from Minimum Percent Residue	Percentage of Original Contract Price
1 - 3	95
4 - 6	85
7 - 9	75
*More than 9	50

*At the discretion of the Engineer, the asphaltic mixture, the base material, the surface treatment, or the mineral seal coat containing this material may be left in place with 50 percent payment made therefore, or be removed to the extent required by the Engineer and acceptably replaced.

The viscosity requirements for all Grades of Emulsified Asphalt used as tack coat or prime coat may be waived by the Engineer if satisfactory results are being obtained.

B. Cover Material for Prime Coat

1. If an emulsified asphalt is used for prime coat, the cover material shall be hot-asphalt coated (mix to contain from two to four percent asphalt-cement) to achieve a prime coat which will remain reasonably intact until the surface course is placed.

2. If material other than emulsified asphalt is used for the prime coat, the cover material shall be either sand (bare or hot-asphalt coated) or screenings. The sand shall be nonplastic and free from any appreciable amount of silt, clay balls and root particles, and from any noticeable sticks, trash, vegetation or other organic matter. Screenings shall be Miami Oolitic rock screenings as specified in FDOT Specification Section 902-5.2.3.

C. Tack Coat

1. Unless a specific type or grade of material is called for in the plans or specifications, the material used for tack coat may be any of the following: Emulsified Asphalt, Grades RS-1, RS-2, CRS-2, SS-1, CSS-1, SS-1H, CSS-1H, AE-60, AE-90, AE-150, or CRS-2H, Special MS Emulsion, or Asphalt Emulsion Prime (AEP). The materials specified above shall not be diluted prior to use.

2. Emulsified asphalt (RS Type) shall meet the following requirements:

	Min.	Max.
Tests on Emulsion:		
Saybolt furol viscosity at 77°F, sec.	75	--
Storage stability 24 Hr., %	--	1.0
Sieve test, %	--	0.1
Naptha content, % by volume	5	15
Residue, %	55	--
Tests on Residue:*		
Penetration at 77°F, 100g, 5 sec.	50	--
Viscosity at 140°F (poises)	800	--
Solubility in trichloroethylene, %	97.5	--

* Residue by distillation shall be in accordance with AASHTO T-59 except that the maximum temperature shall be 329° + 10°F (165° + 5°C) and the sample shall be maintained at this temperature for 20 minutes.

PART 3 - EXECUTION

A. Equipment

Pressure Distributor: The pressure distributor shall be equipped with pneumatic tires having a sufficient width of rubber in contact with the road surface to avoid breaking the bond or forming a rut in the surface. The distance between the centers of openings of the outside nozzles of the spray bar shall be equal to the width of the application required, within an allowable variation of two inches. The outside nozzle at each end of the spray bar shall have an area of opening not less than 25 percent nor more than 75 percent, in excess of the other nozzles. All other nozzles shall have uniform openings. When the application covers less than the full width, the normal opening of the end nozzle at the junction line may remain the same as those of the interior nozzles.

B. Cleaning Base and Protection of Adjacent Work

1. Before any bituminous material is applied, all loose material, dust, dirt, caked clay and other foreign materials which might prevent proper bond with the existing surface shall be removed for the full width of the application. Particular care shall be taken in cleaning the outer edges of the strip to be treated, to insure that the prime or tack coat will adhere.

2. When the prime or tack coat is applied adjacent to curb and gutter, valley gutter or any other concrete surfaces, such concrete surfaces (except where they are to be covered with a bituminous wearing course) shall be covered with heavy paper, or otherwise protected while the prime or tack coat is being applied. Any bituminous material deposited on such concrete surfaces shall be removed.

C. Weather Limitations

Prime and tack coats shall be applied when the air temperature, in the shade, is above 40°F, and when all other weather conditions and the condition of the surface are suitable.

D. Application of Prime Coat

1. General: The surface to be primed shall be clean and the moisture content of the base shall not exceed 90 percent of the optimum moisture. The temperature of the prime material shall be between 100°F and 180°F. The actual temperature shall be that which will insure uniform

distribution. The material shall be applied by means of a pressure distributor. The amount to be applied will be dependent on the character of the surface and shall be sufficient to coat the surface thoroughly and uniformly, with no excess. A prime coat is required on newly constructed limerock, shell, and sand clay bases.

2. Rate of Application

   a. Limerock, Limerock Stabilized, and Local Rock Bases: For these bases, the rate of application shall be not less than 0.10 gallon per square yard.

   b. Sandy-Clay, Shell and Shell Stabilized Bases: The rate of application for these bases shall be not less than 0.15 gallon per square yard.

3. Partial Width of Application: If warranted by traffic conditions, the application may be made on only one-half of the width of the base at one time, in which case positive means shall be used to secure the correct amount of bituminous material at the joint.

4. Sanding

   a. If emulsified asphalt is used to prime coat, the primed base shall be uniformly covered by an application of sand-bituminous hot mix or screenings at an approximate rate of ten pounds per square yard. The entire surface of the sand-bituminous hot mix or screenings cover material shall be rolled with a traffic roller as required to produce a reasonable dense mat.

   b. If material other than emulsified asphalt is used for prime coat, the primed base shall be covered by a light uniform application of cover material. If considered necessary for proper distribution of spread, the cover material shall be lightly dragged with a drag broom, after which it shall be rolled with a traffic roller, for at least ten passes over the entire area.

E. Application of Tack Coat

1. General: Where a bituminous surface is to be laid and a tack coat is required, the tack coat shall be applied as specified herein below.

2. Use a tack coat on existing pavement to be resurfaced, primed bases in areas which have become excessively

dirty and cannot be cleaned, or in areas where the prime has cured and lost its bonding effect.

3. Method of Application: The tack coat shall be applied with a pressure distributor except that, on small jobs if approved by the Engineer, application may be by other mechanical devices or by hand methods. The bituminous material shall be heated to a suitable temperature and shall be applied in a thin, uniform layer.

4. Rate of Application: The rate of application shall be between 0.02 and 0.08 gallon per square yard. For tack coat applied on concrete pavement which is to be surfaced, the rate of application may exceed the upper limit.

5. Curing and Time of Application: The tack coat shall be applied sufficiently in advance of the laying of the bituminous mix to permit drying but shall not be applied so far in advance that it might lose its adhesiveness as a result of being covered with dust or other foreign material.

6. Protection: The tack coat surface shall be kept free from traffic until the subsequent layer of bituminous hot mix has been laid.

END OF SECTION

SECTION 02576 ASPHALT PAVEMENT

PART 1 - GENERAL

A. Description

This section specifies requirements for material, testing and installation of plant mix asphalt pavement.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following:

2. A design mix for the asphalt including gradation of all materials, content of mix, Marshall stability, and laboratory density.

3. Certifications showing that the materials comply with the specifications and contain less than 1% by weight asbestos.

PART 2 - PRODUCTS

A. Asphaltic Concrete

1. Composition, design mix and physical properties shall meet the requirements of the following:

Bituminous Concrete Mixtures
(Gradation Design Range)

Percent by Weight Total Aggregate Passing Sieves

Type	3/4	1/2	3/8	No. 4	No. 10	No. 40	No. 80	No. 200
S-I	100	88-100	75-93	47-75	31-53	19-35	7-21	2-6
S-III		100	88-100	60-90	40-70	20-45	10-30	2-6

(1) 100% passing 1-1/4-inch sieve and 94-100% passing 1-inch sieve.

Marshall Design Properties for
Bituminous Concrete Mixes

Mix Type	Minimum Marshall Stability (lbs)	Flow[1] (0.01 in.)	Minimum VMA (%)	Air Voids (%)	Minimum Effective Asphalt Content (%)
S-I	1500	8-14	14	3-5	5.0
S-III	1500	8-14	15	3-7	5.5

(1) The maximum flow for the mix design shall be one point less than shown. The maximum flow values shown apply only during production.

B. Asphaltic Concrete Type S-I and S-III

1. Type S-I and S-III shall meet the above requirements and the requirements in the following paragraphs.

2. The Asphalt Cement, Viscosity Grade AC-20 or AC-30, shall meet the following except that no spot test is required:

Test	AC-20 Min.	AC-20 Max.	AC-30 Min.	AC-30 Max.
Viscosity, 140°F (60°C), poises	(2000 ± 400)		(3000 ± 600)	
Viscosity, 275°F (135°C), Cs	300	--	350	--
Penetration, 77°F (25°C), 100 gm, 5 Sec.	60	--	50	--
Flash Point, COC, °F (°C)	450	--	(232)	--
Solubility in Trichloroethylene, percent	99.0	--	99.0	--
Tests on Residue from Thin Film Oven Test:				
Viscosity Ratio= Visc. 140°F after TFOT / Visc. 140°F before TFOT	--	4	--	4
Ductility 77°F (25°C) 5 cm per min, cm.	80	--	50	--
Loss on Heating, %	--0.5	--	0.5	

3. Mineral filler shall consist of limerock dust, portland cement, slag dust or hydrated lime. It shall be thoroughly dry and free from lumps, consisting of aggregations of fine particles. The filler shall meet the following gradation requirements:

Sieve Number	Total % Passing
30	100
80	95 (min)
200	65 (min)

Mineral filler may be provided from process screenings from stone or slag provided that the loss in processing under the Los Angeles Abrasion Test does not exceed 45%.

The gradation of this filler shall be such that all of it shall pass the No. 10 sieve, and not more than 35% shall pass the No. 200 sieve. The material passing the No. 200 sieve shall be free of organic impurities and clay minerals shall not exceed 4.0%. The plasticity index of the material passing the No. 200 sieve shall not exceed 4.

4. Coarse Aggregate:

   a. Coarse Aggregate shall consist of gravel, rock or slag and contain less than 1% by weight asbestos. All coarse aggregate shall be washed and shall be free from disintegrated pieces, clay lumps, soft and friable particles, salt, alkali, organic matter and adherent coatings. The weight of deleterious substances shall not exceed the following percentages:

Coal and lignite	1.00
Clay lumps	2.00
Soft and friable particles	2.00
Cinders and clinkers	0.50
Free Shell	1.00
Organic matter (wet)	0.03
Material passing the No. 200 Sieve	1.75
Chert	3.00

      In addition, the sum of the percentages of all substances listed above shall not exceed ten.

   b. Coarse aggregate shall have a maximum loss of 45% when subjected to the Los Angeles Abrasion Test, a maximum loss of 12% when subjected to the Soundness (Sodium Sulfate) Test and contain a maximum of 10% flat or elongated pieces.

   c. Natural Stones: Coarse aggregate may be processed from gravels, granites, limestones, dolomites, sandstones, or other naturally occurring hard, sound, durable materials meeting the requirements of this paragraph.

      (1) Gravel shall be composed of naturally occurring quartz. The loss when the material is subjected to the Los Angeles Abrasion Test (AASHTO T96), shall be no more than 45%. The dry-rodded weight per cubic foot of the gravel, tested according to AASHTO T19, shall be not less than 95 pounds. Crushed gravel shall consist of 85%, by weight, of the material retained on the No. 4 sieve, having three crushed faces.

(2) Granites: Coarse aggregate produced from the crushing of granites shall be sound and durable. For granites to be used in bituminous mixtures and surface treatments, the Los Angeles Abrasion requirement is modified to permit a maximum loss up to 50 (Manual of Florida Sampling and Testing Methods FM 1-T 096). Maximum amount of mica schist permitted is 5% (AASHTO T-189).

(3) Limestones, Dolomites and Sandstone: Coarse aggregates may be produced from limestone, dolomites, sandstones, and other naturally occurring hard, durable materials meeting the requirements of this paragraph.

(4) Pre-Cenozoic limestones and dolomites shall not be used as crushed-stone aggregates, either coarse or fine, for wearing courses of asphaltic concrete surface courses. This specifically includes materials from the Ketona Dolomite (Cambrian), Newala Limestone (Lower Ordovician), Bangor Limestone (Mississippian), and other formations of similar composition and origin occurring in central and northern Alabama and Georgia.

d. Slag shall be clean, tough and durable. It may be either air-cooled blast-furnace slag or phosphate slag. It shall be reasonably uniform in density and quality, and free from deleterious substances. It shall contain not more than 1.5% of sulphur. The dry-rodded weight shall be not less than 70 pounds per cubic foot. The loss, when the slag is subjected to the Los Angeles Abrasion Test, shall not exceed 45%. It shall contain not more than 10% glassy particles.

e. Unless written permission from the Owner is obtained, coarse aggregates of different types shall not be mixed, nor be used alternately in sections of less than one mile.

f. Grading shall be in accordance with FDOT Specification Section 901-1.4 Table 1.

g. Lightweight expanded aggregate shall be clean and durable material produced by firing shale, clay, or slate in a rotary kiln. It shall be reasonably uniform in quality and density and free from deleterious substances, except that the term cinders and clinkers shall only apply to those particles

clearly foreign to the expanded aggregate in question and the maximum percentage of material passing the No. 200 sieve shall be 3.00. The dry-loose unit weight of the material, determined in accordance with AASHTO T19, shall not be less than 33 or more than 55 pounds per cubic foot. The burning process shall be carefully controlled. As an indication of the control of burning, the producer shall obtain and test samples of material at frequent intervals. Control shall be considered adequate if the dry-loose unit weight of such samples does not differ by more than ±6% from the average weight established from the producer's quality control testing records. When subjected to the Los Angeles Abrasion Test, the loss shall not exceed 35%.

5. Fine Aggregate:

   a. Fine aggregate shall consist of natural silica sand, screenings, or a combination thereof, composed of clean, tough, angular grains, free from clay, soft or flaky particles, salt, alkali, organic matter, loam and other foreign matter. As delivered to the mixer it shall be free from clayey lumps of loosely bonded aggregations and the individual particles shall be free from adhering dust. Stone of slag screenings shall be produced from material complying with the abrasion requirements specified for coarse aggregate. The weight of deleterious substances (shale, coal and lignite, cinders and clinkers, clay lumps) shall not exceed 1.0, 1.0, 0.5 and 1.0% respectively.

   b. The following additional limitation shall apply for stone used as aggregate in all asphaltic concrete used as a wearing coarse. Pre-Cenozoic limestones and dolomites shall not be used as crushed-stone aggregates, either coarse or fine, for wearing courses of asphaltic concrete surface coarses. This specifically includes materials from the Ketona Dolomite (Cambrian), Newala Limestone (Lower Ordovician), Bangor Limestone (Mississippian), and other formations of similar composition and origin in central and northern Alabama and Georgia.

   c. Any screenings used in the combination of aggregate shall contain not more than 15% of material passing the No. 200 sieve and, if necessary to meet this requirement, they shall be washed.

d. Any natural sand portion of the fine aggregate other than screenings shall be siliceous and shall contain not more than 10% of material passing the No. 200 sieve.

e. Silica sand, when tested by means of laboratory sieves, shall meet the following requirements:

Passing Sieve	Percent by Weight
No. 4	95-100
No. 8	85-100
No. 16	65- 97
No. 30	25- 70
No. 50	5- 35
No. 100	0- 7
No. 200	Max. 4

f. Screenings: Screenings shall be composed of hard, durable particles, either naturally occurring, such as gravel screenings, or resulting from the crushing or processing of the parent rock, to include natural rock, slags, expanded clays or shales (lightweight aggregates), or other approved inert materials with similar characteristics.

Aggregates classified as screenings shall conform to the following gradation requirements:

Sieve Size	Passing Percent
3/8"	100
No. 4	85 to 100
No. 200	Maximum 15

PART 3 - EXECUTION

A. Hot Bituminous Mixtures

1. Plant operations shall not begin unless all weather conditions are suitable for the laying operations.

2. The mixture shall be spread only when the surface upon which it is to be laid has been previously prepared, is intact, firm and properly cured, and is dry. No mixture shall be spread that cannot be finished and compacted during daylight hours. The mixture shall be spread only when the air temperature (the temperature in the shade away from artificial heat) is above 40°F for layers

greater than one inch (100 lbs per square yard) in thickness and 45°F and above for layers one inch (100 lbs per square yard) or less in thickness (this includes leveling courses). No mixture shall be placed when there is evidence of a frozen base. The mixture shall not be spread when the wind is blowing to such an extent that proper and adequate compaction cannot be maintained or when sand, dust, etc., are being deposited on the surface being paved, to the extent that the bond between layers will be diminished.

3. Mixing at the asphalt plant shall be sufficient to produce a thoroughly and uniformly coated mixture. The ingredients of the mix shall be heated and combined in such a manner as to produce a mixture, which shall be at a temperature, when discharged from the pugmill or surge bin, within the range of 230°F to 310°F and within the tolerance shown in the following table:

Temperature Tolerance From
Job Mix Formula

Any Single Measurement	±25°F
Average of Any Five Consecutive Measurements . .	±15°F

However, the temperature of the mixture, in all cases, shall be such that will yield an asphalt Kinematic viscosity within the range of 280 and 150 centistokes. The mix temperature will be taken at the plant on the first five loads each day and on an average of once every five loads thereafter. Take corrective action if the temperature fails to fall within the specified tolerance.

4. The maximum time that any mix may be kept in a hot storage or surge bin is 72 hours. Produce a homogeneous mixture, free from moisture and with no segregated materials, that meets all requirements of the specifications for the mixture, including compliance with the design limits. These requirements shall apply also to all mixes produced by the drum mixer process and all mixes processed through a hot storage or surge bin, both before and after storage.

5. The mixture shall be transported in tight vehicles previously cleaned of all foreign material and each load shall be covered. The inside surface of the truck bodies shall be thinly coated with soapy water or an emulsion containing not over 5% of oil. Kerosene, gasoline or similar products shall not be used. After the truck bodies are coated and before any mixture is placed

therein, they shall be raised so that all excess liquids will be drained out.

6. Prior to the laying of the mixture, the surface of the base or pavements to be covered shall be cleaned of all loose and deleterious material by the use of power brooms or blowers, supplemented by hand brooming where necessary.

7. All asphaltic concrete mixtures (including leveling courses), other than adjacent to curb and gutter or other true edges, shall be laid by the string-line method, to assure the obtaining of an accurate, uniform alignment of the pavement edge. The temperature of the mix at the time of spreading shall be within ±25°F of the actual mix temperature. The minimum frequency for taking mix temperatures on the road will be an average of one per five trucks. Take corrective action if the temperature range fails to fall within the specified tolerance range. Any mixture caught in transit by a sudden rain may be laid at risk. Should such mixture prove unsatisfactory, it shall be removed and replaced with satisfactory mixture at no additional expense to the Owner. In no case shall the mixture be laid while rain is falling or when there is water on the surface to be covered. The forward speed of the spreader shall be as established by the manufacturer of the equipment and sufficient for an even application. For each paving machine being operated, a separate crew will be required; each crew operating as a full unit. The depth of each layer shall be checked at frequent intervals of approximately 25 feet. Any deviation below the design thickness as shown on the drawings shall be immediately corrected. In limited areas where the use of the spreader is impossible or impracticable, the mixture may be spread and finished by hand. Straight-edging and back-patching shall be done after initial compaction has been obtained and while the material is still hot.

8. For courses other than leveling, upon arrival, the mixture shall be dumped into a mechanical spreader and immediately spread and struck-off to the full width required and to such loose depth for each course that, when the work is completed, the required weight of mixture per square yard, or the specified thickness, will be secured. An excess amount of mixture shall be carried ahead of the screed at all times. Hand raking shall be done behind the machine as required. If necessary due to the traffic requirements, the mixture shall be laid in trips in such manner as to provide for the passage of traffic. Where the road is closed to traffic, the mixture may be laid to the full width, by

machines traveling in echelon. Before any rolling is started the surface shall be checked, any irregularities adjusted, and all drippings, fat sandy accumulations from the screed, and fat spots from any source shall be removed and replaced with satisfactory material. No skin patching shall be done. When a depression is to be corrected while the mixture is hot, the surface shall be well scarified before the addition of fresh mixture.

9. For leveling courses, all depressions in the existing surface more than one inch deep shall be filled by spot patching with leveling course mixture and then thoroughly compacted prior to spreading any leveling course. All leveling courses shall be placed by the use of two motor graders (one of which is equipped with a spreader box) unless otherwise shown in the plans. When the total asphalt mix provided for leveling exceeds 50 pounds per square yard, the mix shall be placed in two or more layers, with the average spread of any layer not to exceed 50 pounds per square yard. When Type S-III Asphaltic Concrete is used for leveling, the average spread of a layer shall not be less than 50 lbs per square yard not more than 75 pounds per square yard. The quantity of mix for leveling shown in the plans represents the average for the entire project; however, the rate of application may vary throughout the project. When leveling in connection with base widening, all the leveling mix must be placed prior to the widening operation. When a leveling course is specified to be placed over cracked concrete pavement (including existing concrete pavement covered with an asphaltic surface), the first layer of leveling shall be placed as soon as possible but no later than 48 hours after cracking the concrete. The remainder of the leveling course shall be placed in the normal sequence of operations. Where a leveling course is to be placed over existing concrete pavement or bridge decks, the excess joint filler in the cracks and joints shall be trimmed flush with the surface prior to placing the first layer of the leveling course.

10. For each paving or leveling train in operation, furnish a separate set of rollers, with their operators. The following equipment, sequence and coverage are only suggested for use based on past successful performance. Utilizing whatever equipment selected, the sequence and coverage of rolling shall meet the minimum density requirements specified:

    a. Seal rolling by using tandem steel rollers weighing 5 to 12 tons, following as close behind the

spreaders as is possible without pick-up, undue displacement or blistering of the material.

b. Rolling with self-propelled pneumatic-tired rollers, following as close behind the seal rolling as the mix will permit. The roller shall cover every portion of the surface with at least five passes.

c. Final rolling with the 8- to 12-ton tandem steel rollers, to be done after the seal rolling and pneumatic-tired rolling have been completed, but before the internal pavement temperature has dropped below 175°F.

11. The initial rolling shall be longitudinal. Where the lane being placed is adjacent to a previously placed lane, the center joint shall be pinched or rolled, prior to the rolling of the rest of the lane. After the rolling or pinching of the center joint, the rolling shall continue across the mat by overlapping each previous roller path by at least one-half the width of the roller wheel. The motion of the roller shall be slow enough to avoid displacement of the mixture, and any displacement shall be corrected at once by the use of rakes, and the addition of fresh mixture if required. Final rolling shall be continued until all roller marks are eliminated. Rolling with the self-propelled, pneumatic-tired rollers shall proceed at a speed of 6 to 10 miles per hour, and the area covered by each roller shall not be more than 4,000 square yards per hour, except that for Type S Asphaltic Concrete, this maximum rate of coverage shall be 3,000 square yards per hour.

a. A sufficient number of self-propelled pneumatic-tired rollers shall be used such that the rolling of the surface for the required number of passes will not delay any other phase of the laying operation nor result in excessive cooling of the mixture before the rolling is complete. In the event that the rolling falls behind, the laying operation shall be discontinued until the rolling operations are sufficiently caught up.

b. Areas which are inaccessible to a roller (such as areas adjacent to curbs, headers, gutters, bridges, manholes, etc.) shall be compacted by the use of hand tamps or other satisfactory means.

c. Self-propelled pneumatic-tired rollers shall be used for the rolling of all patching and leveling courses. Where the initial leveling course is placed over broken concrete pavement, the pneumatic-tired

roller shall weigh at least 15 tons. For Type S-III Asphaltic Concrete leveling courses, the use of a steel-wheel roller, to supplement the traffic rollers, will be required. On other leveling courses, the use of a steel-wheeled roller will be required on all passes after the first.

d. The rollers shall not be allowed to deposit gasoline, oil or grease onto the pavement, and any areas damaged by such deposits shall be removed and replaced. While rolling is in progress, the surface shall be tested continuously and all discrepancies corrected to comply with the surface requirements. All drippings, fat or lean areas and defective construction of any description shall be removed and replaced. Depressions which develop before the completion of the rolling shall be remedied by loosening the mixture and adding new mixture to bring the depressions to a true surface. Should any depression remain after the final compaction has been obtained, the full depth of the mixture shall be removed and replaced with sufficient new mixture to form a true and even surface. All high spots, high joints and honeycomb shall be corrected. Any mixture remaining unbonded after rolling shall be removed and replaced. Any mixture which becomes loose or broken, mixed or coated with dirt or in any way defective, prior to laying the wearing course shall be removed and replaced with fresh mixture which shall be immediately be compacted to conform with the surrounding area. Areas of defective surface may be repaired by the use of indirect heat. No method of repair involving open-flame heaters shall be used.

12. Shoulder pavements wider than 5-1/2 feet shall be compacted by the use of equipment of the type required for other asphaltic concrete pavements. Compaction of asphaltic concrete 5-1/2 feet or less in width, shall be done by the use of tandem steel rollers not exceeding 12 tons in weight. Other compaction in such restricted widths shall be by the use of rubber-tired equipment.

13. The density of a completed course shall be at least 94% of the laboratory density.

14. Placing of the mixture shall be as continuous as possible and the roller shall not pass over the unprotected end of the freshly laid mixture except when the laying operation is to be discontinued long enough to permit the mixture to become chilled. When the laying operation is thus interrupted, a transverse joint shall

be constructed by cutting back on the previous run to expose the full depth of the mat.

15. Where only a portion of the width of pavement is to be laid and opened to traffic, longitudinal joints shall be formed by rolling the exposed edge of the strip first laid. When the adjacent strip is constructed, the Engineer may require the edge of the mixture in place to be trimmed back to expose an unsealed or granular vertical surface. Where the strip first laid is closed to traffic, the edge shall not be sealed but shall be left vertical and the adjacent strip placed against it without trimming.

16. When fresh mixture is laid against the exposed edges of joints (trimmed or formed as provided above), it shall be placed in close contact with the exposed edge so that an even, well-compacted joint will be produced after rolling.

17. The finished surface shall be of uniform texture and compaction and shall be smooth. The surface shall have no pulled, torn, or loosened portions and shall be free of segregation, sand streaks, sand spots, or ripples. Any area of the surface which does not meet the foregoing requirements shall be corrected.

18. All pavements (both intermediate and final courses), intersections, acceleration lanes, deceleration lanes, tapers, crossovers, transitions at beginning and end of project, and similar areas shall be tested with a straightedge for surface tolerance. Any individual surface irregularity in these areas in excess of 3/16-inch as determined by a 15-foot straightedge shall be corrected and retested. Provide a 15-foot manual straightedge at the job site at all times during the paving operation for checking joints and surface irregularities.

19. If the Owner elects to waive corrections, the appropriate pay quantity for Asphaltic Concrete shall be reduced by the equivalent quantity of materials which would have been removed and replaced if the correction had been made.

    a. Where the pay quantity is in square yards, the reduction is based on the area which would have been removed multiplied by the ratio of the layer thickness to the total thickness of the type of mix specified.

b. Where the pay quantity is in tons, the reduction is based on the volume which would have been removed (length x lane width x layer thickness) multiplied by the laboratory density for the mix.

c. Where the project is a lump sum pay quantity based on amount completed, the appropriate reduction in percent complete shall be calculated based on the total amount of paving.

20. Select one of the following correction methods unless overlaying is prohibited.

    a. Removing and Replacing: If correction is made by removing and replacing the pavement, the removal must be for the full depth of the course and extend at least 50 feet on either side of the defective area, for the full width of the paving lane.

    b. Overlaying: If correction is made by overlaying, the overlaying shall cover the length of the defective area and taper uniformly to a featheredge thickness at a minimum distance of 50 feet on either side of the defective area. The overlay shall extend full width of the roadway. Care shall be taken to maintain the specified cross and lengthwise slopes.

21. All corrective work, either by removing and replacing or by overlaying, including the bituminous material, shall be provided at no additional cost to the Owner.

22. Sections of newly compacted asphaltic concrete which are to be covered by additional courses shall be kept clean until the successive course is laid.

23. Blade graders operating adjacent to the pavement during shoulder construction shall have a 2-inch by 8-inch (or larger) board (or other attachment providing essentially the same results) attached to their blades in such manner that it extends below the blade edge, in order to protect the pavement surface from damage by the grader blade.

24. Vehicular traffic shall not be permitted on any pavement which has not hardened sufficiently to prevent rutting or other distortion.

25. The specified thickness and density is the minimum to be supplied and any deficiency(s) shall be corrected either by replacing the full thickness for a length extending at least 50 feet from each end of the deficient area, or

(when permitted by the Owner) by overlaying with a minimum thickness of 75% of the specified thickness..

B. Saw-Cutting

Where existing pavement is to be removed, except brick, saw-cut the surface leaving a uniform and straight edge with minimum disturbance to the remaining adjacent surface.

C. Settlement of Pavement

All settlement of pavement repairs occurring within a period of one year after final acceptance of the project by the Owner shall be repaired or replaced as required by and at no cost to the Owner.

D. Testing

1. Unless otherwise stipulated on the plans, the following tests will be made by an independent testing laboratory.

   a. Extraction of the asphaltic concrete and sieve analysis of the aggregate.

   b. Determination of bitumen content of the asphaltic concrete.

   c. Core borings (approximately every 200 feet) to determine thickness and density.

   d. Marshall stability.

E. Repairs

Repair holes made to test the finished asphalt.

END OF SECTION

SECTION 02610 STABILIZED SUB-BASE

PART 1 - GENERAL

A. Description

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

B. Submittals

Submit copies of a certification from a testing laboratory that the material used for the base meets the specified criteria.

PART 2 - PRODUCTS

A. Materials

Use local or hauled-in clean sand or sand and clay.

B. Stabilizers

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

PART 3 - EXECUTION

A. Construction Methods

Test local material for compliance with the required Florida Bearing Value. 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. 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). Shape the sub-base to within 1/4 inch of the cross section grade shown in the plans prior to making the density tests. MAKE THE DENSITY TESTS BEFORE OTHER WORK PROCEEDS. 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.

B. Required Bearing Value

Unless otherwise specified or shown in the plans, stabilized sub-base shall have a minimum Florida Bearing Value of 50.

C. Tests

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 sq. ft. in area paving. If any test results are unsatisfactory, re-excavate and re-compact the sub-base until the desired compaction is obtained. 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

SECTION 02630 CULVERTS AND STORM SEWERS

PART 1 - GENERAL

A. General

This section includes material, testing and installation of round and elliptical concrete pipe, fittings and other appurtenances.

B. Submittals

Submit shop drawings in accordance with the General Conditions showing the materials to be used and manufacturer's certificates (for pipe, curing compound, gaskets, bituminous coating, fasteners) showing compliance with the specifications.

PART 2 - PRODUCTS

A. Round Concrete Pipe

1. Round Concrete Pipe shall meet the design requirements of Class III (of ASTM C 76) unless otherwise designated.

   a. For all classes, use any of the alternate wall designations shown and the provisions for Alternate Design, as specified in Section 10 of ASTM C76, shall apply.

   b. The process of manufacture and the details of the pipe design, including strength of the concrete may be inspected or checked by the Owner.

   c. Pipe up to and including 18 inches in diameter, which is used as side drain culvert, will not be required to be reinforced and will be reviewed on the basis of the strength tests. Properly mark such pipe.

   d. Furnish pipe without lifting holes.

2. The following provisions of ASTM C 76 shall be revised as shown:

   a. The text of Section 7 is deleted and the following is substituted therefore: Aggregates for concrete shall conform to the following requirements:

      1) Coarse Aggregate

         a) Coarse Aggregate shall consist of gravel, rock or slag and contain less than 1% by

weight asbestos. All coarse aggregate shall be washed and shall be free from disintegrated pieces, clay lumps, soft and friable particles, salt, alkali, organic matter and adherent coatings. The weight of deleterious substances shall not exceed the following percentages:

Coal and lignite	1.00
Clay lumps	2.00
Soft and friable particles	10.00
Cinders and clinkers	0.50
Free Shell	1.00
Organic matter (wet)	0.03
Material passing the No. 200 Sieve	1.75
Chert	3.00

In addition, the sum of the percentages of all substances listed above shall not exceed ten.

b) Coarse aggregate shall have a maximum loss of 45 percent when subjected to the Los Angeles Abrasion Test, a maximum loss of 12 percent when subjected to the Soundness (Sodium Sulfate) Test and contain a maximum of 10 percent flat or elongated pieces.

c) Natural Stones: Coarse aggregate may be processed from gravels, granites, limestones, dolomites, sandstones, or other naturally occurring hard, sound, durable materials meeting the requirements of this paragraph.

1) Gravel shall be composed of naturally occurring quartz. The loss when the material is subjected to the Los Angeles Abrasion Test (AASHTO T96) shall be no more than 50 percent. The dry-rodded weight per cubic foot of the gravel, tested according to AASHTO T19, shall be not less than 95 pounds. Crushed gravel shall consist of 85 percent, by weight, of the material retained on the No. 4 sieve, having three crushed faces.

2) Granites: Coarse aggregate produced from the crushing of granites shall be sound and durable.

3) Limestones, Dolomites and Sandstone: Coarse aggregates may be produced from limestone, dolomites, sandstones, and

other naturally occurring hard, durable materials meeting the requirements of this paragraph.

d) Slag shall be clean, tough and durable. It may be either air-cooled blast-furnace slag or phosphate slag. It shall be reasonably uniform in density and quality, and free from deleterious substances. It shall contain not more than 1.5 percent of sulphur. The dry-rodded weight shall be not less than 70 pounds per cubic foot. The loss, when the slag is subjected to the Los Angeles Abrasion Test, shall not exceed 45 percent. It shall contain not more than ten percent glassy particles.

e) Unless written permission from the Owner is obtained, coarse aggregates of different types shall not be mixed.

f) Grading shall be in accordance with FDOT Spec Section 901-1.4 Table 1.

g) Lightweight expanded aggregate shall be clean and durable material produced by firing shale, clay, or slate in a rotary kiln. It shall be reasonably uniform in quality and density and free from deleterious substances, except that the term cinders and clinkers shall only apply to those particles clearly foreign to the expanded aggregate in question and the maximum percentage of material passing the No. 200 sieve shall be 3.00. The dry-loose unit weight of the material, determined in accordance with AASHTO T19, shall not be less than 35 or more than 55 pounds per cubic foot. The burning process shall be carefully controlled. As an indication of the control of burning, the producer shall obtain and test samples of material at frequent intervals. Control shall be considered adequate if the dry-loose unit weight of such samples does not differ by more than $\pm$6 percent from the average weight established from the producer's quality control testing records. When subjected to the Los Angeles Abrasion Test, the loss shall not exceed 35%.

2) Fine Aggregate

a) Fine aggregate shall consist of natural silica sand, screenings, or a combination thereof, composed of clean, tough, angular

grains, free from clay, soft or flaky particles, salt, alkali, organic matter, loam and other foreign matter. As delivered to the mixer it shall be free from clayey lumps of loosely bonded aggregations and the individual particles shall be free from adhering dust. Stone or slag screenings shall be produced from material complying with the abrasion requirements specified for coarse aggregate. The weight of deleterious substances (shale, coal and lignite, cinders and clinkers, phosphate, clay lumps) shall not exceed 1.0, 1.0, 0.5, 1.0 and 1.0 percent respectively.

b) Any screenings used in the combination of aggregate shall contain not more than 15 percent material passing the No. 200 sieve and, if necessary to meet this requirement, they shall be washed.

c) Any natural sand portion of the fine aggregate other than screenings shall be siliceous and shall contain not more than ten percent material passing the No. 200 sieve.

d) Silica sand, when tested by means of laboratory sieves, shall meet the following requirements:

Passing Sieve	Percent by Weight
No. 4	95-100
No. 8	85-100
No. 16	65- 97
No. 30	25- 70
No. 50	5- 35
No. 100	0- 7
No. 200	Max. 4

e) Screenings: Screenings shall be composed of hard, durable particles, either naturally occurring, such as gravel screenings, or resulting from the crushing or processing of the parent rock, to include natural rock, slags, expanded clays or shales (lightweight aggregates), or other approved inert materials with similar characteristics.

Aggregates classified as screenings shall conform to the following gradation requirements:

Sieve Size	Passing Percent
3/8"	100
No. 4	85 to 100
No. 200	Maximum 15

b. Paragraph (d) of Section 16 (for curing by membrane compound) shall not apply. For membrane curing the compound used shall meet the requirements set forth in this section. The coating shall be applied immediately after the pipe has been removed from the mold and shall be applied by spraying in a single-coat, continuous operation at a uniform coverage of at least one gallon to each 200 square feet of pipe surface. Any cracks, checks, or other defects in the coating shall be recoated within 30 minutes. The coating shall remain undisturbed for a period of 72 hours.

c. Paragraph (c) of Section 19 is deleted.

d. The provisions of Section 22, pertaining to facilities for testing pipe, shall be superseded by the following:

Each manufacturer of the pipe shall provide a suitable apparatus for testing his products. Upon the request of the Owner and under his supervision the manufacturer shall perform such tests and in such manner as the Owner may deem necessary in order to establish the quality of the product as required by these specifications. No payment or allowance will be made to the manufacturer for such equipment, for expenses in testing, or for the pipe broken. The manufacturer shall furnish facilities for inspection during the manufacture.

e. Paragraph (d) of Section 23 shall be revised as follows: "Variations in laying lengths of two opposite sides of pipe shall not be more than 1/8 inch (3.2 mm) per foot of diameter, with a maximum of 1/2 inch (1.27 cm) in any length of pipe, except where beveled-end pipe for laying on curves is specified by the purchaser."

f. In Section 25, the line headed "(a)" shall be revised to read "(a) The pipe class, and type of wall."

g. The provisions of Article 28 of ASTM C 76 (for repairs) shall not apply.

3. The following are special requirements for pipe joints when round rubber gaskets are used.

   a. When round rubber gaskets are to be installed in the pipe joint the gasket shall be the sole element relied on to maintain a tight joint.

   b. The joint shall be of the bell-and-spigot type or the double spigot and sleeve type. The joint shall be so proportioned that the spigot, or spigots, shall readily enter the bell or sleeve of the pipe.

   c. The joint ring forms for forming the joint surface shall be of heavy steel, cast iron, or aluminum, and shall be accurately machined to the dimensions of the joint. They shall be a true circular form within a tolerance of 1/32 of an inch. Dimensional checks of joint ring form shall indicate for each size pipe a length of spigot, or tongue, not more than 1/8 inch shorter than the bell, or groove, depth. The pipe shall be so manufactured that joint surfaces are concentric with the inside of the pipe within a tolerance of 3/32 inch. The shape and dimensions of the joint shall be such as to provide compliance with the following requirements:

      1) The joint shall be so dimensioned that when the gasket to be used is placed on the spigot it will not be stretched more than 20 percent of its original length.

      2) The space provided for the gasket shall be a groove in the spigot end of the pipe and such space, when the joint is made, shall not be more than 110 percent of the volume of the gasket.

      3) The joint shall be so designed that when the outer surface of the spigot and the inner surface of the bell come into contact at some point on the periphery, the diametric deformation in the gasket at the point of contact shall not be greater than 50 percent of the normal gasket diameter, and the diametric deformation in the gasket at a point opposite the contact point shall not be less than 20 percent of the normal gasket diameter.

      4) When the pipes are joined there shall be parallel surfaces on both the bell and the spigot, extending from the edge of the gasket toward the bell face for a distance of not less than 3/4 inch. These parallel surfaces shall in no case be farther apart than 1/8 inch when the spigot is cen-

tered in the bell. The tapers on these surfaces shall not exceed three degrees.

5) The inside surface of the bell at the end of the bell shall be flared to facilitate joining the pipe sections without damaging or displacing the gasket.

d. The entire surfaces of near-contact of the jointed pipes shall be free from air holes, chipped or spalled concrete laitance, and other such defects.

e. Pipes showing minor manufacturing imperfections or handling injuries to the bell or spigot may be acceptable if such defects can be, and are, acceptably repaired as prescribed below.

f. Individual air holes (trapped air), or spalled areas with a length of up to one-half the pipe radius, or 12 inches whichever is smaller, may be repaired by careful use of a hand-placed, stiff, pre-shrunk, one-to-one mortar of cement and fine sand, and with no additional preparation other than a thorough washing with water of the defect. Curing shall be done either by moisture curing under wet burlap or by application of an approved membrane curing compound. Such repaired pipe which is sound, properly finished and cured, and which otherwise conforms to specification requirements will be considered acceptable.

4. Membrane curing compound shall conform to the requirements of AASHTO M 148 (Type 1 for clear compound and Type 2 for white-pigmented compound), and the following additional requirements.

a. The membrane curing compound shall be of a consistency suitable for spraying at temperatures prevalent at the time of construction operations, and which forms a continuous, uniform film. It shall be free from precipitated matter caused by conditions of storage or temperature. The compound shall be relatively nontoxic.

b. The curing compound shall be delivered to the job in the manufacturer's original container, labeled with the manufacturer's name, plant location, grade designation of compound, lot number and quantity, and no material will be acceptable unless all such requirements are complied with.

B. Elliptical Concrete Pipe

1. Elliptical concrete pipe shall conform with the requirements of ASTM C 507, except that the exceptions and modifications to ASTM C 76, as specified for round concrete pipe, shall apply also to elliptical pipe. Standard elliptical pipe shall meet the requirements of Table I for Class HE-III and special elliptical pipe shall meet the requirements of Table I for Class HE-IV.

2. Furnish pipe without lifting holes.

3. Use preformed flexible joint sealer conforming to Federal Specification SS-5-00210 (GSA-FSS).

C. Pipe Gaskets

1. Except where O-ring type gaskets are specified for special cases and for special type pipe, round rubber gaskets for use in concrete pipe joints shall meet the requirements of Article 5.9 of ASTM C 361, with the additional requirements that the gasket used shall be of such cross sectional area and perimeter as to properly fit the space provided in the pipe joint in which it is to be used.

2. Prior to use, the gasket shall be stored, in as cool a place as practicable.

3. For sealing elliptical concrete pipe joints, cold adhesive preformed plastic gaskets may be used.

   a. Cold adhesive preformed plastic gaskets shall be of a material, shape and size so as to effect a permanent water tight seal in joints of elliptical concrete pipe. A minimum of two pieces of gasket material shall be used in each joint.

   b. The gasket material shall be protected by a two-piece removable wrapper. To facilitate application, the two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half.

   c. The size of the gasket shall be in accordance with the manufacturer's recommendation for the particular joint in which it is to be used. However, the minimum size for each of the gaskets used in a joint shall be in accordance with the following:

Pipe Size (Inches)	Nominal Gasket Size (Inches)	Minimum Cross Section (Sq. Inches)
Up to 19 x 30	1 1/2	1.75
19 x 30 to 53 x 83	1 3/4	2.50
Over 53 x 83	2	3.25

The above minimum size requirements are based on a joint designed with a maximum taper of 10 degrees and an in-place annular space of approximately 1/4 inch.

4. The gasket sealing the joints shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler. The material shall contain no solvents and shall not produce irritating fumes or obnoxious odors. The gasket shall not depend on oxidizing, evaporation or chemical action for its adhesive or cohesive strength.

5. The chemical composition of the gasket material shall meet the following requirements:

	Min.	Max.
Bitumen (petroleum plastic content (% by weight)	50	70
Ash-Inert Mineral Matter (% by weight)	30	50
Volatile Matter (@ 325°F) (% by weight)		2.0 Max.

6. The gasket joint sealing compound when immersed for 30 days at ambient room temperature separately in 5% solution of caustic potash, a mixture of 5% hydrochloric acid, a 5% solution of sulfuric acid, and a saturated hydrogen sulfide solution shall show no visible deterioration.

7. The physical properties of the gasket joint sealing compound as shipped shall meet the following requirements:

	Min.	Max.
Specific Gravity @ 77°F	1.20	1.35
Ductility @ 77°F (cm)	5.0	
Softening Point @ 77°F	320°F Min.	
Penetration 77°F (150 gms) 5 sec.	50	120

The manufacturer of the gasket material shall furnish the Owner certified test results covering the shipment of material to the project.

D. Inspection Independent of Tests

1. The following imperfections in a pipe or special fitting will be considered injurious and cause for rejection without consideration of the test results hereinabove specified:

   a. Cracked Pipe: A single crack in the barrel of the pipe, extending through the entire thickness, regardless of the length of such crack; a single crack which extends through one-fifth of the barrel thickness and is over 3 inches long; any surface fire crack which is more than 1/32-inch wide at its widest point.

   b. Surface Imperfections: Surface imperfections such as lumps, blisters, pits, or flakes on the interior surface of a the pipe or fitting.

   c. Socket-Out-of-Round: When the bore or socket of the pipe varies from a true circle more then 3 percent of its nominal diameter.

   d. Broken Pipe: A joint of pipe with a piece broken from either the socket or spigot end.

   e. Foreign Matter Fused to the Pipe: Pipe joints that have tramp clays, grog, or other foreign matter fused permanently to the exterior surface of the pipe or fitting.

PART 3 - EXECUTION

A. Laying Storm Sewers

1. Keep trenches free of water during the laying operation. Lay all pipe without break, upgrade from structure to structure, with the bell ends of the pipe upgrade, to the line and grade given and in such a manner as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. Clean the interior of the sewer pipe of all dirt and superfluous materials of all description as the work progresses. Do not flush the new line into the downstream system.

2. Storm sewers shall be watertight.

B. Lamping

1. After the pipe has been installed and the compacted backfill placed, "lamp" the installed drainage pipe between

manholes, inlets or other structures in order to ascertain that they are clear and to correct alignment. The diameter of lamp image shall have no vertical reduction from that of the pipe inside vertical diameter and not more than 20 percent horizontal reduction. The Owner or his representative may observe the lamping.

END OF SECTION

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SECTION 02778 CONCRETE CURBS, GUTTERS, AND SIDEWALKS

PART 1 - GENERAL

A. Description

This section includes materials and installation of concrete curbs, gutters, and sidewalks.

B. Submittals

Submit six copies of a report from a testing laboratory verifying that crushed rock and aggregate material contains less than 1% asbestos by weight or volume and conforms to the specified gradations or characteristics.

C. Testing for Compaction

The Owner will test for compaction as described in Section 02200.

D. Standard Specifications

Wherever reference is made in this section to the State Specifications, such reference shall be understood to mean the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.

PART 2 - MATERIALS

A. Forms

1. Forms shall conform to the requirements of Section 03100. Provide stakes and bracing materials to hold forms securely in place.

2. Materials for sidewalk forms shall be 2-inch dressed lumber straight and free from defects, or standard metal forms. Where short-radius forms are required, 1-inch dressed lumber or plywood may be used. Provide stakes and bracing materials to hold forms securely in place.

B. Crushed Rock Base

Clean 3/4-inch and smaller crushed rock or crushed gravel, free from foreign material and containing less than 1%

asbestos by weight or volume, and conforming to Class 12 per Section 901 of the Florida State Specifications.

C. Expansion Joint Filler

Expansion joint filler shall be 1/2 inch thick for curbs and 1/4 inch thick for sidewalks and shall conform to premolded joint filler in Section 03250.

D. Concrete

Concrete shall be Class I per Section 345 in the Florida State Specifications.

E. Reinforcing Steel

Conform to Section 415 and 931 in the Florida State Specifications.

F. Curing Compound

Curing compound shall be as specified in Section 03345.

G. Excavation and Backfill

Conform to Section 02200.

PART 3 - EXECUTION

A. Preparation of Subgrade

Excavate and shape subgrade to line, grade, and cross-section. Compact subgrade until the top 12 inches are compacted to 90% relative compaction. Remove all soft material disclosed by compacting and replace with crushed rock base. The finished subgrade shall be within a tolerance of ±0.08 of a foot of the grade and cross-section shown and shall be smooth and free from irregularities at the specified relative compaction. The subgrade shall be considered to extend over the full width of the base course.

B. Placing Crushed Rock Base

After the subgrade for curbs, sidewalks, and roadway slabs is compacted and at the proper grade, spread crushed rock base material. Sprinkle with water and compact. Top of the compacted gravel shall be at the proper level to receive the concrete. Compact crushed rock base 4 inches or more of compacted crushed rock base material.

C. Setting Forms

1. Conform to Section 03100.

2. Forms on the face of the curb shall not have any horizontal joints within 7 inches of the top of the curb. Brace forms to prevent change of shape of movement in any direction resulting from the weight of the concrete during placement. Construct short-radius curved forms to exact radius. Tops of forms shall not depart from gradeline more than 1/8 inch when checked with a 10-foot straightedge. Alignment of straight sections shall not vary more than 1/8 inch in 10 feet.

D. Sidewalk Construction

Sidewalk construction shall be in accordance with Section 522 of the Florida State Specifications.

END OF SECTION

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SECTION 02810 SODDING

PART 1 - GENERAL

A. Description

Provide all materials, water, equipment, transportation, tools, and labor, to establish grass plus all items called for or that can be reasonably inferred from the drawings, including sodding, grading, fertilizing, watering, mowing, replacing and maintaining the area for a complete job. Sod all areas disturbed. Seed and mulch not allowed.

B. Applicable Publications

Portions of the publications listed below form a part of this specification only to the extent referenced.

1. Florida Department of Transportation, "Standard Specifications for Road and Bridge Construction" (Fla. DOT SPEC).

2. Turfgrass Producers Association of Florida, "Standards of Sod Quality."

C. Records

Submit written weekly records to the County of all grassed areas for use in determining the beginning and ending of the maintenance period for each area. The records shall indicate the date of grassing, fertilizing and mowing, the type (sod), quantity (sq. ft., sq. yds, or acres) and location of grassing.

D. Submittals

1. Submit Shop Drawings in accordance with the General Conditions, Section 01300 and the following. Submit certificates stating that the materials conform to the requirements of this specification as follows:

   a. Certificate from sod producer stating that sod meets the requirements for "Florida Standard Grade" as defined by the Turfgrass Producers Association of Florida, and set forth in paragraph "SOD" of this specification.

   b. Fertilizer manufacturer's certificate of analysis including Nitrogen, Phosphorus Potash and complete micro-nutrients in accordance with paragraph "Fertilizer" of this specification.

2. Submit a copy of the certificate(s) with each delivery.

PART 2 - PRODUCTS

A. Sod

1. Argentine Bahia with well matted roots. The sod shall be taken up in commercial-size rectangles, preferably 12-inch by 24-inch or larger, except where 6-inch strip sodding is called for.

2. The sod shall have no visible broadleaf weeds when viewed from a standing position and the turf shall be visibly consistent with no obvious patches of foreign grasses. In no case may the total amount of foreign grasses or weeds exceed 2% of the total canopy. Florida Standard Grade sod shall be neatly mowed and mature enough that when grasped at one end it can be picked up and handled without damage. The sod shall be sufficiently thick to secure a dense stand of live grass. The sod shall be live, fresh and uninjured, at the time of planting. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling.

B. Fertilizer

Commercial grade, controlled release, granular fertilizer consisting of blend of coated prilled urea with iron included in a slowly soluble form, free flowing and uniform in composition conforming to Florida DOT Specification 982-1, and bearing the manufacturer's guaranteed statement of analysis by weight of 12 parts nitrogen, 8 parts phosphoric acid and 8 parts potash, plus complete micronutrient including magnesium, sulfur, zinc, manganese, copper and boron.

C. Source Requirements for Sod and Mulch

Comply with all current restrictions for transporting sod and mulch material from or through quarantine areas for the white fringed beetle, witchweed, and West Indian sugar cane borer weevil, as issued by the Division of Plant Industry, Florida Department of Agriculture and the Animal and Plant Health Inspection Service, U.S. Department of Agriculture.

D. Water for Grassing

Water shall be free of acid, alkali, or organic materials and shall have a pH of 7.0 to 8.5. Provide all water needed for grassing. Provide permanent or temporary piping and valves, and temporary trucks to convey water from the source to the point of use. Provide any meters required and pay for

water used if the water is taken from a public water system. Water shall be free of petroleum products, pesticides and any other deleterious constituents.

PART 3 - EXECUTION

A. Coordination of Work

Coordinate all work activities to provide for establishment of grass cover at the earliest possible time in the construction schedule to minimize erosion of topsoil.

B. Construction Methods - General

1. Provide and establish grass in all areas designated on the drawings or that are disturbed during construction (except areas to be paved, landscaped or covered with structures).

2. Do not fertilize when wind velocities exceed 15 miles per hour. Sod only when the soil is in proper condition to induce growth.

3. When a length of roadway slopes or adjacent areas have been graded and made ready, commence grassing in accordance with these specifications. Incorporate grass covering into the project at the earliest practical time in the life of the contract to reduce potential erosion.

4. Store fertilizer in dry locations away from contaminants. Sprinkle sod with water and protect from exposure to wind and direct sunlight until planted. Provide covering that will allow air to circulate so that heating will not develop.

C. Construction Methods for Grassing

1. The location of grassing will be as called for in the drawings. If the type is not designated, match the type of grass in adjacent areas.

2. Sequence of Operations: The several operations involved in the work shall proceed in the following sequence:

   a. Preparation of the ground.

   b. Sodding.

   c. Watering and maintaining

D. Preparation of Area to be Grassed

1. Prepare the areas to be grassed by disc-harrowing and thoroughly pulverizing them to a depth of at least 6 inches.

2. Bring all areas to be grassed to finished grades, remove weeds, surplus dirt and rock debris over 1 inch in diameter, and rough grade the area.

3. Test the soil for pH. If the soil is below a pH level of 5.5, spread lime to raise the pH level to at least 5.5.

4. Uniformly apply fertilizer at the rate of 400 to 500 pounds per acre. Immediately after the fertilizer and/or lime are spread over the area, mix them into the soil to a depth of approximately 4 inches.

5. Float the area to a smooth uniform grade. Slope all areas to drain. Establish flow lines as shown on the drawings. Finish areas to be grassed approximately 1 inch below top of adjoining curb or pathway.

E. Sodding

1. Incorporate sodding into the project at the earliest practical time in the life of the contract. Do not use sod which has been cut for more than 3 days. Stack any sod which is not planted within 24 hours after cutting and maintain properly moistened.

2. Place the sod on a prepared surface, with abutting joints. Fill any gaps or cracks between sod blocks with sod. Roll with a minimum one-ton roller to obtain an even surface. Bring the sod edge in a neat, clean manner to the edge of all paving and shrub areas and project limits.

3. Where sodding is used in drainage ditches, stagger the setting of the pieces to avoid a continuous seam along the line of flow.

4. On areas where the sod may slide due to height and slope, peg the sod with pegs driven through the sod blocks into firm earth at suitable intervals. Replace any pieces of sod which, after placing, show an appearance of extreme dryness.

F. Mowing

1. Mow first when the grass reaches a height of 3 to 4 inches. Mow a second time when the grass reaches a

height of 6 inches and before a seedhead occurs. Subsequent mowings should establish a uniform grass surface of 2-1/2 inches and be made before seedhead occurs. All mowings should be made with a cut height as low as possible to stop shading of the Bahia grass.

2. Mow sod to establish a uniform grass surface of 2-1/2 inches.

3. Provide equipment for mowing that does not rut the soil surface. Fill any ruts that are in excess of two (2) inches deep with native soil free from twigs and rocks larger than 1 inch in diameter. Temporarily suspend mowing operations when the soil is too wet to provide adequate support and traction for equipment.

G. Watering

1. Maintain a balanced watering program until the acceptance of work.

2. Apply water in sufficient quantities and as often as seasonal conditions require keeping the grassed areas moist.

3. Provide supplemental water and irrigate seed areas when the rainfall is not adequate to maintain soil moisture necessary for germination and growth of the grass. It is Contractor's responsibility to determine the quantities of water required and when to irrigate. This obligation shall remain in full force and effect until final acceptance of the work by County and shall be provided at no additional cost to County.

4. County, at his discretion, may relieve Contractor of this obligation at such time as County is able to provide irrigation. This action, however, does not relieve Contractor of the provisions and guarantees set forth in the Contract Documents.

H. Maintenance

1. Maintain all grassed areas for a period of 90 days after the date of substantial completion and guarantee against all defects and faults of material and workmanship.

2. Maintain grass areas by watering, fertilizing, and mowing to establish an even and uniform grass surface of 2-1/2 inches, as specified above.

3. In the event that the grass exhibits iron chlorosis symptoms during the establishment period, apply liquid iron at manufacturer's recommended rates.

I. Guarantee

1. Guarantee all grasses areas to be alive and in satisfactory growth at the end of the maintenance period (90 days).

2. Replace any grass that is dead or not in satisfactory growth, as determined by the County or County's representative. Guarantee new sod or seed for an additional 90 days.

3. The term "Satisfactory Growth" as used in this section is defined as even plant growth in healthy conditions without bare spots larger than one square foot in seeded areas and without bare spots in sodded areas. Bare spots larger than one square foot in seeded areas shall be re-seeded and bare spots in sodded areas resodded. All grassed and sodded areas shall be maintained until satisfactory growth has been demonstrated. In the event that the subsequent stand of grass is found to be contaminated with weeds or other obnoxious or undesirable growth, effectively eliminate such undesirable growth, at the Contractor's expense.

4. Replace sod with the same variety as initially specified.

J. Inspection

1. Request inspection from the County and his representative at least 72 hours in advance of the time inspection is required.

2. Provide an authorized representative to be on-site during inspection.

END OF SECTION

SECTION 02834 STEEL CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

A. Description

This section includes materials and installation of galvanized steel chain link fence and gates, top and bottom tension wires, top rail and bottom tension wire, and anticlimb extension arms with barbed wire.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit manufacturer's descriptive literature and drawings of fence and gate installation.

3. Submit manufacturer's certificate or original shipping tags showing compliance with cited U.S. Federal and ASTM specifications.

PART 2 - MATERIALS

A. Galvanized Chain Link Fabric

1. Fabric height shall be 96 inches unless otherwise shown in the drawings.

2. ASTM A392, Class 1; or U.S. Federal Specification RR-F-191/1D, Type I; 1.2 ounces per square foot zinc coating, hot-dip galvanized after weaving, 2-inch diamond mesh, 11-gauge steel wire for height 60 inches or less, 9 gauge for height over 60 inches.

3. Top selvage knuckled, bottom selvage twisted and barbed.

4. Tie wire shall be same material and gauge as the chain link fabric.

B. Galvanized Posts and Braces

1. Steel Pipe: ASTM F1083. Galvanize 1.8 ounces per square foot.

2. Provide posts and braces in compliance with the over 6-foot classification of U.S. Federal Specification RR-F-191/3D, as follows:

   a. End, Corner, and Pull Posts: 2-1/2-inch steel pipe, 5.79 pounds per linear foot.

   b. Line Posts: 2-inch steel pipe, 3.65 pounds per linear foot.

   c. Gateposts for up to 6-Foot Leaf Width Gate: 2-1/2 inches, 5.79 pounds per linear foot.

   d. Gatepost for 6- to 13-Foot Leaf Width Gate: 3-1/2 inches, 9.1 pounds per linear foot.

3. Alternatively, provide steel pipe, posts, and braces as follows:

   Steel pipe shall conform to ASTM A1011 or A653, cold-formed, electric welded, minimum yield strength of 50,000 psi. Provide posts and braces with Type A galvanized coating in compliance with ASTM F1043 for heavy industrial fence, Group IA pipe or Group II rolled shapes as follows:

   a. End, Corner, and Pull Posts: 2.875-inch (outside diameter) steel pipe, 4.64 pounds per linear foot.

   b. Line Posts: 2.375-inch (outside diameter) steel pipe, 3.12 pounds per linear foot.

   c. Gateposts for up to 6-Foot Leaf Width Gate: 2.875 inches (outside diameter), 4.64 pounds per linear foot.

   d. Gatepost for 6- to 13-Foot Leaf width Gate: 4 inches (outside diameter), 6.56 pounds per linear foot.

4. Post Brace Assembly: At gateposts and end posts and at each side of corner and pull posts, place a horizontal compression brace to the next post at midheight of fabric. Truss the two posts together with a diagonal tension rod. Use 1-1/4-inch minimum pipe for the horizontal brace and 3/8-inch (nominal, 5/16-inch true) diameter adjustable diagonal truss rod.

5. Length of Posts into Footing: At line posts for fabric height of less than 72 inches, provide 24 inches. At line posts for fabric height of 72 inches and more,

provide 36 inches. At end, corner, and pull posts, provide 10 inches more than at line posts. At gateposts, provide 16 inches more than at line posts. In solid rock, the portion of the depth of footing that is in solid rock may be reduced to one-half of the above lengths.

C. Galvanized Hardware

Comply with U.S. Federal Specification RR-F-191/4D or ASTM F626 and the following:

1. Caps: Weathertight caps on exposed ends of tubular members.

2. Tension Wires: 7-gauge galvanized steel coil spring steel.

3. Tension or Stretcher Bars: One piece, 2 inches less than fabric height, 3/16 inch by 3/4 inch. Provide one bar for each gatepost and end post and two for each corner and pull post.

D. Galvanized Barbed Wire

1. Barbed Wire: ASTM A121, Class 3, two twisted 12-1/2-gauge steel wires, 0.80-ounce-per-square-foot zinc coating, 4-point round-shape barbs 5 inches apart.

2. Extension Arms: Post cap and anticlimb 45-degree galvanized steel single extension arm per ASTM F626 for three barbed wires. Top wire: 12 inches above fabric. Provide way for top rail.

E. Galvanized Gates

1. Provide gates in accordance with ASTM F900, except as modified.

2. Tubular Perimeter Members: Provide 2-inch pipe, 3.65 pounds per linear foot. Provide intermediate vertical member for width over 8 feet and intermediate horizontal member for width over 10 feet. Assemble frame by welding or with malleable or pressed steel corner fittings, riveted for rigid connection. Provide fabric and barbed wire as for fence. Use stretcher bars at vertical edges and optional at top and bottom edges. Diagonal cross bracing of 3/8-inch (nominal, 5/16-inch true) diameter adjustable truss rods. Form anticlimb extension by extending vertical members 12 inches above fabric.

Provide hinged gates to swing through 180 degrees from closed to open.

3. Gate Hardware:

   a. Hinges: Provide pressed or forged steel or malleable iron, nonlift-off type, offset for 180-degree opening, one and one-half pairs for each leaf over 6 feet high.

   b. Latch: Provide forked type or plunger-bar type for operation from either side, with padlock eye as integral part.

   c. Cane Bolt: Provide one 24-inch-long cane bolt at each leaf more than 4 feet 0 inches wide.

F. Concrete

Five, 94-pound sacks of portland cement per cubic yard. Do not use accelerating admixtures.

PART 3 - EXECUTION

A. Preparation for Installation

Clear the line of the fence and dispose of resulting material. Grade between post centers, excavate high spots, and fill low spots so bottom of fabric will be between 1 and 2 inches above finished grade.

B. Installation

Install in accordance with ASTM F567, except as modified herein.

C. Setting Posts

1. Space line posts uniformly at maximum intervals of 10 feet between gateposts and corner posts.

2. Excavate postholes so concrete will be 3 inches below and around metal posts, except that minimum diameter of concrete footing for end, corner, pull, and gateposts is 12 inches. In solid rock, diameters may be reduced to post outside diameter plus 3 inches.

3. Set posts plumb to within 1/4 inch of the post vertical centerline.

4. Fill postholes with concrete to 2 inches above finish grade and crown to slope away from post. In solid rock, emplace posts with a grout of one part portland cement to three parts sand, with sufficient water for workability.

D. Installing Fabric

1. Place fabric on security side of fence. Place tension bands on side opposite fabric side and peen bolt ends or score threads.

2. Tie fabric to line posts and clip tension bar to end, corner, pull, and gateposts at 15-inch intervals. Tie fabric to tension wires or weave tension wires through fabric at 24-inch intervals. Gauge of tie wire equal to gauge of fabric. Tie tension wires to line posts with 6-gauge wire. Twist tie wires two full turns and bend back edges to reduce hazard.

3. Join rolls of fabric by weaving a single strand into ends of the rolls to form a continuous mesh.

END OF SECTION

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DIVISION 3 – CONCRETE

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SECTION 03100 CONCRETE FORMWORK

PART 1 GENERAL

1.01 DESCRIPTION:

A. Design and furnish materials for formwork and shoring for cast-in-place concrete as indicated and in compliance with Contract Documents.

1.02 REFERENCES

A. American Concrete Institute (ACI):

1. 117/117R: Standard Tolerances for Concrete Construction and Materials.

2. 309.2R: Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces.

3. 318/318R: Building Code Requirements for Structural Concrete and Commentary.

4. 347: Guide to Formwork for Concrete.

B. Engineered Wood Association (APA)

C. National Institute of Product Standards and Technology

1. Voluntary Product Standard PS 1 Structural Plywood

1.03 DESIGN REQUIREMENTS

A. Design formwork in conformance with methodology of ACI 347R for anticipated loads, lateral pressures, depth of concrete placement and rate of concrete placement. Design shall consider any special requirements due to the use of self-consolidating, plasticized and/or retarded set concrete.

1.04 QUALIFICATIONS

A. Formwork Designer: Formwork and shoring design shall be by an engineer licensed in the State where the Project is located.

1.05 SUBMITTALS

A. Submit product data for form ties, spreaders, chamfer strips, form coatings, and bond breakers.

B. Submit shoring drawings, signed and sealed by a professional engineer registered in the state of Florida, to the Engineer for record.

1.06 QUALITY ASSURANCE

A. Design of Formwork:

1. Construction joints, openings, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features shall be provided.

2. Formwork shall be designed to be readily removable without impact, shock, or damage to 'green' concrete surfaces and adjacent materials.

3. The maximum panel deflection shall be 1/360 of the span between structural members.

B. Unless otherwise specified herein, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits as given in ACI 117.

C. Materials, fabrications and workmanship found defective shall be promptly removed and replaced and new acceptable work shall be provided in accordance with Contract requirements at no additional cost to the owner.

1.07 DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered to the site in an undamaged condition.

B. Material shall be stored and protected in a clean, properly drained location. Material shall be kept off the ground under a weather-tight covering permitting good air circulation. Formwork materials shall be stored on dry wood sleepers, pallets, platforms or other appropriate supports which have slope for positive drainage. Materials shall be protected from distortion, excessive stresses, corrosion and other

damage. Materials shall not be stored on the structure in a manner that might cause distortion or damage to the supporting structure.

PART 2 PRODUCTS

2.01 LUMBER

A. Lumber used in form construction shall be Southern Yellow Pine, No. 2, S4S, Standard Grade Rules Southern Pine Inspection Bureau. Boards shall be 6 inches or more in width.

2.02 PLYWOOD

A. Only grade-marked plywood conforming to APA shall be provided.

B. Plywood used in form construction shall be Grade B-B, Class 1 plyform, mill-oiled, and sanded on both sides in conformance with U.S. Product Standard PS 1 Structural Plywood.

C. Thickness shall be sized to maintain alignment and surface smoothness.

2.03 STEEL FORMS

A. Commercial grade sheets not less than 16 gage shall be provided.

B. Stock material that is free from warps, bends, kinks, cracks, and rust or other matter that could stain the concrete shall be provided.

2.04 FORM MATERIAL

A. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particleboard, or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.

B. Chamfer Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

2.05 FORM TIES

A. Locate form ties on exposed surfaces in a uniform pattern. Place form ties so they remain embedded in the concrete except for a removable portion at each end. Form ties shall have conical or spherical type inserts with a maximum diameter of 1 inch. Construct form ties so that no metal is within 1-1/2 inch of the concrete surface when the forms, inserts, and tie ends are removed. Ties shall withstand all pressures and maintain forms within acceptable deflection limits.

B. Wire ties are not permitted.

2.06 BOND BREAKER

A. Bond breaker shall be a V.O.C.-compliant nonstaining type that will provide a positive bond prevention.

B. Manufacturers:

1. Edoco Burke; Clean Lift 90 W.B.

2. Nox-Crete, Inc.; Silcoseal 97EC.

2.07 FORM CAULKING

A. Form caulking shall be a one-component, gun-grade silicone sealant that is capable of producing flush, watertight and non-absorbent surfaces and joints. Sealant shall be compatible with the type of forming material and concrete ingredients used.

B. Products:

1. Series 1200 Construction Caulking; GE Silicones, Waterford, NY.

2. Dow Corning 999-A; Dow Corning Co., Midland, MI.

2.08 CHAMFER STRIPS

A. Provide 3/4 inch by 3/4-inch chamfer strips milled from clear, straight-grain pine, surfaced each side, or extruded vinyl type with or without nailing flange unless otherwise shown on the Contract Documents.

2.09 INSERTS

A. Provide galvanized cast steel or galvanized welded steel inserts, complete with anchors to concrete and fittings such as bolts, wedges and straps.

2.10 FORM RELEASE AGENT

A. Form release agent shall not bond with, stain, or adversely affect concrete surfaces and shall not impair subsequent treatments of concrete surfaces when applied to forms. Form release agent shall be a ready-to-use water-based material formulated to reduce or eliminate surface imperfections and containing no mineral oil or organic solvents.

B. Manufacturers and Products:

1. BASF, Shakopee, MN; MBT, Rheofinish 211.

2. Cresset Chemical Company; Crete-Lease 20-VOC.

3. Unitex Chemicals; Farm Fresh.

4. Magic Kote: Symons Corporation, Des Plaines, IL

PART 3 EXECUTION

3.01 FORM TOLERANCES

A. Comply with the requirements of ACI 117 for tolerances for formed surfaces except as specified in Table -1.

Table 03100-1	
Vertical alignment (plumbness)	1/4-inch in any 10 feet and 1-inch maximum for entire length
Variation in the lines and surfaces of foundation mats, base slabs and walls	1/4-inch in any 10 feet and 1-inch max. for entire length
Variation from the level or from the grades indicated on the drawings	1/4-inch in any 10 feet
Variation of the linear building lines from established position in plan	1/2-inch in any 20 feet and 1-inch maximum for entire length

Table 03100-1	
Variation of distance between walls	1/4-inch in any 10 feet and 1-inch maximum for entire length and height
Variation in the sizes and locations of sleeves, floor openings and wall openings	Minus 1/4-inch Plus 1/2-inch
Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus 1/4-inch Plus 1/2-inch
Offset between adjacent panels of formwork facing material	1/2-inch (ACI 117 Class C finish).
Offset between adjacent panels of formwork facing material for exposed surfaces where appearance is of importance	1/8-inch (ACI 117 Class A finish).

B. Tolerances are not cumulative

C. Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.

D. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner.

3.02 PREPARATION

A. Clean form surfaces to be in contact with concrete or foreign material prior to installation. Tape, gasket, plug, and/or caulk joints, gaps, and apertures in forms so that the joint will remain watertight and withstand placing pressures without bulging outward or creating surface irregularities.

B. Coat form surfaces in contact with concrete with a form release agent prior to form installation.

C. Keep form coatings off steel reinforcement, items to be embedded, and previously placed concrete.

D. Steel Forms: Apply form release agent to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.

3.03 ERECTION AND INSTALLATION

A. Forms shall be constructed in accordance with ACI 347 to required dimensions, plumb, straight and mortar tight, and all joints and seams shall be made mortar-tight. Forms shall be substantial, properly braced, and tied together to maintain position and shape and to resist all pressures to which they may be subject. Unless otherwise indicated on the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits in ACI 117 and herein specified.

B. Provide means for holding adjacent edges and ends of form panels tight and in accurate alignment to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Forms shall be tight and shall prevent the loss of mortar and fines during placing and vibration of concrete.

C. Provide 3/4 inch chamfer on external corners of exposed concrete walls, beams, columns, equipment pads and exposed edges of construction joints. Do not chamfer columns flush with masonry walls.

D. Provide means for removing forms without injury to the surface of finished concrete.

E. Do not embed any form-tying device or part thereof other than metal in the concrete.

F. Use only form or form-tying methods that do not cause spalling of the concrete upon form stripping or tie removal.

G. Form surfaces of concrete members except where placement of the concrete against the ground is shown in the drawings or as indicated below. The dimensions of concrete members shown in the drawings apply to formed surfaces, except where otherwise indicated. Add 2 inches of concrete where concrete is placed against trimmed undisturbed ground in lieu of forms. Placement

of concrete against the ground shall be limited to footings and other nonexposed concrete and only where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing.

H. Openings shall be of sufficient size to permit final alignment of pipes or other items without deflection or offsets of any kind. Allow space for packing where items pass through the wall to ensure watertightness. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with additional reinforcement as shown in the typical structural details. Reinforcing shall be at least 2 inches clear from the opening surfaces and encased items.

I. Set anchor bolts and other embedded items accurately before placing concrete and hold securely in position until the concrete is placed and set. Check special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after placing concrete. Check nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to placing concrete.

3.04 PROTECTION

A. During installation, the forms shall not be used as a storage platform nor as a working platform until the forms have been permanently fastened in position.

3.05 PIPES AND WALL CASTINGS CAST IN CONCRETE

A. Install wall spools, wall flanges, and wall anchors before placing concrete. Do not weld, tie, or otherwise connect the wall castings or anchors to the reinforcing steel.

B. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will occur during construction.

C. Pipes or wall castings located below operating water level or where shown on Contract Drawings shall have water stop ring collars and shall be cast in place. Do

not block out such piping and grout after the concrete section is cast unless permitted, authorized or directed by the Engineer. Pipes fitted with thrust rings shall be cast in place.

3.06 REMOVAL OF FORMS

A. Forms shall be removed in accordance with ACI 347 recommendations without damage to concrete and in a manner to ensure complete safety to the structure. Forms, form ties, bracing, and shoring shall not be removed without specific permission of the Contractor's Registered Professional Engineer.

B. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed; during which the air surrounding the concrete is above 50 degrees F.

Table 03100-2	
Sides of footings and encasements	24 hours
Walls, vertical sides of beams, girders, columns, and similar members not supporting loads	48 hours
Shoring for slabs, beams, and girders	Until concrete strength reaches 70 percent of specified 28-day strength but not less than 7 days.

C. Removal times will be increased if the concrete temperature following placement is permitted to drop below 50 degrees F.

D. Do not remove supports and reshore.

3.07 ALUMINIUM SURFACES IN CONTACT WITH CONCRETE

A. Coat aluminum surfaces that will be in contact with concrete per Section 09900.

3.08 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 03200 CONCRETE REINFORCING

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide concrete reinforcement as indicated and in compliance with Contract Documents:

1. Section Includes:

a. Reinforcement bars.

b. Welded wire reinforcement.

c. Reinforcement accessories.

1.02 REFERENCES

A. American Society for Testing and Materials International International (ASTM):

1. A82: Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

2. A184: Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

3. A185/A185M: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

4. A496: Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.

5. A497: Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete Reinforcement.

6. A615: Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

7. A616: Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.

8. A617: Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.

9. A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

B. American Concrete Institute (ACI):

1. 301: Standard Specification for Structural Concrete.

2. 315: Details and Detailing of Concrete Reinforcement.

3. 318: Building Code Requirements for Structural Concrete.

4. 350: Building Code Requirements for Environmental Engineering Concrete Structures

5. SP-66: ACI Detailing Manual.

C. Concrete Reinforcing Steel Institute (CRSI):

1. Manual of Standard Practice.

2. Placing Reinforcing Bars.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.03 SUBMITTALS

A. Each submittal shall include reinforcement only for the individual structure to which it pertains.

B. Shop Drawings:

1. Submit bar lists and placing drawings for all reinforced concrete and masonry structures in accordance with Section 01300.

2. Detail reinforcement in conformance with ACI SP-66.

3. Clearly indicate bar sizes, spacings, locations and quantities of reinforcement steel, bending schedules, and supporting and spacing devices. Show joints, with applicable joint reinforcement.

4. Coordinate bar splicing and placement with Contractor's concrete placing schedule and joint locations. Do not add or delete joints without permission from the Engineer .

5. Show wall reinforcement in elevation.

6. Show slab reinforcement in plan view.

7. Show location and size of all penetrations greater than 12-inches in diameter or least dimension of the opening with the corresponding added reinforcement around the penetrations.

8. Clearly show marking for each reinforcement item.

9. Indicate locations of reinforcement bar cut-offs, splices and development lengths.

1.04 QUALITY ASSURANCE

A. Do not fabricate reinforcement until shop and placement drawings have been reviewed and accepted by the Engineer.

B. Perform concrete reinforcement work in accordance with CRSI Manual of Practice, ACI 301, ACI SP-66, and ACI 318/318M.

1.05 INSPECTION AND TESTING

A. In no case shall any reinforcement steel be covered with concrete until the installation of the reinforcement has been observed by the Engineer and the Engineer's authorization to proceed with the concreting has been obtained. The Engineer shall be given 48 hours minimum prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished observations of the reinforcement steel.

1.06 DELIVERY STORAGE AND HANDLING

A. Keep reinforcement steel free from mill scale, rust, dirt, grease or other foreign matter.

B. Ship and store reinforcement steel with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted placing drawings.

C. Store reinforcement steel off the ground, protected from moisture and kept free from dirt, oil or other injurious contaminants.

PART 2 PRODUCTS

2.01 REINFORCEMENT STEEL

A. Reinforcement Steel: ASTM A615/A615M, Grade 60 ksi yield grade; deformed billet steel bars.

B. Welded Wire Reinforcement:

1. Provide welded wire reinforcement conforming to ASTM A185.

2. Provide support bars and reinforcement bar supports as specified herein to obtain the concrete cover indicated.

3. Provide welded wire reinforcement heavier than W2.9xW2.9 in flat sheets with a minimum spacing of 6″x6″. Unless otherwise noted, welded wire reinforcement shall be 6x6-W2.9xW2.9.

2.02 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, and Spacers: sized and shaped for strength and support of reinforcement during concrete placement, including load bearing pad on bottom of base slabs and slabs on grade to prevent puncturing the vapor barrier, where vapor barrier is noted.

C. Special Chairs, Bolsters, Bar Supports, and Spacers Adjacent to Weather Exposed Concrete Surfaces: plastic coated steel.

D. Provide 3-inch by plain precast concrete blocks, precast concrete doweled blocks or concrete brick for support of bottom reinforcement in foundation mats, base slabs, footings and slabs on grade. Provide block thickness to produce concrete cover of reinforcement as indicated.

2.03 FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Standard Practice, ACI SP-66, ACI 318, ACI 318M, ASTM A184/A184M.

B. Cold bend bars. Do not straighten or rebend bars.

C. Do not heat reinforcement steel to bend or straighten.

D. Bend bars around a revolving collar having a diameter of not less than that recommended by the ACI 318.

PART 3 EXECUTION

3.01 INSTALLATION

A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Place reinforcement a minimum of 2 inches clear of any metal pipe or fittings.

B. Do not displace or damage vapor retarder.

C. Position dowels accurately. Rigidly support, align and securely tie dowels normal to the concrete surface before concrete placement. Setting dowels into wet concrete is prohibited.

D. Position wall dowels projecting from base slabs on grade with templates or guides held in place above the concrete placement line. Position the templates to obtain the required clearance between the dowels and the face of the walls.

E. Bars additional to those indicated that may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no additional cost to the Owner.

F. Do not extend continuous reinforcement or other fixed metal items through expansion joints. Provide 2 inches clearance from each face of expansion joint.

G. Provide additional reinforcement bars to support top reinforcement in slabs. Do not shift reinforcement bars from positions in upper layers to positions in lower layers as a substitute for additional support bars.

H. Support reinforcement steel in accordance with CRSI “Placing Reinforcement Bars” with maximum spacing of 4 feet-0 inches.

I. Tie reinforcement steel at intersections in accordance with CRSI “Placing Reinforcement Bars”:

1. Maximum tie spacing for footings, walls and columns: every third intersection or 3 feet-0 inches.

2. Maximum spacing for slabs and other work: every fourth intersection or 3 feet-0 inches.

3. Tie a minimum of 25 percent of all intersecting bars in foundation mats, base slabs, footings, slabs on grade and elevated slabs.

4. Secure all dowels in place before placing concrete.

5. Tie wires shall be bent away from the forms and from finished concrete surfaces in order to provide the required concrete coverage.

J. Locate reinforcement to avoid interference with items drilled in later, such as concrete anchors.

K. Provide and place safety caps on all exposed ends of vertical reinforcement that pose a danger to injury or life safety.

3.02 WELDED WIRE REINFORCEMENT

A. Extend welded wire reinforcement to within 2 inches of edges of slab or section. Lap sheets at least 12 inches or two wire spaces, whichever is greater, at ends and edges and wire tightly together. Stagger end laps.

B. Unless shown otherwise on Drawings, place welded wire reinforcement in slabs on grade between the upper third point and mid-point of slab. Placing welded wire reinforcement on the subgrade and pulling it up during concrete placement is not permitted.

C. Support welded wire reinforcement placed over the ground on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction.

D. Setting bars and welded wire reinforcement on layers of fresh concrete as the work progresses or adjusting reinforcement during the placement of concrete is prohibited.

3.03 CONCRETE COVER OVER REINFORCEMENT BARS

A. Maintain clear cover as noted on drawings. Tolerances shall be in accordance with ACI 117 and ACI 318 unless otherwise noted.

3.04 REINFORCEMENT AROUND OPENINGS AND PENETRATIONS

A. Accommodate placement of formed openings and penetrations.

B. Provide additional reinforcement steel on each side of opening or penetration as noted on Drawings.

C. Refer to details on Drawings for additional diagonal bars around openings or penetrations and bar extension length on each side of openings or penetrations.

D. Where welded wire reinforcement is used provide extra reinforcement using fabric or deformed bars around opening or penetration.

3.05 SPLICING OF REINFORCEMENT

A. Splices may be used to provide continuity due to bar length limitations. Minimum length of bars spliced for this reason is 20 feet.

B. Stagger bar splices.

C. Provide tension lap splices at all laps in compliance with ACI 318. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Use Class B splices at all other locations.

D. Reinforcement may be spliced at construction joints provided that entire lap is placed within only one concrete placement.

3.06 ACCESSORIES

A. Provide accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.

B. Use precast concrete blocks where the reinforcement steel is to be supported over soil.

C. Provide stainless steel bar supports or steel chairs with plastic tips where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity or liquid (including bottom of slabs over liquid containing areas) unless otherwise noted on contract documents.

D. Do not use metal chairs, ferrous clips, nails, etc. that extend to the surfaces of the concrete. Do not use stones, brick or wood block supports.

E. Do not use alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcement steel fastened to the bottom and top mats unless permitted by the Engineer.

3.07 FIELD QUALITY CONTROL

A. Remove reinforcement with kinks or bends not shown on shop or placement drawings. Remove such reinforcement

from job site and replace with new fabricated steel. Do not field bend reinforcement unless reinforcement is indicated or specified to be field bent.

B. Protect reinforcement from rusting, deforming, bending, kinking and other damage. Clean in-place reinforcement that has rusted, or been splattered with concrete using sand or water blasting prior to incorporation into the Work.

3.08 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 03250 CONCRETE JOINTS AND ACCESSORIES

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes materials, testing, and installation of concrete joints and accessories as specified and as shown on contract drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. C920: Specification for Elastomeric Joint Sealants

2. C1193: Guide for Use of Joint Sealants

3. D412: Standard Test Methods or Vulcanized Rubber and Thermoplastic Elastomers – Tension.

4. D570: Standard Test Method for Water Absorption of Plastics

5. D624: Standard Test method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.

6. D638: Standard Test Method for Tensile Properties of Plastics

7. D746: Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

8. D747: Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.

9. D792: Standard Test Methods for Density and Specific Gravity of Plastics by Displacement.

10. D994: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

11. D1171: Standard Test Method for Rubber Deterioration – Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

12. D1259: Standard Test Methods for Nonvolatile Content of Resin Solutions.

13. D1752: Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

14. D2240: Standard Test Method for Rubber Property – Durometer Hardness

B. Environmental Protection Agency (EPA):

1. 40 CFR 59: National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.

C. Corps of Engineers:

1. CRD-C 572: Specifications for Polyvinylchloride Waterstop.

D. Federal Specifications:

1. TT-S-00230C: Sealing Compound: Elastomeric Type, Single Component

1.03 SUBMITTALS

A. Submit following shop drawings in accordance with 01300.

1. Manufacturer's printed data and application instructions for specified materials and locations where materials are to be used.

2. Submit layouts for joints.

3. Certification that materials used within the joint system are compatible with each other.

1.04 QUALITY ASSURANCE

A. Do not add, relocate or omit joints without written permission from the Engineer.

B. Reject material exceeding expiration date for use.

1.05 DELIVERY, STORAGE AND HANDLING

A. Transport, handle and deliver materials to the job site in the manufacturer's sealed bags, unopened containers or banded pallets.

B. Store materials off the ground on a platform or skids and protect with covers from rain and ground splatter.

C. Store plastic products under cover in a dry location, out of direct sunlight.

1.06 MANUFACTURER'S SERVICES

A. Prior to joint preparation for joints receiving sealant materials, require joint manufacturer's technical representative to demonstrate, on site, joint preparation, priming, and sealant materials application for the Contractor's personnel performing joint work.

PART 2 PRODUCTS

2.01 ELASTOMERIC JOINT SEALANT

A. Federal Specification TT-S-00230C Type 1, Class A, single component, cold applied, pourable, polyurethane.

1. Products:

a. Euclid Chemical Corp; Eucolastic 1

b. Mameco ; Vulkem 45

c. Or accepted equivalent product.

2.02 JOINT SEALANT FOR CONCRETE STRUCTURES

A. Joint sealant shall be a multipart, gray, nonstaining, nonsagging, gun grade polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall comply with ASTM C920, Type M, Grade P, Class 25 for horizontal joints

and Grade NS, Class 25 for vertical joints. Troweling of sealants into joints will not be permitted. Sealant shall meet requirements in Table 03250-3.

TABLE 03250-3	
Characteristic or Parameter	Technical Requirements
Pot life	1 to 3 hours
Hardness	35 Shore A, +/- 5
Elongation	650 percent, ASTM D412
Tensile strength	200 psi, ASTM D412
Peel strength on concrete	No adhesion loss at 25 pounds
Temperature service range	40 to 167 degrees F

B. Products:

1. Tremco; Vulkem 227 or Vulkem 245 (for Type M, Grade P, Class 25)

2. Sika Corporation; Sikaflex-2CNS (for Grade NS, Class 25), Sikaflex-2CSL

3. Or accepted equivalent product.

2.03 EPOXY JOINT SEALANT:

A. 100 percent solids per ASTM D1259, two-part epoxy with an instantaneous Shore D hardness of 50 to 65 per ASTM D2240.

1. Metzger-McGuire Co.; MM80 or Edge Pro50

2. Euclid Chemical Corp. ; Euco700

3. Or accepted equivalent product.

2.04 BOND BREAKER TAPE

A. Provide an adhesive-backed glazed butyl or polyethylene tape that will adhere to the premolded joint material or concrete surface. The tape shall be the same width

as the joint. The tape shall be compatible with the sealant.

2.05 PREMOLDED JOINT FILLER FOR PAVEMENTS AND SLABS

A. Sponge Rubber per ASTM D1752, Type I. Preformed, nonextruded type constructed of closed-cell neoprene.

B. Bituminous-type preformed expansion joint filler conforming to ASTM D994.

PART 3 EXECUTION

3.01 JOINTS

A. Make joints only at locations shown on the contract drawings or as permitted by the Engineer. Any addition or relocation of construction joints proposed by the Contractor, must be submitted to the Engineer for written permission.

B. Cast slabs and beams monolithically without horizontal joints.

C. Do not use horizontal joints within foundation mats, base slabs, footings, slabs on grade or elevated beams and slabs.

D. Provide joints in concrete fills and toppings at the same location as the joints in the supporting concrete.

E. Construction Joints

1. Allow 48 hours between pours of adjacent slabs.

2. After the pour has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose concrete, foreign material, and expose clean aggregate by waterblasting the surface of construction joints before placing the new concrete.

3. In case of emergency, place additional construction joints. (An interval of 45 minutes between two consecutive batches of concrete shall

constitute cause for an emergency construction joint.)

F. Control Joints:

1. Locate control joints on slabs on grade as shown on Drawings. Unless otherwise noted, do not provide control joints in foundation mats, elevated structural slabs or tank bottom slabs.

2. Form control joints with sawcuts.

3. For sawcutting:

a. Using early entry saws, saw joints in slabs before the formation of uncontrolled cracking (i.e., cracking that occurs at locations other than construction, control, or contraction joints) and as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing.

b. Fill saw cut to full depth with elastomeric joint sealant for joints not exposed to vehicular traffic. Fill joints to full depth with epoxy joint sealant for joints exposed to vehicular traffic.

4. Unless noted otherwise on the Contract Drawings, total reduction in concrete member thickness shall be at least 1/4 the member thickness.

3.02 INSTALLATION OF JOINT SEALANTS

A. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.

B. Apply masking tape along the edges of the exposed surface of the exposed joints.

C. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.

D. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer.

E. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.

F. After the sealant has been applied, remove the masking tape and any sealant spillage.

3.03 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 03300 CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide cast-in-place concrete as indicated and in compliance with Contract Documents.

1.02 REFERENCES

A. American Concrete Institute (ACI):

1. 117: Specifications for Tolerances for Concrete Construction and Materials and Commentary.

2. 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

3. 214R: Recommended Practice for Evaluation of Strength Test Results of Concrete

4. 301: Standard Specifications for Structural Concrete

5. 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete

6. 304.2R: Placing Concrete by Pumping Methods

7. 305R: Hot Weather Concreting

8. 306R: Cold Weather Concreting

9. 308: Standard Practice for Curing Concrete

10. 309R: Guide for Consolidation of Concrete

11. 311.4R: Guide for Concrete Inspection

12. 318: Building Code Requirements for Structural Concrete

13. 350: Code Requirements For Environmental Engineering Concrete Structures

B. American Society for Testing and Materials 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. C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field

4. C33: Standard Specification for Concrete Aggregates

5. C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

6. C40: Standard Test Method for Organic Impurities in Fine Aggregates for Concrete

7. C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

8. C87: Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar

9. C88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

10. C94: Standard Specification for Ready-Mixed Concrete

11. C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or Cube Specimens)

12. C123: Standard Test Method for Lightweight Particles in Aggregate

13. C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

14. C138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

15. C143: Standard Test Method for Slump of Hydraulic Cement Concrete

16. C150: Standard Specification for Portland Cement

17. C157: Standard Test Method for Length Change of Hardened Hydraulic Cement, Mortar and Concrete

18. C171: Standard Specification for Sheet Materials for Curing Concrete

19. C172: Standard Practice for Sampling Freshly Mixed Concrete

20. C192: Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

21. C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

22. C260: Standard Specification for Air-Entraining Admixtures for Concrete

23. C289: Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)

24. C295: Standard Guide for Petrographic Examination of Aggregates for Concrete

25. C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

26. C311: Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete

27. C494: Standard Specification for Chemical Admixtures for Concrete

28. C595: Standard Specification for Blended Hydraulic Cements

29. C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

30. C881: Standard Test Method for Epoxy Resin Base Bonding Systems for Concrete

31. C882: Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear

32. C989: Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

33. C1017: Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

34. C1064: Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete

35. C1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

36. C1116: Standard Specification for Fiber Reinforced Concrete

37. C1240: Standard Specification for Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout

38. D75: Standard Practice for Sampling Aggregates

39. E154: Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

40. E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

41. E329: Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction

C. American Association of State Highway and Transportation Officials (AASHTO):

1. M182: Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

1.03 TOLERANCES

A. Conform to ACI 117.

B. Concrete slabs for buildings shall be within 3/16 inch of 10 ft straightedge in each direction except where slabs are dished for drains. Deviations from elevation indicated shall not exceed 3/4 in.

C. Pitch floor to floor drains minimum of 1/8 inch/ft or as shown on Drawings. Minimum thickness of slabs and depth of beams shall be as dimensioned on Drawings. Pitch bottom of slab or beam to match top slope of slab or beam to maintain thickness or depth noted. As an alternate, bottom of slab or beam may be poured level provided that minimum thickness or depth is maintained.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

B. Product Data:

1. Manufacturer's specifications and instructions including Material safety Data Sheets (MSDS) for admixtures and curing materials. Manufacturer’s certification of compatibility of all admixtures.

C. Proposed mix designs including complete details of product additives and certification that all additives are compatible with all other additives.

D. Submit prequalification test results to the Engineer for each Ready Mix Concrete Mix proposed, showing adequate performance for:

1. Compressive strength

2. The standard deviation for the concrete compressive strength tests shall be in conformance with ACI 214.3R 88(97) “Recommended Practice for Evaluation of Compression Test Results of Concrete.”

3. Air entrainment

E. Shop Drawings:

1. Provide certificate that cement used complies with ASTM C150 and these specifications.

2. Provide certificates that aggregates comply with ASTM C33. Submit gradation analysis with concrete mix designs.

3. Provide certificate of compliance with these specifications from the manufacturer of the concrete admixtures.

4. For each formulation of concrete proposed, provide concrete mix designs and laboratory 7-day and 28-day compressive tests, or submit test results of 7- and 28-day compressive tests of the mix where the same mix has been used on two previous projects in the past twelve months.

5. Proposed special procedures for protection of concrete under wet weather placement conditions.

6. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.

F. Manufacturers' Instructions

1. Provide epoxy bonding compound manufacturer's specific instructions for use. Provide manufacturer's data sheets as to suitability of product to meet job requirements with regard to surface, pot life, set time, vertical or horizontal application, and forming restrictions.

G. Field Quality Control Submittals

1. Provide delivery tickets for ready-mix concrete or weighmasters certificate per ASTM C94, including weights of cement and each size aggregate and amount of water added at the plant and record of pours. Record the amount of water added on the job on the delivery ticket. Water added at the plant shall account for moisture in both coarse and fine aggregate.

1.05 QUALITY ASSURANCE

A. Plant Certification: Plant or concrete supplier shall comply with requirements of National Ready Mixed Concrete Association (NRMCA) certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, nonagitating units, and ticketing system.

B. Testing of Ready Mix Concrete

1. Testing will be performed by an independent testing agency arranged by the Owner.

2. Testing of Ready Mix Concrete trucks on delivery will include:

a. Slump

b. Air content

c. Wet density

d. Concrete temperature

3. Samples will be cast for laboratory testing for:

a. Compressive strength

4. Samples may be taken for other testing as determined by the Engineer.

5. Copies of the results of all concrete testing carried out by the independent testing agency will be made available to the Engineer upon request.

6. The provision of the test results from the independent testing agency does not relieve the Contractor of the responsibility to furnish materials and construction in compliance with the performance requirements of the contract documents and to carry out their own testing program.

7. The Contractor shall take samples and carry out testing as part of their quality control procedures to verify that the concrete satisfies the performance requirements set out in these

specifications. Where possible, these tests shall be carried out on the same batches as tested by the independent testing agency.

8. Copies of the test results for all tests carried out by the Contractor must be made available to the Engineer for review and records.

C. Unless otherwise indicated, materials, workmanship, and practices shall conform to the following standards:

1. Local building codes.

2. ACI 301, "Structural Concrete for Buildings."

3. ACI 318, "Building Code Requirements for Reinforced Concrete."

4. ACI 350, "Code Requirements For Environmental Engineering Concrete Structures."

D. Where provisions of pertinent codes and standards conflict with this specification, the more stringent provisions govern.

E. Concrete not meeting the minimum specified 28-day design strength shall be cause for rejection and removal from the work.

F. Perform concrete work in conformance with ACI 301 unless otherwise specified.

G. Do not use admixtures, including calcium chloride, which will cause accelerated setting of cement in concrete.

H. Do not place concrete until design mix and material test results are accepted by the Engineer.

I. Employ an independent testing laboratory, acceptable to the Engineer, to develop concrete mix designs and testing. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent.

J. Methods of Sampling and Testing:

1. Fresh Concrete Sampling: ASTM C172

2. Specimen Preparation: ASTM C31

3. Compressive Strength: ASTM C39

4. Air Content: ASTM C231

5. Slump: ASTM C143

6. Temperature: ASTM C1064

7. Unit Weight: ASTM C138

8. Obtaining Drilled Cores: ASTM C42

K. Acceptance of Structure: Acceptance of completed concrete work requires conformance with dimensional tolerances, appearance and strength as indicated or specified.

L. Hot weather concrete to conform to ACI 305R and as specified herein.

M. Cold weather concrete to conform to ACI 306R and as specified herein.

N. Reject concrete delivered to job site that exceeds the time limit or temperature limitations specified.

O. Do not place concrete in water or on frozen or uncompacted ground.

P. Workability

1. Concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive vibrating and without permitting the materials to segregate or free water to collect on the surface.

2. Adjust the proportions to secure a plastic, cohesive mixture, and one that is within the specified slump range.

3. To avoid unnecessary changes in consistency, obtain the aggregate from a source with uniform

quality, moisture content, and grading. Handle materials to minimize variations in moisture content that would interfere with production of concrete of the established degree of uniformity and slump.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. Deliver concrete to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

B. Reject concrete not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket.

1.07 SITE CONDITIONS:

A. Do not place concrete until conditions and facilities for making and curing control test specimens are in compliance with ASTM C 31 and as specified herein.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement:

1. Portland Cement, ASTM C150, Type I or Type II.

2. Shall be one brand form one source. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.

3. Maximum tricalcium aluminate shall not exceed 8 percent. The maximum percent alkalies shall not exceed 0.6 percent.

B. Fly Ash:

1. Provide fly ash conforming to the following requirements:

a. Class F fly ash conforming to ASTM C 618 for chemical and physical properties.

b. Supplemental requirements in percent:

(1) Maximum carbon content: 3 percent

(2) Maximum sulfur trioxide (SO3) content: 4 percent

(3) Maximum loss on ignition: 3 percent

(4) Maximum water requirement (as a percent of control): 100 percent

(5) Fineness, maximum retained on No. 325 sieve: 25 percent

C. Fine Aggregates:

1. Clean, sharp, natural sand conforming to requirements of ASTM C33 with a fineness modulus between 2.50 and 3.0.

D. Coarse Aggregate:

1. Well graded crushed stone, natural rock conforming to requirements of ASTM C33.

E. Water and Ice:

1. Use water and ice free from injurious amounts of oil, acid, alkali, salt, organic matter or other deleterious substances and conforms to requirements of ASTM C94.

2. Water shall not contain more than 500 mg/L of chlorides nor more than 500 mg/L of sulfate.

3. Heat or cool water to obtain concrete temperatures specified, and in conformance with ACI 305R and ACI 306R.

F. Color Additive for Exterior Electrical Duct Encasement:

1. For exterior electrical duct concrete encasements, use a color additive for identification purposes.

G. Concrete Admixtures:

1. Maintain compressive strength and maximum water-cement ratios specified in Table 03300-1 when using admixtures. Include admixtures in solution form in the water-cement ratio calculations.

2. Do not use any admixture that contains chlorides or other corrosive elements in any concrete. Admixtures shall be nontoxic after 30 days.

3. Use admixtures in compliance with the manufacturer’s printed instructions. The manufacturer shall certify the compatibility of multiple admixtures used in the same mix.

4. Do not use admixtures in greater dosages than recommended by manufacturer.

5. Water Reducing:

a. Water-reducing admixture shall conform to ASTM C494, Type A. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.

b. Products:

(1) BASF Corporation; Polyheed Series

(2) Sika Corporation, Plastocrete 161

(3) WR Grace & Co.;Darex II-AEA

(4) Euclid Chemical Company; Eucon NW

6. Water Reducing and Retarding:

a. Water-reducing and retarding admixture shall conform to ASTM C494, Type D. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.

b. Products:

(1) BASF Corporation; Pozzolith Series

(2) Sika Corporation; Plastiment

(3) Euclid Chemical company; Eucon WR-91

7. High-Range Water-Reducing Admixture (Superplasticizer):

a. High-Range water-reducing admixture shall conform to ASTM C494, Type F or ASTM C1017, Type I.

b. Products:

(1) BASF Corporation; Glenium Series

(2) WR Grace & Co.; Daracem 100

(3) Euclid Chemical company; Eucon SPC

H. Fiber Reinforcement:

1. Concrete noted as fiber reinforced concrete on Drawings shall be fiber reinforced in accordance with the following:

a. Fiber reinforcing shall conform to ASTM C 1116, Type III.

b. Fibers shall be macro fibers. Micro fibers are prohibited.

c. Fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement.

d. Volume of fibers shall be a minimum of 1-1/2 pounds per cubic yard.

e. Fiber length: 1/2-inch to 3/4-inch.

I. Epoxy Bonding Agent:

1. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives. The class of epoxy bonding agent shall be suitable for ambient and substrate temperatures.

2. Products:

a. Sika Corp.; Sikadur 32

b. Euclid Chemical Company; Duralcrete

c. BASF Corporation, Concresive Liquid LPL

J. Vapor Retarder: 10 mil polyethylene sheet conforming to ASTM E1745.

K. Curing Compound:

1. Liquid form, which will form impervious membrane over, exposed surface of concrete when applied to fresh concrete by means of spray gun. Compound shall not inhibit future bond of floor covering or concrete floor treatment. Use Type I-D compound with red fugitive dye, Class B, having 18 percent minimum solids conforming to ASTM C309.

2. Products:

a. BASF Construction Chemicals: Kure-N-Seal

b. Euclid Chemical Company: Rez-Seal

L. Burlap Mats:

1. Conform to AASHTO M182.

M. Sisal-Kraft Paper and Polyethylene Sheets for Curing:

1. Conform to ASTM C171.

2.02 MIXES

A. Conform to ASTM C94, except as modified by these specifications.

B. Air content as determined by ASTM C231: 2 +/- 1 percent

C. Provide concrete with the following compressive strengths at 28 days and proportion it for strength and quality requirements in accordance with ACI 318. The resulting mix shall not conflict with limiting values specified in Table 03300-1.

Table 03300-1

Class	Type of Work	28-Day Minimum Compressive Strength (psi)	Minimum Cementitous Content (lbs per C.Y.)	Maximum Water/ Cement Ratio
A	Concrete for all structures and concrete not otherwise specified.	4,000	560	0.44
B	Pavement, concrete topping, pipe encasement	3,000	500	0.54
C	Miscellaneous unreinforced concrete, mud slab	2,000	376	0.60
E	Precast concrete	5,000	630	0.40

D. Measure slump in accordance with ASTM C143:

1. Proportion and produce the concrete to have a maximum slump of 4±1 inches.

2. Mixes containing water reducers shall have a maximum slump of 6 inches after the addition of a mid-range water reducer and maximum slump of 8 inches after the addition of a high range water reducer.

E. Pozzolan Content:

1. Water to cementitious ratio shall not exceed water to cement ratio given on table.

2. Fly Ash: Use of is optional. Combine fly ash with cement at rate of 1.0 lb fly ash/lb reduction of cement. Fly ash shall not be less than 15 percent

nor more than 20 percent of the total cementitous content given in table.

F. Aggregate Size:

1. Aggregate size shall be 3/4-inch maximum for slabs and sections 8 inches thick and less. Aggregate size shall be 1 inch maximum for sections greater than 8 inches and less than 17 inches. Aggregate size shall be 1-1/2 inches maximum for all thicker slabs and sections. Aggregate size for floor topping shall be maximum 3/8-inch.

2. Combined aggregate grading shall be as shown in the following table:

Table 03300-2				
Maximum Aggregate Size	1-1/2 inch	1 inch	3/4-inch	3/8-inch
Aggregate Grade per ASTM C33	467	57	67	8

PART 3 EXECUTION

3.01 SUBGRADE INSPECTION:

A. Examine the subgrade and the conditions under which work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions are corrected to comply with specified subgrade conditions in a manner acceptable to the Engineer.

3.02 MIXING AND TRANSPORTING CONCRETE:

A. General: Conform to concreting procedures set forth in ASTM C94, ACI 304R and as specified herein.

B. Transport concrete to discharge locations without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

C. Discharge concrete into forms within 1-1/2 hours after cement has entered mixing drum or before the drum has revolved 300 revolutions after the addition of water, whichever occurs first.

D. Do not add water at the jobsite.

E. Keep a record showing time and place of each pour of concrete, together with transit-mix delivery slips certifying the contents of the pour.

F. Discharge of concrete shall be completed within the limits set out in Table 03300-3.

Table 03300-3	
Maximum Time to Concrete Discharge	
Concrete Temperature	Limit
Over 90 Degree F	Remove concrete from jobsite and discard concrete
86 to 90 Degree F	45 minutes
81 to 85 Degree F	60 minutes
70 to 80 Degree F	75 minutes
Below 70 Degree F	90 minutes

3.03 CONCRETE ACCEPTANCE

A. Accept or reject each batch of concrete delivered to the point of agitator or mixer truck discharge. Sign delivery batch tickets to indicate concrete acceptance.

B. Reject concrete delivered without a complete concrete delivery batch ticket as specified herein. The concrete supplier will furnish copies of the signed batch ticket to the Contractor and Engineer.

C. The testing agency shall perform field tests at the point of agitator or mixer truck discharge. Accept or reject concrete on the basis of conformity with slump, air content and temperature specified. Slump and air content of pumped concrete will be tested at pipe discharge.

D. The testing agency shall inspect concrete transit truck's barrel revolution counter and gauge for measuring water added to the concrete. Reject concrete that exceeds the maximum barrel revolution of 300, the

limits in Table 03300-3 or concrete that has water content exceeding the specified water-cement ratio.

E. Reject concrete not conforming to specification before discharging into the forms.

3.04 PREPARATION AND COORDINATION

A. Contractor shall notify the Engineer of readiness to place concrete in any portion of the work a minimum of 5 working days prior to concrete placement. Failure to provide this notification could be cause for delay in placing concrete.

B. Reinforcement, positioning of embedded items, and condition of formwork will be observed by the Engineer prior to concrete placement.

C. Coordinate the sequence of placement such that construction joints will occur only as designed.

D. Schedule sufficient equipment for continuous concrete placing. Provide for backup equipment and procedures to be taken in case of an interruption in placing. Provide backup concrete vibrators at the project site. Test concrete vibrators the day before placing concrete.

E. Compact the subgrade and/or bedding. Saturate the subgrade approximately eight hours before placement and sprinkle ahead of the placement of concrete in areas where vapor retarder is not used. Remove standing water, mud, and foreign matter before concrete is deposited.

F. Where shown on contract drawings, intentionally roughen surfaces of set concrete in a manner to expose bonded aggregate uniformly at joints.

G. When shown on contract drawings, install a granular base beneath slabs on ground. Place granular material on a compacted subgrade and compact granular base.

H. Place vapor retarder under slabs on grade and where shown on contract drawings. Install material with 6 inch lap at joints and seal joints with tape as recommended by the vapor retarder manufacturer. Tape material cut for slab penetrations to the pipe, conduit

or other items passing through the slab. Use tape recommended by the vapor retarder manufacturer.

I. Install vapor retarder without punctures or tears and protect against punctures and breaks.

J. Where concrete is required to be placed and bonded to existing concrete, coat the contact surfaces with epoxy bonding agent. The method of preparation and application of the bonding agent shall conform to the manufacturer's recommendations.

3.05 CONCRETE PLACEMENT

A. Placement shall conform to ACI 304R as modified by these specifications.

B. Alternate sections of concrete walls and slabs may be cast simultaneously. Do not place adjacent sections of walls until seven days after placement of first placed concrete.

C. Do not place concrete until free water has been removed or has been diverted by pipes or other means and carried out of the forms, clear of the work. Do not deposit concrete underwater, and do not allow free water to rise on any concrete until the concrete has attained its initial set. Do not permit free or storm water to flow over surfaces of concrete so as to injure the quality or surface finish.

D. Do not place concrete during inclement weather. Protect concrete placed from inclement weather. Keep sufficient protective covering ready at all times for this purpose.

E. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing. Do not deposit concrete in large quantities in one place to be worked along the forms with a vibrator.

F. Deposit concrete continuously and in level layers. Place in lifts not exceeding 24 inches. Avoid inclined layers and cold joints. Place concrete at lower portion of slope first on sloping surfaces.

G. Do not deposit partially hardened concrete in forms. Retempering of partially hardened concrete is not permitted. Remove partially hardened concrete from site at no additional compensation.

H. Do not allow concrete to fall freely in forms to cause segregation (separation of coarse aggregate from mortar). Limit maximum free fall of concrete to 4 feet. Do not move concrete horizontally more than four feet from point of discharge. Space points of deposit not more than eight feet apart.

I. At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams or slabs supported thereon. Place beams monolithically as part of the floor or roof system, unless otherwise shown on contract drawings.

J. Consolidate concrete using mechanical vibrators operated within the mass of concrete and/or on the forms conforming to procedures set forth in ACI 309R and as specified herein.

K. Conduct vibration to produce concrete of uniform texture and appearance, free of honeycombing, streaking, cold joints or visible lift lines.

L. Conduct vibration in a systematic manner with regularly maintained vibrators. Furnish sufficient backup units at job site. Use vibrators having minimum frequency of 8,000 vibrations per minute and of sufficient amplitude to consolidate concrete.

M. Insert and withdraw vibrator vertically at a uniform spacing over the entire area of placement. Space distances between insertions such that spheres of influence of each insertion overlap.

N. Use additional vibration with pencil vibrators on vertical surfaces and on exposed concrete to bring full surface of mortar against the forms so as to eliminate air voids, bug holes and other surface defects. Employ the following additional procedures for vibrating concrete as necessary to maintain proper consolidation of concrete:

1. Reduce distance between internal vibration insertions and increase time for each insertion.

2. Insert vibrator as close to face of form as possible without contacting form or reinforcement.

3. Use spading as a supplement to vibration where particularly difficult conditions exist.

O. Pumping Concrete:

1. Conform to the recommendations of ACI 304.2R except as modified herein.

2. Base pump size on rate of concrete placement, length of delivery pipe or hose, aggregate size, mix proportions, vertical lift, and slump of concrete.

3. Use pipe with inside diameter of at least three times the maximum coarse aggregate size, but not less than 2 inches.

4. Do not use aluminum pipes for delivery of concrete to the forms.

3.06 CURING AND PROTECTION

A. General:

1. Protect concrete from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain concrete with minimal moisture loss at relatively constant temperature.

2. Comply with curing procedures set forth in ACI 301, ACI 308 and as specified herein.

3. Perform hot weather concreting in conformance with ACI 305R and as specified herein when the ambient atmospheric temperature is 80 degrees F or above.

4. Perform cold weather concreting in conformance with ACI 306R.

5. Concrete required to be moist cured shall remain moist for the entire duration of the cure. Repeated wetting and drying cycles of the curing process will not be allowed.

B. Curing Duration:

1. Start initial curing after placing and finishing concrete as soon as free moisture has disappeared from unformed concrete surfaces. Initial curing starts as soon as concrete achieves final set. Forms left tightly in place are considered as part of the curing system, provided that wooden forms are kept continuously moist. Keep continuously moist for not less than 72 hours.

2. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures for a total curing period, initial plus final, of at least 10 days.

3. Avoid rapid drying at the end of the final curing period.

C. Curing Requirements:

1. Unformed Surfaces: Cover and cure entire surface of newly placed concrete immediately after completing finishing operations and water film has evaporated from surface or as soon as marring of concrete will not occur. Protect finished slabs from direct rays of the sun to prevent checking, crazing and plastic shrinkage.

2. Formed Surfaces: Minimize moisture loss for formed surfaces exposed to heating by the sun by keeping forms wet until safely removed. Keep surface continuously wet by warm water spray or warm water saturated fabric immediately following form removal.

3. Below grade structures: Moist cure by the application of water to maintain the surface in a continually wet condition.

4. Other concrete: Moist cure by moisture-retaining cover curing, or by the use of curing compound.

D. Curing Methods:

1. Water Curing: Use water curing for unformed surfaces. Continuously water cure all exposed concrete for the entire curing period. Provide moisture curing by any of the following methods:

a. Keeping the surface of the concrete continuously wet by ponding or immersion.

b. Continuous water-fog spray or sprinkling.

c. Covering the concrete surface with curing mats, thoroughly saturating the mats with water, and keeping the mats continuously wet with sprinklers or porous hoses. Place curing mats so as to provide coverage of the concrete surfaces and edges, with a 4 inch lap over adjacent mats. Weight down the curing cover to maintain contact with the concrete surface.

2. Sealing Materials:

a. Use common sealing materials such as plastic film or waterproofing (kraft) paper.

b. Lap adjacent sheets a minimum of 12 inches. Seal edges with waterproof tape or adhesive. Use sheets of sufficient length to cover sides of concrete member.

c. Place sheet materials only on moist concrete surfaces. Wet concrete surface with fine water spray if the surface appears dry before placing sheet material.

d. The presence of moisture on concrete surfaces at all times during the prescribed curing period is proof of acceptable curing using sheet material.

3. Membrane Curing Compound:

a. Apply membrane-curing compound uniformly over concrete surface by means of roller or spray at a rate recommended by the curing compound manufacturer, but not less than 1 gallon per 150 sq. ft. of surface area. Agitate curing material in supply container immediately before transfer to distributor and thoroughly agitate it during application for uniform consistency and dispersion of pigment.

b. Do not use curing compounds on construction joints or on surfaces to receive dustproofer/sealer, concrete paint, concrete fills and toppings or other applications requiring positive bond.

c. Reapply membrane-curing compound to concrete surfaces that have been subjected to wetting within 3 hours after curing compound has been applied by method for initial application.

E. Protection from environmental conditions: Maintain the concrete temperature above 50 degrees F continuously throughout the curing period. Make arrangements before concrete placing for heating, covering, insulation or housing to maintain the specified temperature and moisture conditions continuously for the curing period.

1. When the atmospheric temperature is 80 degrees F and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering.

2. Protect the concrete continuously for the entire curing period.

3. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes.

4. Avoid temperature changes in concrete that exceed 5 degrees F in any one hour and 50 degrees F in any 24-hour period.

F. Protection from physical injury: Protect concrete from physical disturbances such as shock and vibration during curing period. Protect finished concrete surfaces from damage by construction equipment, materials, curing procedures and rain or running water. Do not load concrete in such a manner as to overstress concrete.

3.07 FIELD QUALITY CONTROL:

A. Hot Weather Requirements

1. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305R and the following.

2. When the weather is such that the temperature of the concrete as placed would exceed 90 degrees F, use ice or other means of cooling the concrete during mixing and transportation so that the temperature of the concrete as placed will not exceed 90 degrees F .

3. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.

4. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

B. Cold Weather Requirements

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306R and the following.

2. When the temperature of the surrounding atmosphere is 40 degrees F or is likely to fall below this

temperature, use heated mixing water not to exceed 140 degrees F. Do not allow the heated water to come in contact with the cement before the cement is added to the batch.

3. When placed in the forms during cold weather, maintain concrete temperature at not less than 55 degrees F. Materials shall be free from ice and frozen lumps before entering the mixer.

4. Maintain the air and the forms in contact with the concrete at temperatures above 40 degrees F for the first five days after placing, and above 35 degrees F for the remainder of the curing period. Provide thermometers to indicate the ambient temperature and the temperature 2 inches inside the concrete surface.

5. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

C. Backfill Against Walls

1. 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.

D. Concrete Testing

1. Concrete quality testing shall be performed on the concrete by independent testing agency retained by the Owner.

2. The testing agency will use concrete samples provided by the Owner to perform slump (per ASTM C143), air content (per ASTM C231), and temperature tests (per ASTM C1064) and for field control test specimens.

3. The testing agency will submit test reports of concrete field measurements specified above to the Owner and to the Engineer.

4. Provide and maintain facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C31.

5. Concrete Quality Test Specimen:

   a. Perform sampling and curing of test specimen in accordance with ASTM C31.

   b. Testing agency personnel will record truck and load number from the delivery batch ticket, the concrete placement location of each specimen, the date, concrete strength, slump, air content and temperature.

   c. The testing agency will cast a minimum of one set of 8 test specimens, each 4 inch diameter by 8 inch long cylinders, for each 50 cubic yard of each mix design of concrete but not less than once a day.

   d. Test cylinders in accordance with ASTM C39. Test two cylinder at 7 days for information; test three cylinders at 28 days for acceptance; and hold three reserve cylinders for verification. Strength acceptance will be based on the average of the strengths of the three cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use a reserve cylinder for the test result.

6. The Contractor may take field control test specimens for small quantities of concrete.

7. Concrete acceptance shall be based on the requirements of ACI 318 and ACI 350.

8. Field cured cylinders conforming to ASTM C31 will be required to determine field compressive strength of concrete. Laboratory cured cylinders for concrete quality testing shall not be used for determining field compressive strength.

9. Concrete Coring:

a. When the concrete quality test specimen compression tests fail to be in compliance with the Contract Documents or when the Engineer detects deficiencies in the concrete, the Contractor will take concrete cores at least 2 inches in diameter from the structure in conformance with ASTM C 42 at locations determined by the Engineer.

b. Obtain at least three representative cores from each member or area of concrete that is considered potentially deficient.

c. Obtain additional cores to replace cores that show evidence of having been damaged subsequent to or during removal from the structure.

d. The testing agency shall compression test the cores taken from the structure in conformance with ASTM C39 and submit test strength test results of cores specified above to the Contractor and to the Engineer.

e. All costs associated with coring and testing of cores will be borne by the Contractor at no additional cost to the Owner.

3.08 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 03350 CONCRETE FINISHES AND FLOOR TREATMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes materials and methods of concrete finishes for cast in place concrete and floor treatment.

1.02 REFERENCES

A. American Concrete Institute (ACI):

1. 301: Specifications for Structural Concrete.

2. 302.1R: Construction of Concrete Floors.

3. 303R: Architectural Cast-in-Place Concrete.

4. 303.1: Architectural Cast-in-Place Concrete.

5. 311.4R: Guide for Concrete Inspection.

B. American Society for Testing and Materials International (ASTM):

1. D4263: Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

1.03 SUBMITTALS

A. Submit following shop drawings in accordance with 01300.

B. Submit manufacturer's product data and surface preparation and application instructions.

C. Submit VOC content information for floor treatment products.

D. Qualifications:

1. Submit statement of qualifications, experience, and training of concrete finishing personnel.

1.04 QUALITY ASSURANCE

A. Prior to concrete construction, develop an outlined quality control program for concrete finishing.

B. For concrete that will receive additional applied floor finishes, ensure that concrete surface finish and preparation is compatible with the accepted floor finish manufacturer's products. Provide documentation from the floor product manufacturer that specifies the concrete finish and preparation required for proper installation of the floor products.

C. Make changes in concrete finishes and preparation necessary to accommodate flooring products different from those specified at no additional cost to the Owner. Submit the proposed new finishes and their construction methods to the Engineer.

PART 2 PRODUCTS

2.01 FLOOR SEALERS

A. Shall be acrylic polymer curing and sealing compound meeting requirements of ASTM C309.

B. Products:

1. BASF Construction Chemicals: Kure-N-Seal

2. Euclid Chemical Company: Rez-Seal

2.02 FLOOR SEALERS AND DENSIFIERS

A. Shall contain silicate and siliconate and be VOC compliant.

B. Products:

1. Dayton Superior: Sure Hard Densifier J17

2. Euclid Chemical Company: Euco Diamond Hard

3. BASF Construction Chemicals: Kure-and-Harden

PART 3 EXECUTION

3.01 CONCRETE FINISHES

A. Do not use curing compound where epoxy, urethane, mortar bed, grout, additional concrete or other toppings or adhesive will be applied.

B. Do not sprinkle with dry cement or add water when finishing concrete surfaces.

C. Finish concrete surfaces in accordance with the following schedule:

Table 03350-1	
Finish Designation	Area Applied
F-1	Beams, columns, and exterior walls not exposed to view.
F-2	Underside of slab and integral beams exposed to view.
F-3	Columns and vertical surfaces exposed to view
F-4	Not applicable
S-1	Slabs and floors to be covered with concrete or grout.
S-2	Slabs and floors exposed to view.
S-3	Not applicable
S-4	Exterior Exposed Slabs

1. Finish F-1: Repair defective concrete, fill depressions deeper than 1/2-inch and fill tie holes.

2. Finish F-2: Repair defective concrete, remove fins, fill depressions 1/4-inch or deeper and fill tie holes. Grind smotth all joint marks.

3. Finish F-3: In addition to Finish F-2, fill depressions and airholes with mortar. Dampen surfaces and then spread a slurry consisting of one part cement and one and one-half parts sand by damp loose volume, over the surface with clean

burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.

4. Finish F-4: Repair defective concrete, remove fins, fill depressions 1/16-inch or deeper, fill tie holes, remove mortar spatter, and remove bulges higher than 1/16-inch.

5. Finish S-1: Screed to grade without special finish unless otherwise shown on contract documents. Roughen and/or apply bonding agent where shown on contract drawings.

6. Finish S-2: Smooth steel trowel finish.

7. Finish S-3: Steel trowel finish free from trowel marks and all irregularities.

8. Finish S-4: Float and light broom finish.. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.

D. Protect finished concrete surfaces from damage by construction equipment, materials, curing procedures and rain or running water.

3.02 FINISHING OF FORMED SURFACES

A. Cure surfaces until finishing and repairing are completed.

B. Perform finish work in accordance with the schedule in Table 03350-1 as soon as possible after forms are removed.

C. Conform to the requirements specified in Section 03100 for tolerances for formed surfaces.

3.03 FINISHING OF UNFORMED SURFACES

A. Perform finish work in accordance with the schedule in Table 03350-1.

3.04 FLOOR TREATMENT APPLICATION

A. Prepare concrete surface in accordance with manufacturer's printed instructions.

B. Perform concrete moisture testing in accordance with product manufacturer's requirements.

C. Apply floor treatment in accordance with product manufacturer's written instructions.

D. Provide mock ups for Nonslip aggregate floor finish and Dry Shake Hardener floor finish. Minimum size of mock up sample shall be 2 feet x 2 feet.

E. Colors for colored floor treatment shall be as selected by Owner.

F. Floor Treatment Schedule:

Table 03350-2	
Floor Treatment	Area Applied
Sealer	Exterior slab, Interior non-traffic areas.
Sealer/Densifier	Interior slab subject to traffic.
Polyurethane Coating with Aggregate Per Contract Drawings	Truck pit and elevated slab.

3.05 CONCRETE REPAIR

A. Surface Defects:

1. Do not repair defects until concrete has been inspected by the Engineer. Repair of concrete surfaces shall be in accordance with Section 03730.

2. Repair defects including, air voids and bug holes with a nominal diameter or depth greater than 1/4-inch, honeycombed areas, visible construction joints, fins, burrs, color and texture variations and other defects as determined by the Engineer. Make concrete repairs with a polymer modified cementitous repair mortar in accordance with Section 03730 to produce a concrete surface

uniform in color and texture and free of all irregularities.

B. Crack Repair

1. Shall be in accordance with Section 03730.

C. Tie-hole Repair

1. Shall be in accordance with Section 03100.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 03461 PRECAST CIRCULAR CONCRETE MANHOLES

PART 1 - GENERAL

A. DESCRIPTION

This section includes design, materials, testing, and installation of precast circular concrete manholes.

B. SUBMITTALS

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit manufacturer's catalog data on precast concrete manholes, frames, and covers. Show dimensions and materials of construction by ASTM reference and grade. Show lettering on manhole covers.

PART 2 - MATERIALS

A. PRECAST CIRCULAR CONCRETE MANHOLES

1. Precast circular concrete manholes shall comply with ASTM C478, except that the wall thickness shall be 5 inches minimum. Precast circular manholes are to be compliant with the Orange County Utilities Standards and Construction Specifications Manual. Minimum manhole diameter shall be 48 inches. Design manholes for the depths shown in the drawings, assuming a soil density of 110 pounds per cubic foot.

2. Minimum allowable steel shall be hoops of No. 4 wire cast into each unit.

3. Precast top sections shall be eccentric cone, except in specific instances where approved by the Resident Project Representative (RPR) for utility conflict resolution.

4. Design joints using a butyl rubber sealant per ASTM C990.

5. Precast circular concrete manholes shall be batched with concrete dyed crystalline waterproofing admixture with corrosion protection. Reference the Orange County Utilities Standards and Construction Specifications Manual’s Approved Product List included in Attachment A.

B. MANHOLE FRAMES AND COVERS

1. Manhole frames and covers shall be made of cast iron conforming to ASTM A48, Class 30. Castings shall be smooth, clean, and free from blisters, blowholes, and shrinkage. Frames and covers shall be designed for H20-44 traffic loads. The cover shall seat firmly into the frame without rocking.

2. Grind or otherwise finish each cover so that it will fit in its frame without rocking. Frames and covers shall be matchmarked in sets before shipping to the site.

3. Sewer manhole covers shall have the word "SANITARY" and the letters as indicated in the drawings cast thereon. Do not apply any other lettering.

4. Before leaving the foundry, clean castings and subject them to a hammer inspection.

C. PIPE CONNECTIONS FOR SEWER MANHOLES

Provide resilient watertight connectors between the manhole and piping in accordance with ASTM C923 and OCU standards. Connections shall consist of a chemically resistant neoprene EPDM flexible boot, locking ring, and pipe clamp(s). The locking ring shall be stainless steel and shall lock the boot into the preformed opening in the manhole. The pipe clamp shall be stainless steel. Alternatively, cast the flexible boot in the manhole and eliminate the locking ring. Pipe connections shall be Kor-N-Seal (Dukor Corporation), Z-Lok-XP (A-Lok Products, Inc.), or equal.

D. CONCRETE

1. Cement for manholes and precast bases shall conform to ASTM C150 and C595, Type IP (MS) or, in lieu of Type IP (MS), provide a mixture of 85% Type II portland cement and 15% pozzolan fly ash.

2. Concrete used in pouring the manhole base shall be Class A per Section 03300.

3. Concrete shall be batched with concrete dyed crystalline waterproofing admixture with corrosion protection. Reference the Orange County Utilities Standards and Construction Specifications Manual’s Approved Product List included in Attachment A.

E. SEALING COMPOUND AND MORTAR

Butyl rubber sealing compound shall comply with ASTM C990. Mortar shall comply with ASTM C387, Type S, or use grout complying with Section 03300.

F. CRUSHED ROCK FOR MANHOLE BASE

Crushed rock shall comply with Section 02223. Crushed rock shall be the same material as the pipe bedding. If rock is not used for the pipe bedding, use 3/4-inch crushed rock for the manhole base.

PART 3 - EXECUTION

A. MANHOLE BASE

1. Excavate for the manhole and install a crushed rock base, 9 inches thick, per Section 02223. Crushed rock base material shall extend 9 inches beyond the outside edge of the concrete manhole base. Compact to 90% relative density.

2. Form and pour concrete bases as one monolithic pour. For sewer manholes, form the portion above the invert elevation of the sewer pipe to provide a smooth channel section. Channels shall vary uniformly in size and shape from inlet to outlet.

B. SEALING AND GROUTING OF MANHOLE SECTIONS

Clean ends of precast sections of foreign materials. Place two wraps of butyl rubber sealing compound around the groove of the lower section. Set next section in place. Fill remaining interior and exterior joint cavity completely with mortar of the proper consistency. Trowel interior and exterior surfaces smooth on tongue-and-groove joints. Wipe off any excess grout from the interior and exterior of the joints. Prevent mortar from drying out by applying curing compound or comparable method. Chip out and replace cracked or defective mortar. Completed manhole shall be rigid and watertight.

C. INSTALLING MANHOLES

1. Set each precast concrete manhole unit plumb on a bed of sealant or mortar to make a watertight joint at least 1/2 inch thick with the concrete base or with the preceding unit. Point the inside joint and wipe off the

excess sealant or mortar. Secure the manhole frame to the grade ring with grout and cement mortar fillet. Backfill, compact, and replace pavement.

2. Assemble units so that the cover conforms to the elevation determined by the manhole location as follows:

   a. In Paved Areas: Top of cover shall be flush with the paving surface.

   b. In Shoulder Areas: Top of cover shall be flush with existing surface where it is in traveled way of shoulder and 0.1 foot above existing surface where outside limits of traveled way but not in the existing roadside ditch.

   c. In Roadside Ditch or Unpaved Open Areas: Top of cover shall be 18 inches above the ground surface.

D. LEAKAGE TESTING OF SEWER MANHOLES

Test manholes for leakage in accordance with specification section 02530.

E. BACKFILL AROUND MANHOLES

Backfill and compact around the manholes using native material, per Section 02223 and the pipe specification.

F. COATING MANHOLE EXTERIORS (OTHER THAN ELECTRICAL UTILITY MANHOLES)

Coat interior and exterior of manholes per the Orange County Utilities Standards and Construction Specifications Manual’s Approved Product List included in Attachment A.

END OF SECTION

SECTION 03600 GROUT

PART 1 GENERAL

1.01 DESCRIPTION

A. Furnish all labor, materials, equipment, and incidentals required, and install grout complete as shown on the Drawings and as indicated and in compliance with Contract Documents.

1.02 SUMMARY

A. Section Includes:

1. Material for grouting reinforcing bars, anchor bolts into existing or newly placed concrete.

2. Material for grouting under bearing plates for columns or beams.

3. Materials for grouting under equipment.

4. Materials for miscellaneous grouting including but not limited to railing posts, equipment guides, bollards, precast concrete joints and supports etc.

1.03 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1. M182: Burlap Cloth made from Jute or Kenaf

B. American Petroleum Institute (API):

1. RP 686: Recommended Practice for Machinery Installation and Installation Design

C. American Society for Testing and Materials International (ASTM):

1. C33: Standard Specification for Concrete Aggregates

2. C150: Standard Specification for Portland Cement

3. C531: Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, and Monolithic Surfacings

4. C827: Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixes

5. C1107: Standard Specification for Packaged Dry, Hydraulic, Cement Grout (Non-shrink)

6. D695: Standard Test Method for Compressive Properties of Rigid Plastics

D. U.S. Army Corps of Engineers Standard (CRD):

1. C621: Corps of Engineers Specification for Non-shrink Grout

1.04 DESIGN REQUIREMENTS

A. Design grout and related anchorage systems in accordance with the design loads specified on the contract drawings or as required by the equipment manufacturer.

B. The design and selection of the grout and grouting system shall be based on the duration and magnitude of the load and the frequency of application. The use of a grout for a specific application shall be verified by the manufacturer of the grout.

1.05 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

B. Product Data:

1. Manufacturer’s product literature.

2. Manufacturer’s written application procedure.

1.06 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturer to have a minimum of 5 years experience in the production and use of the type of grout proposed for the Work.

1.07 WARRANTY

A. Warrant the materials and products specified in this Section against defective materials and workmanship with the manufacturer’s standard warranty, but for no less than one year from the date of substantial completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers, and printed instructions.

B. Store materials in accordance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to six months or the manufacturer's recommended storage time, whichever is less.

C. Reject material that becomes damp, lumpy or otherwise unacceptable and immediately remove from the site and replace with acceptable material at no cost to the Owner.

D. Deliver non-shrink cement based grouts as pre-blended, prepackaged mixes requiring only the addition of water.

E. Deliver non-shrink epoxy grouts as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.09 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall instruct the Contractor's personnel in the mixing, proper use and application of the non-shrink grout and epoxy grout.

B. The manufacturer's representative shall provide written certification that materials have been mixed and applied properly and surfaces to receive these products have been prepared properly, all in conformance with manufacturer's requirements.

C. The on-site time required for the manufacturer's representative to achieve a successful installation shall be at the expense of the Contractor.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide materials produced by one manufacturer or supplier in order to provide standardization of appearance.

2.02 APPLICATION

A. Unless indicated otherwise, provide grouts as listed below:

Table 03600-1	
Type of Grout	Application
Cement Grout	Surface repairs
Non-Shrink – Class I	Storage tanks and other non-motorized equipment.
	Filling block-out spaces for embedded items such as railing posts, gate guide frames, etc. (Where placement time is less than 20 min.).
	Repair of holes and defects in concrete members that are not water bearing and not in contact with soil or other fill material.
Non-Shrink – Class II	Column base plates.
	Filling block-out spaces for embedded items such as railing posts, gate guide frames, etc. (where placement time exceeds 20 min.)
	Under precast concrete elements.

Non-Shrink Epoxy	Machinery subject to severe shock loads and high vibration.

2.03 MATERIALS

A. Non-shrink Class I Grout:

1. Non-shrink Class I Grout shall have a minimum 28-day compressive strength of 5000 psi, when mixed at a fluid consistency.

2. Non-shrink Class I grout shall meet the requirements of ASTM C1107, Grade B or C, when mixed to fluid, flowable and plastic consistencies.

3. Products:

a. Sika Corp.; SikaGrout 212.

b. Master Builders, Inc.; Set Grout.

c. The Euclid Chemical Co.; Euco NS.

B. Non-shrink Class II Grout:

1. Non-shrink grout shall be a high precision, fluid, extended working time grout. The minimum 28-day compressive strength shall be 7,500 psi, when mixed at a fluid consistency.

2. Grout can be mixed to plastic, flowable and fluid consistency depending on intended use and workability requirements.

3. Grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C1107.

4. Non-shrink grouts shall meet the requirements of ASTM C1107; Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C939.

5. The grout when tested shall not bleed or segregate at maximum allowed water.

6. Products:

a. Master Builders, Inc.; Masterflow 928.

b. The Euclid Chemical Co.; Hi-Flow Grout.

c. Sika Corp.; SikaGrout 212.

C. Cement Grout:

1. Cement grouts shall be a mixture of one part portland cement conforming to ASTM C150 types I, II, or III and one to two parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout, but not to the degree that it will allow the grout to flow.

D. Non-shrink epoxy-based grout:

1. Provide a pre-proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in seven days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30 x 10-6 when tested in conformity with ASTM C531.

2. Products

a. Ceilcote 648 CP by Master Builders, Inc.

b. Five Star Epoxy Grout by U.S. Grout Corp.

c. Sikadur 42 Grout-Pak by Sika Corp.

d. High Strength Epoxy Grout by the Euclid Chemical Co.

PART 3 EXECUTION

3.01 GENERAL

A. Grout shall not be placed until base concrete or masonry has attained its design strength.

B. Prepare surfaces, for curing, and protection of cement grout in accordance with Section 03300 Cast-in-Place Concrete.

C. Shade the work sites from sunlight for at least 24 hours before and 48 hours after grouting.

D. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.02 PREPARATION

A. Clean concrete surfaces to receive grout free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints, and free of all loose or unsound material or foreign matter that may affect the bond or performance of the grout.

B. Prepare contact surfaces in accordance with product manufacturer’s written instructions.

3.03 MIXING AND PLACING

A. Grouting under equipment bases:

1. Place sealing materials where necessary to retain grout until hardened.

2. Work grout from one side to other. Avoid trapping air under base plates.

3. Remove plastic anchor bolt tops where used and fill with grout at same time base plates are grouted.

B. Mix components in accordance with manufacturer’s written instructions.

C. Apply, place and cure in accordance with manufacturer’s written instructions.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 03730 CONCRETE REPAIR

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide concrete repair as indicated and in compliance with Contract Documents.

B. Complete repair work in accordance with this specification and the product manufacturer's instructions regarding surface preparation and application.

C. The areas of concrete repair shall be determined by the Contractor and the Engineer and shall include any location where concrete deterioration has reached a depth of 1/2-inch or deeper and at any air voids, bugholes or poorly consolidated concrete areas where the specified filler/surfacer materials cannot be used for filling or surfacing of the concrete.

D. If repair work is required for an area indicated to receive protective lining or coating, provide such repair in accordance with the requirements of this specification and the related product manufacturer's written instructions.

E. The repair work specified herein is intended to cover the requirements for repair of concrete only, to a maximum depth of approximately 1-1/2-inch. If after blasting and cleaning, an area is discovered that requires a repair greater than 1-1/2-inch deep, or an area is discovered that requires repair or replacement of reinforcing steel notify the Engineer so that details may be provided to the Contractor to complete the repair.

1.02 REFERENCES

A. American Concrete Institute (ACI):

1. 503.4: Standard Specification for Repairing Concrete with Epoxy Mortars

B. American Society for Testing and Materials International (ASTM):

1. C33: Standard Specifications for Concrete Aggregates

2. C150: Standard Specification for Portland Cement

3. C321: Standard Test Method for Bond Strength of Chemical-Resistant Mortars

4. C882: Test Method for Bond Strength of Epoxy Resin Systems

5. D570: Test Method for Water Absorption of Plastics

6. D638: Test Method for Tensile Properties of Plastics

7. D695: Test Method for Compressive Properties of Rigid Plastics

8. D790: Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

9. D4262: L.R. Standard Test Method for pH of Chemically Cleaned or Acid Etched Concrete Surfaces

10. E337: L.R. Standard Practice Test Method for Measuring Humidity with a Psychrometer.

C. National Association of Corrosion Engineers (NACE):

1. 6D-173: “A Manual for Painter Safety”

2. 6F-163: “Surface Preparation of Steel or Concrete Tank Interiors”

3. TPC2: “Coatings and Linings for Immersion Service”

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01300.

1. Procedures proposed for the accomplishment of repair work. Include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations to be coordinated with other works in progress.

2. Manufacturer’s recommendations and product data sheets for all repair materials including performance criteria, surface preparation, ambient condition requirements and applications, curing

requirements, volatile organic compound (VOC) data, and safety requirements.

3. Material Safety Data Sheets (MSDS) for any materials brought on-site including all repair system materials, solvents and abrasive blast media.

4. Qualifications of foreman and epoxy gun operators and demonstration of meeting the minimum requirements specified.

5. Design Mixes: Provide concrete and cement mortar in conformance with Section 03300 and as specified herein.

1.04 QUALITY ASSURANCE

A. Furnish the names of all subcontractors proposed for use for this work including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, polyurethane, polymer-modified and cement-based compounds.

B. Include in accepted applicator qualifications:

1. A minimum of five years experience in applying epoxy polyurethane and polymer-modified and cement-based compounds similar to those specified in this Section.

2. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for the preparation of the surface, and proper methods for mixing, placing, curing, and caring of the manufacturer's products. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

C. Adhere strictly to the manufacturer’s recommendations regarding temperature at time of application for all work. Do not use epoxy materials when either the temperature of the concrete to be repaired or the ambient temperature is below 50 degrees F . 24 hours before, during, or for a period of 48 hours after the completion of the repair. Temporary heat may be used to meet the specified requirements.

D. Use new repair materials and use within the shelf life limitations set forth by the manufacturer.

E. The Contractor is ultimately responsible for the concrete repair work. Inspections by the Engineer or others do not limit the Contractor’s responsibility.

F. Make all parts of the work accessible for inspections by the Engineer. Correct any conditions not in conformance with the specifications at no additional cost to the Owner.

G. Submit any changes in the specified repair work methods to the Engineer for review.

H. Provide technical field support or training services required by the accepted material manufacturers at no additional cost to the Owner.

I. Provide materials from a single manufacturer for all components of a single repair.

1.05 SERVICES OF MANUFACTURERS REPRESENTATIVES

A. Provide the services of a qualified manufacturer's technical representative to instruct the Contractor's personnel in the mixing, proper use and application of the epoxy, polyurethane polymer-modified and cement-based compounds.

B. Provide written certification from the manufacturers' representative that materials have been mixed and applied properly and surfaces to receive these products have been prepared properly, all in conformance with manufacturer's requirements.

C. Provide on-site time required for the manufacturer's representative to achieve a successful installation at no additional cost to the Owner.

1.06 DELIVERY, STORAGE AND HANDLING

A. Provide shelter to store materials in area or areas designated by the Owner solely for this purpose. Confine mixing, thinning, clean-up and associated operations and storage of repair mortar materials debris before authorized disposal, to these areas.

B. Mix all specified materials in the sheltered mixing operation and materials from direct sunlight and inclement weather. Protect facilities from staining and damage.

C. Do not dispose of waste materials on-site.

D. Store waste temporarily in closed, nonflammable containers until final disposal. Keep no rubbish in Contractor's area longer than 24 hours.

E. Deliver all materials to the job site in new, unopened containers. Each container shall bear the manufacturer's name and label. Labels on all material containers shall contain the following information:

1. Name of product.

2. Federal Specification Number if applicable.

3. Manufacturer's batch number.

4. Manufacturer's name.

5. Generic type of material.

6. Hazardous material identification label.

7. Shelf life date.

F. Clearly mark all containers indicating any safety hazards associated with the use of or exposure to the materials.

G. Handle and store materials to prevent damage or loss of label. Protection of materials is the Contractor's responsibility.

1.07 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Comply with the repair material manufacturer's recommendations as to environmental conditions under which materials can be applied and cured.

2. Do not apply materials when dust is being generated.

B. Protection:

1. Cover or otherwise protect finish work or other surfaces not being repaired.

C. Ventilation:

1. Provide ventilation to meet product requirements prior to, during, and after application.

PART 2 PRODUCTS

2.01 WATER

A. The water used for mixing concrete repair products shall be clear, potable and free of deleterious substances.

2.02 AGGREGATE

A. All aggregates shall conform to ASTM C33 and Section 03300.

2.03 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures.

B. Products:

1. Sika Corp.; Sikdur 32

2. Euclid Chemical Company; Duralcrete

2.04 ANTI-CORROSION COATING

A. Anti-corrosion coating shall be a three-component, epoxy-modified cementitious material.

B. Products:

1. Sika Corp.; Sika Armatec 110

2. Sto Concrete Restoration Division; CR 246

3. Euclid Chemical Company; Duralprep

2.05 EPOXY CRACK REPAIR BINDER

A. Epoxy crack repair binder shall be a two-component, 100 percent solids, high-modulus, low viscosity epoxy adhesive suitable for crack grouting by injection.

B. Products:

1. Sika Corp.; Sikadur 52

2. Euclid Chemical Company; Duralcrete LV

3. BASF Chemical Company; SBC Concresive 1380

2.06 FLEXIBLE POLYURETHANE CRACK REPAIR MATERIAL

A. Flexible polyurethane crack repair material shall be a one-component, water-activated polyurethane hydrophilic injection grout capable of 700 percent expansion. Polyurethane grout shall form a tough flexible foam seal that is impenetrable to water.

B. Products:

1. Prime Resins; Prime Flex 900 XLV

2. Avanti International; Scotch Seal 5600 Chemical Grout

2.07 EPOXY REPAIR MORTAR

A. Epoxy Repair Mortar shall be two-component, 100 percent solids, 100 percent reactive epoxy resin system.

B. Spall repair mortar for use in horizontal applications.

1. Products:

a. BASF Building Systems; Concresive Paste LPL

b. Sika Chemical Corp.; Sikadur 22 Lo-Mod

C. Spall repair mortar for use in vertical and overhead applications.

1. Products:

a. Sika Chemical Corp.; Sikadur 23 Lo-Mod Gel

2.08 SPALL REPAIRS USING NON-SHRINK CEMENTITOUS MORTAR

A. Products:

1. BASF Building Systems; EMACO S88 CI

2. BASF Building Systems; Thorite

3. Sauereisen, Inc.; Underlayment F-120

2.09 SPALL REPAIRS USING POLYMER MODIFIED CEMENTITOUS MORTAR

A. Repair spalls repair not requiring formwork using a two-component, polymer-modified cementitious mortar having a minimum 28-day compressive strength of 7,000 psi.

B. Spall repair mortar for use in horizontal applications.

1. Products:

a. Sika Corp.; Sikatop 122 Plus

b. Euclid Chemical Company; Duraltop Fast Set

C. Spall repair mortar for use in vertical applications.

1. Products:

a. Sika Corp; Sikatop 123 Plus

b. Euclid Chemical Company; Duraltop Gel

2.10 SPALL REPAIRS REQUIRING FORMWORK

A. Repair spalls repair requiring formwork using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 6,000 psi. Mix each unit of mortar with Saturated Surface Dry (SSD) pea gravel to form the repair material following the manufacturer's recommendations.

B. Products:

1. Sika Corp.; Sikatop 111 Plus

2. Euclid Chemical Company; Duraltop Flowable Mortar

2.11 SEALANT

A. Sealant shall be a two-component polyurethane sealant as specified in Section 03250. Primers and bond breakers shall conform to the sealant manufacturer's recommendations.

2.12 EXPANSION JOINT FILLER

A. Expansion joint filler shall be as specified in Section 03250.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform exterior work during dry weather and appropriate temperature conditions in accordance with the manufacturer's recommendations. Protect unfinished work during inclement weather with tarpulins or heavy gage polyethylene sheeting.

B. Perform work in spaces within structures at temperature and conditions suitable for proper curing in accordance with the manufacturer's recommendations.

C. Coordinate concrete rehabilitation work with other work being performed.

D. Remove scaling, broken, loose and disintegrating materials by use of hand tools or power driven saws, down to solid unyielding material.

E. Clean surfaces thoroughly of efflorescence, oils, grease and other objectionable material in area to be repaired in accordance with the manufacturer's recommendations.

3.02 EPOXY BONDING AGENT

A. Use epoxy bonding agent to adhere fresh mortar to existing concrete. Roughen existing concrete surfaces prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Place repair material while bonding agent is still tacky or per the written instructions of the manufacturer. Reapply bonding agent if bonding agent cures prior to placement of repair material.

B. Conform to all the requirements of ACI 503.4, and as specified herein.

3.03 ANTI-CORROSION COATING

A. Sandblast clean and coat reinforcing steel that is cut or exposed during alteration and/or repair operations with an anti-corrosive coating.

B. Cover all exposed parts of the steel with the coating and apply according to manufacturer's recommendations.

3.04 EPOXY CRACK REPAIR

A. Cracks on horizontal surfaces: When permitted by the Engineer, repair existing structural cracks by gravity feeding an epoxy crack repair binder into the prepared crack.

1. Rout concrete surface at the crack to form a minimum 1/4-inch wide by 1/4-inch deep V-notch and clean to remove all loose and foreign particles. Fill crack with clean, dry sand and pour epoxy crack repair binder into V-notch, completely filling crack.

2. As binder penetrates into crack, apply additional binder to the V-notch.

B. Cracks on vertical or horizontal surfaces: Repair existing structural cracks by pressure injecting an epoxy crack repair binder into the prepared crack. Seal cracked surfaces and install injection ports per manufacturer's recommendations.

1. Do not cut reinforcement steel when drilling holes injection ports. If rebar is encountered during drilling, abandon the hole and relocate. Patch the abandoned hole immediately with epoxy mortar flush with the surface of the existing concrete.

2. Once the surface sealing material has cured, inject crack with epoxy crack repair binder as directed by the manufacturer.

3. Remove injection ports upon satisfactory completion of crack injection and patch with epoxy mortar.

3.05 RIGID AND FLEXIBLE POLYURETHANE CRACK REPAIR

A. Repair leaking cracks by pressure injecting with a waterproof hydrophilic or hydrophobic injection grout

seal crack surfaces and install injection ports per manufacturer's recommendations.

B. Do not cut rebar when drilling holes for injection ports. If rebar is encountered during drilling, abandon the hole and patch immediately with epoxy mortar flush with the surface of the existing concrete.

C. Once the surface sealing material has cured, inject crack with waterproof hydrophilic or hydrophobic injection grout as directed by the manufacturer.

3.06 SPALL REPAIR

A. Saw cut the perimeter of the repair area to a minimum depth of 1/2-inch below the surface of the concrete.

B. Chip all loose concrete in the repair area to remove loose and degraded concrete to a minimum of 1/2-inch or until a sound substrate is reached.

C. Clean the area and repair to the original dimensions with spall repair patching material according to the manufacturer's recommendations.

D. Make final finished surface of patches flat, level and even with the existing concrete surface. Do not feather repair mortar to meet existing concrete surface.

E. Finish final patches on horizontal surfaces consistent with the finish on the existing structure.

3.07 JOINT REPAIR

A. Remove sealant, bond breaker and joint filler.

B. Remove unsound concrete on the joint faces.

C. Remove laitance and provide a clean dry surface.

D. Prepare an epoxy mortar by combining epoxy crack repair binder with aggregate following the manufacturer's instructions.

E. Restore surface to original dimensions by trowelling epoxy mortar onto the existing substrate in a manner to ensure bonding following the manufacturer's instructions.

F. Cure repair in accordance with the manufacturer's instructions.

G. Install new joint filler, bond breaker and sealant.

3.08 CURING

A. Cure repair materials in accordance with manufacturer recommendations.

3.09 CLEANING

A. Mechanically remove excess material from walls, floors, etc. after material has cured.

B. Clean excess materials caused by work under this Section from existing surfaces by the use of power sanders. Vacuum surfaces to receive final cleaning and finishing specified under other sections of the specifications. Sand cracks flush to adjacent surfaces.

C. Remove misplaced sealants using methods and materials recommended by the manufacturers. Leave finished work and work area in a neat and clean condition.

3.10 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

DIVISION 4 – MASONRY

04200 Unit Masonry and Accessories

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SECTION 04200 UNIT MASONRY AND ACCESSORIES

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide unit masonry and accessories as indicated and in compliance with Contract Documents.

1. The work under this Section includes the following:

a. Concrete masonry units.

b. Mortar and grout.

c. Steel reinforcing bars.

d. Masonry joint reinforcement.

e. Ties and anchors.

f. Miscellaneous masonry accessories.

1.02 REFERENCES

A. American Concrete Institute (ACI):

1. 530/ASCE 6/TMS 602: Building Code Requirements for Masonry Structures & Commentary.

2. 530.1/ASCE 6/ TMS 602: Specification for Masonry Structures & Commentary.

3. SP-66: ACI Detailing Manual.

B. American Society for Testing and Materials International (ASTM):

1. A82/A82M: Standard Specification for Steel Wire, Plain for Concrete Reinforcement.

2. A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

3. A951/A951M: Standard Specification for Steel Wire for Masonry Joint Reinforcement.

4. C90: Standard Specification for Loadbearing Concrete Masonry Units.

5. C91: Standard Specification for Masonry Cement.

6. C109/C109M: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).

7. C140: Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.

8. C143/C143M: Standard Test Method for Slump of Hydraulic-Cement Concrete.

9. C144: Standard Specification for Aggregate for Masonry Mortar.

10. C150: Standard Specification for Portland Cement.

11. C207: Standard Specification for Hydrated Lime for Masonry Purposes.

12. C270: Standard Specification for Mortar for Unit Masonry.

13. C404: Standard Specification for Aggregates for Masonry Grout.

14. C476: Standard Specification for Grout for Masonry.

15. C1019: Standard Method of Sampling and Testing Grout.

16. C1329: Standard Specification for Mortar Cement.

1.03 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of

masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI SP-66, "Details and Detailing of Concrete Reinforcement."

D. Qualification Data: For testing agency.

E. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Material certification for concrete masonry units. Test data shall not be more than 1 year old.

2. Cementitious materials. Include brand, type, and name of manufacturer.

3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

4. Grout mixes. Include description of type and proportions of ingredients.

5. Reinforcing bars.

6. Joint reinforcement.

7. Anchors, ties, and metal accessories.

F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91 for air content.

2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

G. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.06 DELIVERY STORAGE AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed

location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.07 PROJECT/SITE CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls at end of each day's work. Cover partially completed masonry when construction is not in progress.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

D. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

2. Provide bullnose units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

a. Products:

(1) ACM Chemistries; RainBloc.

(2) BASF Aktiengesellschaft; Rheopel Plus.

(3) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.

C. CMUs: ASTM C90

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.

2. Density Classification: Normal weight.

2.02 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

1. Concrete Lintels: Precast concrete lintels complying with requirements in Division 03 Section "Cast-in-Place Concrete," and with reinforcing bars indicated.

2. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.03 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91

E. Mortar Cement: ASTM C1329

F. Aggregate for Mortar: ASTM C144

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

3. White-Mortar Aggregates: Natural white sand or crushed white stone.

4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Aggregate for Grout: ASTM C404

H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.

1. Products:

a. ACM Chemistries; RainBloc for Mortar.

b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.

c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

I. Water: Potable.

2.04 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A951/A951M.

1. Interior Walls and Exterior Walls: Hot-dip galvanized, carbon steel.

2. Wire Size for Side Rods: 0.148-inch diameter.

3. Wire Size for Cross Rods: 0.148-inch diameter.

4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.

5. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

2.05 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M; with ASTM A153/A153M, Class B-2 coating.

B. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 7.6 to 12.7 mm and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick, steel sheet, galvanized after fabrication.

C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units.

2. Wire: Fabricate from 3/16-inch-diameter, hot-dip galvanized steel wire.

E. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.

2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch-diameter, hot-dip galvanized steel wire.

2.06 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

2. Use portland cement-lime, masonry cement or mortar cement mortar unless otherwise indicated.

3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270. Provide Type N, 750 psi minimum.

D. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.

3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

2. Verify that foundations are within tolerances specified.

3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Thickness: Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

3.03 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2-inch or minus 1/4-inch.

2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2-inch.

3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4-inch in a story height or 1/2-inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet or 1/2 inch maximum.

2. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

3. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

4. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

5. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than +/- 1/8-inch, with a maximum thickness limited to 1/2 inch.

2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

3. For head joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.04 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Shall be running bond.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

G. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

3.05 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.

2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.06 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.

2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.07 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry with anchors embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.08 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install preformed control-joint gaskets designed to fit standard sash block.

2. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.

3. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.09 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete or masonry lintels where shown and where openings of more than 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

2. Limit height of vertical grout pours to not more than 5 feet.

3.11 FIELD QUALITY CONTROL

A. Testing Prior to Construction: One set of tests.

B. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

C. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

D. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

E. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.

F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

3.14 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700.

END OF SECTION

DIVISION 5 – METALS

05500	Miscellaneous Metal
05515	Aluminum Stairs
05520	Metal Railing
05530	Metal Grating

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SECTION 05500 MISCELLANEOUS METAL

PART 1 GENERAL

1.01 DESCRIPTION

A. This section includes metal fabrications not specifically included in other Sections and required for completion of work as shown on Contract Drawings and in accordance with Contract Documents.

B. Furnish labor, materials, equipment and incidentals necessary to install the products specified.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. B18.5: Round Head Bolts.

B. American Society for Testing and Materials International (ASTM):

1. A6: General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling.

2. A36: Standard Specification for Carbon Structural Steel.

3. A48: Standard Specification for Gray Iron Castings.

4. A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

5. A108: Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.

6. A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

7. A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

8. A193/A193M: Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.

9. A240: Standard Specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels.

10. A276: Standard Specification for Stainless Steel Bars and Shapes.

11. A307: Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

12. A325: Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.

13. A366: Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.

14. A489: Standard Specification for Carbon Steel Lifting Eyes.

15. A500: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

16. A501: Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

17. A502: Steel Structural Rivets.

18. A536: Standard Specification for Ductile Iron Castings.

19. A569: Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality.

20. A570: Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

21. A572: Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

22. A576: Steel Bars, Carbon, Hot-Wrought, Special Quality.

23. A675: Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

24. A786: Rolled Steel Floor Plates.

25. A992: Standard Specification for Structural Shapes.

26. B26: Specification for Aluminum-Alloy Sand Castings.

27. B211: Specification for Aluminum-Alloy Bars, Rods, Profiles and Tubes.

28. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

29. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

30. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.

31. B308: Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

32. B 429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

33. D1056: Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

34. F436: Standard Specification for Hardened Steel Washers.

35. F541: Standard Specification for Alloy Steel Eyebolts.

36. F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

37. F594: Standard Specification for Stainless Steel Nuts.

38. F844: Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

39. F1554: Standard Specification of Anchor Bolts, steel, 36, 55 and 105-ksi Yield Strength.

40. F2329: Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

C. American Institute of Steel Construction (AISC):

1. ANSI/AISC 360-5: Specification for Structural Steel Buildings

2. AISC Manual of Steel Construction, Thirteenth Edition

D. American Welding Society (AWS):

1. A2.4: Standard Symbols for Welding, Brazing, and Nondestructive Examination.

2. D1.1: Structural Welding Code.

3. D1.2: Structural Welding Code - Aluminum.

E. Aluminum Association:

1. Aluminum Design Manual–Specifications and Guidelines for Aluminum Structures.

a. AA M31C22A41

(1) M31: Mechanical Finish, Fine Satin

(2) C22: Finish, Medium Matte

(3) A41: Clear Anodic Coating, Class I

F. International Code Council – Evaluation Services (ICC-ES):

1. ICC-ES Acceptance Criteria 01: Mechanical Anchors in Masonry Elements

2. ICC-ES Acceptance Criteria 58: Adhesive Anchors in Masonry Elements

3. ICC-ES Acceptance Criteria 193: Mechanical Anchors in Concrete Elements

4. ICC-ES Acceptance Criteria 308: Post-installed Adhesive Anchors in Concrete Elements

1.03 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

1. Submit shop drawings and product data showing materials of construction and details of installation for all items furnished under this Section. Shop drawings shall show sizes of members, method of assembly, anchorage and connection to other members.

2. Product Data:

a. Manufacturer’s catalog sheets on pre-manufactured items.

3. Miscellaneous Submittals:

a. Provide International Conference of Building Officials (ICBO) or other similar building code organization recommendations regarding safe allowable design loads for concrete anchors.

4. Stamped by Professional Engineer registered in State where the project is located.

1.04 QUALITY ASSURANCE

A. Test and inspect structural assemblies in accordance with Section 01065.

B. Design connections not detailed on the Drawings under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State where the Project is located.

C. Steel:

1. Conform to codes for arc and gas welding in building construction of AWS and to AISC Specifications. Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except mill scale that will withstand vigorous wire brushing may remain. Perform no welding when base metal is lower than 0 degrees F.

2. Qualify welding operators in accordance with AWS D1.1. Qualification tests shall be run by a recognized testing laboratory acceptable to the Engineer at Contractor's expense.

D. Aluminum:

1. Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with AWS.

E. Adhesive Anchors:

1. Adhesive Anchor Installers shall be trained and certified by manufacturer.

F. Galvanized Coating:

1. Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY STORAGE AND HANDLING

A. Insofar as practical, factory assemble items specified herein. Package, ship and tag unassembled materials in a manner that will protect materials from damage and will facilitate identification and field assembly.

B. Package stainless steel items in a manner to provide protection from carbon impregnation.

C. Protect painted coatings and hot-dip galvanized finishes from damage due to metal banding and rough handling. Use padded slings and straps.

D. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.

E. Store fabricated items in a dry area, not in direct contact with ground.

1.06 FIELD MEASUREMENTS

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.

B. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

PART 2 PRODUCTS

2.01 MISCELLANEOUS METAL SHAPES, CASTINGS, BOLTS AND ACCESSORIES

A. Structural Steel Shapes:

1. W Shapes: ASTM A992, 50 ksi

2. M Shapes: ASTM A36

3. S, C and MC Shapes: ASTM A36

4. L Shapes: ASTM A36

5. HSS Rectangular Shapes: ASTM A500, Grade B, 46 ksi

6. HSS Round Shapes: ASTM A500, Grade B, 42 ksi

7. Pipe Shapes: ASTM A53, Grade B, 35 ksi

8. Plates and Bars: ASTM A36

9. Steel Sheets: ASTM A366

B. Stainless Steel Shapes:

1. Exterior and Submerged Uses: AISI, Type 316

2. Industrial Uses: AISI, Type 316

3. Interior and Architectural Uses: AISI, Type 304

4. For Welding: AISI, Type 304L, Type 316L

5. Shapes and Bars ASTM A276

6. Plate, Sheet and Strip ASTM A240

C. Aluminum Shapes:

1. Structural Shapes ASTM B308, Alloy 6061-T6

2. Extruded Pipe ASTM B429, Alloy 6063-T6

3. Aluminum Sheet& Plate ASTM B209, Alloy 6061-T6

D. High Strength Bolts for Steel Members ASTM A325

E. Steel Washers ASTM F436

F. Plain Unhardened Steel Washers: ASTM F844

G. Anchor Bolts: ASTM F1554, Grade 36 standard headed bolts with heavy hex nuts, Grade A washers, hot-dip galvanized, unless otherwise specified.

H. Stainless Steel Bolts and Nuts: F593 and F594, AISI Type 316

I. Connection Bolts for Wood Members: ASTM A307, galvanized where specified

J. Iron Castings: ASTM A48, Class 35

K. Galvanizing: ASTM A123, Zn w/0.5 percent minimum Ni.

L. Galvanizing, hardware: ASTM A153, Zn w/0.5 percent minimum Ni.

2.02 POST INSTALLED ANCHORS:

A. Mechanical Expansion Type Anchors: Anchors shall be qualified per ICC-ES AC193.

1. Products:

a. Hilti Corporation, Kwik-Bolt TZ

b. Powers Fasteners, Power Stud SD1+ Stud Anchor

c. Simpson Strong Tie, Strong Bolt

2. General:

a. Use Zinc or chromate-plated carbon steel where totally embedded, in interior locations with controlled humidity and other protected locations, unless otherwise specified on Contract Drawings.

b. Use stainless steel in other locations or when attaching aluminum and stainless steel.

c. Do not use expansion anchors in submerged and dynamic load applications.

B. Adhesive Anchors:

1. Products:

a. Hilti Corporation, HIT-RE 500-SD

b. Powers Fasteners, PE1000+ Epoxy Adhesive Anchoring System

c. Simpson Strong Tie, SET-XP Epoxy-Tie or Acrylic-Tie

2. General:

a. Adhesive anchors shall be Stainless Steel Type 316 unless otherwise noted.

C. Adhesive Anchors for masonry:

1. Products:

a. Hilti Corporation, HIT-HY 20.

b. Powers Fasteners, AC100+ Gold

c. Simpson Strong Tie, SET High Strength Epoxy Tie

2. General:

a. Epoxy anchors shall be Stainless Steel Type 316 unless otherwise noted.

2.03 FABRICATION

A. Connections and Workmanship

1. Fabricate details and connection assemblies in accordance with Contract Drawings and Specifications, with projecting corners clipped and filler pieces welded flush.

2. Fit work together in fabrication shop and deliver complete or in parts, ready to be set in-place or assembled in field.

3. Provide work true to detail; with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture free from defects impairing strength or durability.

4. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

5. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion; smooth and well cleaned by shot blasting.

6. Welding:

a. Provide rigid and continuous welds or spot welded as specified and as shown on Contract Drawing. Dress the face of welds flush and smooth. Close fit exposed joints and locate where least conspicuous.

b. Weld aluminum work on the unexposed side when possible in order to prevent pitting or discoloration.

c. Weld aluminum in compliance with the latest edition of AWS D1.2. Support and clamp

component parts of built-up members in proper position for welding.

d. Weld shop connections and bolt or field weld connections, unless otherwise specified.

e. Grind exposed edges of welds to 1/8-inch minimum radius. Grind burrs, jagged edges, and surface defects smooth.

f. Prepare welds and adjacent areas so there is:

(1) No undercutting or reverse ridges on weld bead.

(2) No weld spatter on or adjacent to weld or other area to be painted or coated.

(3) No sharp peaks or ridges along weld bead.

7. Bolting:

a. Use bolts of lengths required so bolts do not project more than 1/4-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.

b. Provide holes required for connection of adjacent or adjoining work wherever noted on Drawings. Locate holes for bolting equipment to supports to tolerance of +/- 1/16-inch of dimensions indicated.

B. Galvanizing:

1. Galvanize after fabrication by hot-dipped process conforming with ASTM A123.

2. Ship and handle in manner to avoid damage to zinc coating.

C. Shop Painting:

1. Do not paint or coat ferrous metal surfaces embedded in concrete.

2. Comply with Section 09900.

PART 3 EXECUTION

3.01 EXAMINATION

A. Upon receipt of material at job site, inspect all materials for shipping damage. Replace damaged items at no cost to Owner.

B. Examine supports for size, layout and alignment.

C. Correct defects considered detrimental to proper installation.

3.02 INSTALLATION

A. Provide items such as bolts, shims, blocks, nuts, washers, and wedging pieces to complete installation.

B. Erect to lines and levels, plumb and true, and in correct relation to adjoining Work. Secure parts using concealed connections when practicable.

C. Plumb and true vertical members to tolerance of +/- 1/8 inch in 10 feet. Level horizontal members to tolerance of +/- 1/8 inch in 10 feet.

D. Use steel bolts to connect structural steel members. Use stainless steel bolts to connect structural aluminum members.

E. Anchor Bolts and Concrete Anchors:

1. Preset anchor bolts using templates. Do not use concrete anchors in place of anchor bolts.

2. After anchor bolts are embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of equipment or metalwork.

3. Do not install concrete anchors until concrete has reached specified minimum compressive strength.

4. Install concrete anchors in accordance with anchor manufacturer recommendation. Embedment depth of

anchor shall be as recommended by the anchor manufacturer, but not less than as shown on Contract Drawings.

5. Locate concrete anchors to clear reinforcing bars in concrete.

F. Weld headed anchor studs in accordance with manufacturer's recommendations.

G. Do not place new holes or enlarge unfair holes by use of cutting torch.

3.03 PAINTING, REPAIR, AND PROTECTION

A. Paint aluminum in contact with concrete in accordance Section 09900. Under no circumstances shall aluminum contact dissimilar metal.

B. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-inch thick neoprene isolator pads, 85 +/- 5 Shore A durometer, sized for full width and length of bracket or support.

C. Apply an anti-seize compound on all stainless steel fasteners to prevent galling.

D. Field paint in compliance with Section 09900.

E. Field repair of damaged galvanized coatings:

1. Clean and repair Zinc coating that has been burned by welding, abraded, or otherwise damaged after installation. Clean damage area by wire brushing and removing all traces of welding flux and loose or cracked zinc coating

2. Coat surfaces using zinc-rich paint.

F. Field repair of damaged primer.

1. Touch up abrasions in the shop primer immediately after erection. Paint areas left unprimed for welding with primer after welding.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 05515 ALUMINUM STAIRS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section describes materials, fabrication, and installation of aluminum stairs as indicated and in compliance with Contract Documents.

1.02 REFERENCES

A. Aluminum Association (AA):

1. Aluminum Design Manual–Specifications and Guidelines for Aluminum Structures.

B. American Society for Testing and Materials International (ASTM):

1. A276: Standard Specification for Stainless Steel Bars and Shapes.

2. B26: Specification for Aluminum-Alloy Sand Castings.

3. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

4. B211: Specification for Aluminum-Alloy Bars, Rods, Profiles and Tubes.

5. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

6. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.

7. B429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

C. American Welding Society (AWS):

1. A2.4: Standard Symbols for Welding, Brazing, and Nondestructive Examination.

2. D1.1: Structural Welding Code - Steel.

1.03 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

1. Shop drawings showing clearly the location, size and details of all members.

2. Indicate materials, dimensions, connection attachments, anchorage, size and type of fasteners, holes, finishes, and accessories.

3. Reference materials of construction by ASTM designation and grade.

4. Indicate welds including length and size of all shop and field welds by symbols conforming to AWS standards.

B. Product Data:

1. Manufacturer’s catalog sheets on pre-manufactured items.

2. Manufacturer’s specifications, load tables, anchor details, and installation details.

C. Certificates:

1. Welders' Certificates: Certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

2. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Obtain field measurements and elevations prior to preparation of shop drawings and fabrication.

B. Welding Qualification and Certification:

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.

2. Use welders, tackers and welding operators certified by test to perform type of work required in conformance with AWS Structural Welding Code. Maintain current test records certified by an independent testing laboratory.

3. Maintain duplicate qualification and certification records at the job site readily available for examination.

1.05 DELIVERY, STORAGE AND HANDLING

A. Identify and match-mark materials, items and fabrications, for installation and field assembly.

B. Deliver items to jobsite as complete units, wherever practicable, ready for installation or erection, with anchors, hangers, fasteners and miscellaneous metal items required for installation.

C. Carefully handle and store materials, protected from weather, corrosion and other damage.

D. Store off the ground on suitable supports.

E. Accept material on site. Inspect for damage.

F. Do not incorporate damaged material in the work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aluminum materials and welding electrodes per Section 05500.

B. Aluminum plates, shapes, pipe and castings shall conform to the following ASTM specifications, alloy and temper designations.

1. Extruded structural shapes, bars and tubes: ASTM B221 Alloy 6061-T6.

2. Extruded structural tube or pipe: ASTM B429 Alloy 6061-T6.

3. Sheet and plate: ASTM B209 Alloy 6061-T6.

4. Die and hand forgings: ASTM B247 Alloy 6061-T6.

5. Castings: ASTM B26.

6. Bolts, washers and nuts: Type 304 stainless steel.

7. Gratings (bearing bars): ASTM B211 Alloy 6061-T6 (connecting bars): ASTM B211 Alloy 6061-T5.

2.02 FABRICATION

A. General:

1. Fabricate true to shape, size and tolerances as indicated and specified.

2. Straighten work bent by shearing or punching.

3. Dress exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded.

4. Provide sufficient quantity and size of anchors for the proper fastening of the work.

5. Fabricate details and connection assemblies in accordance with drawings, with projecting corners clipped and filler pieces welded flush.

6. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

7. Use connections of type and design required by forces to be resisted, and to provide secure fastening.

8. Fit work together in fabrication shop and deliver complete, or in parts, ready to be set in place.

B. Welding:

1. Grind exposed edges of welds to a 1/8 inch minimum radius. Grind burrs, jagged edges and surface defects smooth.

2. Prepare welds and adjacent areas such that there is no undercutting or reverse ridges on the weld bead and no sharp peaks or ridges along the weld bead.

3. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

C. Bolting:

1. Provide stainless steel stud bolts and nuts with heavy aluminum washers for fastening aluminum material.

2. Provide holes required for the connection of adjacent or adjoining work wherever noted on drawings. Locate holes for bolting to supports to a tolerance of 1/16-inch of exact dimensions indicated.

2.03 ALUMINUM STAIRS:

A. Provide aluminum stairs fabricated from structural aluminum channel stringers, aluminum pipe rails and aluminum treads.

B. Rectangular Bar Grating Treads:

1. Provide stair treads of the same type and bar spacing as grating specified.

2. Provide serrated top surface of bearing bars.

3. Provide minimum 3 inch by 3/16 inch carrier end plates welded to stair treads and punched for bolting to stringers.

4. Provide 1-1/4 inch abrasive nosings.

5. Manufacturers:

a. IKG Borden Metal Products Co.; Type B.

b. Ohio Gratings, Inc.; Type SG Series.

c. McNichols Co.; Type A.

PART 3 EXECUTION

3.01 GENERAL:

A. Set and secure in place as indicated. Where bolted connections are used, draw together and draw nuts tightly. Use bolts of lengths required so that they do not project more than 1/4-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.

B. Locate anchors and anchor bolts and build into connecting work.

C. Install stairs in accordance with accepted shop drawings.

3.02 STAIRS:

A. Provide structural aluminum angles, struts, rod hangers, closure plates, and brackets indicated.

3.03 CORROSION PROTECTION FOR ALUMINUM SURFACES:

A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 09900.

B. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

3.04 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 05520 METAL RAILINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Design, furnish and install handrails and railing systems, including connectors, fasteners, and system required accessories.

1.02 REFERENCES

A. Aluminum Association (AA):

1. Aluminum Association Designation System for Aluminum Finishes

2. AAMA 607.1: Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

B. American Society of Civil Engineers (ASCE):

1. 7: Minimum Design Loads for Buildings and Other Structures.

C. American Society for Testing and Materials (ASTM):

1. B210: Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes

2. B221/B221M: Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

3. B241: Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

4. B429: Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

5. E935: Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings

6. E985: Standard Specification for Permanent Metal Railing Systems and Rails for Buildings

D. American Welding Society (AWS)

1. C5.6: Recommended Practices for Gas Metal Arc Welding

2. D1.1-1.17: Structural Welding Code.

E. International Code Council

1. FBC: Florida Building Code.

F. National Ornamental & Miscellaneous Metals Association (NOMMA):

1. Guideline 1: Joint Finishes.

2. Metal Rail Manual.

1.03 PERFORMANCE/ DESIGN CRITERIA

A. Design and provide handrail and guardrail system to meet FBC, OSHA and the criteria specified herein. Railing shall be capable of withstanding the following loads without exceeding design allowable stress of materials for handrails, railing anchors and connections.

1. Top rail:

a. Uniform load of 50 pounds per foot applied in any direction.

b. Concentrated load of 200 pounds applied in any direction at any point.

c. Uniform and concentrated loads above need not be assumed to act concurrently.

2. Intermediate rail:

a. Uniform load of 50 pounds per foot applied in any direction. Uniform load above need not be assumed to act concurrently with loads acting on top rail.

B. Thermal movements: Provide adequate expansion within the system to allow for thermal expansion and contraction caused by a temperature change of 120 degrees F to 15 degrees F without buckling or warping, opening of joints, overstressing of components, failure of connections and other detrimental effects.

C. Control of corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

1. Show fabrication and installation of handrails and railings assembled from standard components. Include plans, elevations, component details, materials, finishes, connection and joining methods, and mounting details to adjoining work.

2. Identify location and type indicated.

3. Submit certification demonstrating that the railing system will resist the loads specified herein, FBC and OSHA. Calculations shall be stamped by Professional Engineer registered in State where the Project is located.

B. Product Data:

1. Manufacture’s literature.

2. Assembly and installation instructions.

C. Certificates:

1. Welders' Certificates: Certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

2. Submit certification that the railing system is in compliance with FBC and OSHA

D. Operation and Maintenance Data:

1. Manufacturer’s instructions describing procedures for maintaining including cleaning materials, application methods, and precautions as to use of materials which may be detrimental to finish when improperly used.

1.05 QUALITY ASSURANCE

A. Obtain field measurements prior to preparation of shop drawings and fabrication.

B. Handrails provided shall be end products of one manufacturer to achieve standardization for appearance, maintenance and replacement.

C. Manufacturer shall have minimum five years experience specializing in manufacturing products specified in the section.

D. Welding Qualification and Certification:

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.

2. Each welder, tacker and welding operator shall be certified by test to perform type of work required in conformance with AWS Structural Welding Code. Testing shall be conducted, and witnessed by an independent testing laboratory.

3. Maintain duplicate qualification and certification records at the job site readily available for examination.

1.06 DELIVERY STORAGE AND HANDLING

A. Deliver, store and handle materials in manner preventing damage to finished surfaces.

B. Store materials in a dry, well ventilated, weather tight place away from uncured concrete or masonry.

1.07 SITE CONDITIONS

A. Field verify measurements prior to fabrication and indicate measurements in shop drawings.

PART 2 PRODUCTS

2.01 ALUMINUM RAILING SYSTEM AND COMPONENTS

A. Material: ASTM B429, alloy 6063-T6, Schedule 40, 1-1/2 inch diameter minimum extruded structural pipe or tube rails and schedule 80 posts.

B. Railings at open-side construction shall consist of two members with posts. Locate intermediate rails between top rail and finish floor as indicated on Drawings.

C. Provide 1/4-inch thick by 4 inch high or “S” type toe plate except on stairs and where concrete curb provided. Provide 1/4-inch clearance above floor level. Expansion joint location to match railing joint location.

D. Fabrication:

1. Angles, offsets, other changes in alignment, and joining of posts and rails shall be made with welded connections. Miter and weld joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Run top rails continuously over post.

2. Rail splices shall be butted and reinforced by tight fitting interior sleeve not less than 6 inch long.

3. Space posts not more than 5 feet. Erect posts plumb in each direction.

E. Anchorage:

1. For posts set on stair or platform stringers, provide base flange welded to post and bolted to stringer with minimum of two 1/2-inch bolts, or weld post to stringer.

F. Finishes:

1. Aluminum Association Finish Designation: AA-M12A41 (Mechanical finish, nonspecular, anodic coating, architectural Class I, clear coating 0.7 mil complying with AAMA 607.1 on exposed surfaces.

   a. Extruded Components: 0.7 mil anodized.

   b. Cast Components: 0.4 mil anodized.

2.02 DISSIMILAR METAL

A. Keep surfaces of dissimilar metal from direct contact by coating the dissimilar metal with a heavy coat of a two part epoxy.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install as shown on Drawings and accepted Shop Drawings.

B. Set posts plumb and aligned in each direction to within 1/4-inch in 12 feet.

C. Set rails horizontal or parallel to rake of steps to within 1/4 inch in 12 feet.

D. Fit exposed connections together to form tight, hairline joints.

E. Provide anchorage devices and fasteners for securing handrails and railings and for transferring loads to structures.

F. Provide mechanical joints for permanently connecting railing components at nonwelded connections.

3.02 CLEANING

A. Wash thoroughly using clean water and soap, rinse with clean water.
B. Do not use acid solution, steel wool or other harsh abrasive.

C. When stain remains after washing, remove finish and restore in accordance with manufacturer’s instructions.

3.03 PROTECTION

A. Protect surfaces of completed installations to prevent damage during construction activities.

3.04 REPAIR OF DEFECTIVE WORK

A. Remove stained or otherwise defective work and replace with no additional cost to Owner.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

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SECTION 05530 METAL GRATING

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide metal grating as indicated and in compliance with Contract Documents.

B. This section includes:

1. Aluminum Bar Grating.

C. Furnish all labor, materials, equipment and incidentals necessary to install the products specified.

1.02 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. B26: Specification for Aluminum-Alloy Sand Castings.

2. B209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

3. B221: Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

4. B247: Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings.

B. American Welding Society (AWS):

1. D1.1: Structural Welding Code.

2. D1.2: Structural Welding Code - Aluminum.

C. National Association of Architectural Metal Manufacturers (NAAMM):

1. MBG 531: Metal Bar Grating Manual.

2. MBG 532: Heavy Duty Metal Bar Grating Manual.

3. MBG 533: Welding Specifications for Fabrication of Steel, Aluminum and Stainless Bar Grating.

D. Aluminum Association:

1. Aluminum Association Designation System for Aluminum Finishes

2. AAMA 607.1: Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

1.03 DESIGN CRITERIA

A. Grating

1. Provide grating meeting the specified floor design live load but not less than a uniform live load of 100 psf or a concentrated load of 300 pounds over a 12 inch area at the center or span, whichever produces the greatest stresses.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

1. Detail shop drawings indicating:

a. Dimensions.

b. Sectional assembly.

c. Location and identification mark.

d. Connections and fastening methods.

e. Size and location of supporting frames required.

f. Materials of construction.

g. Installation instructions.

2. Catalog data and design tables showing limits for span length and deflection under load.

1.05 QUALITY ASSURANCE

A. Obtain field measurements prior to preparation of shop drawings and fabrication.

B. Aluminum:

1. Weld with gas metal arc (GMA) or gas tungsten arc (GTA) processes in accordance with manufacturer's recommendations as accepted and in accordance with recommendations of AWS D1.2.

1.06 DELIVERY STORAGE AND HANDLING

A. Store to avoid damage.

B. Remove material that has become damaged as to be unfit for use.

C. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

1.07 FIELD MEASUREMENTS

A. Verify dimensions and make any field measurements necessary and be fully responsible for accuracy and layout of the work.

B. Review the Contract Drawings and report any discrepancies to the Engineer for clarification prior to starting fabrication.

PART 2 PRODUCTS

2.01 ALUMINUM BAR GRATING

A. Manufacturers:

1. IKG Borden Metal Products Co.; Type S/B.

2. Ohio Gratings, Inc.; Type SG Series.

3. McNichols Co.; GAL Series.

B. Provide aluminum alloy 6063-T6 grating material.

C. Provide 3/16-inch thick bearing bars spaced 1-3/16-inch center to center with cross bars pressure locked on 4 inch centers.

D. Fabricate in standard size sections where possible with a maximum panel weight of no more than 80 pounds.

E. Apply bearing bar banding at ends of grating sections and at fixture or pipe openings where two or more bearing bars are cut.

F. Anchor grating to support members using stainless steel saddle clips, grating clamps, or Z-Clips.

G. Provide top surface with mill finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Upon receipt of material at job site, inspect all materials for shipping damage. Damaged items shall be replaced at no cost to Owner.

B. Examine supports for size, layout and alignment. Surface shall be free of debris.

C. Correct defects considered detrimental to proper installation.

3.02 PROTECTION

A. Protect aluminum from contact with dissimilar metals, concrete, masonry or mortar. Paint aluminum in contact with concrete in accordance Section 09900. Under no circumstances shall aluminum contact concrete or dissimilar metal.

B. Apply one coat of bituminous paint coating.

C. Before coating application, clean contact surfaces, remove dirt, grease, oil, foreign substances, followed by immersing in, or wipe thoroughly with, an acceptable solvent. Rinse with clean hot water and dry thoroughly.

3.03 INSTALLATION

A. Install and make connections in accordance with accepted submittals and manufacturer's written instructions.

B. Install materials accurately in location and elevation, level and plumb. Field fabricate as necessary for accurate fit.

C. Coordinate and furnish anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

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DIVISION 7 – THERMAL AND MOISTURE PROTECTION

07920 Joint Sealants

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SECTION 07920 JOINT SEALANTS

PART 1 - GENERAL

A. RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SUMMARY

1. Section Includes:

   a. Silicone joint sealants.

   b. Latex joint sealants.

2. Related Sections:

   a. Section 04200 "Unit Masonry and Accessories" for masonry control and expansion joint fillers and gaskets.

C. ACTION SUBMITTALS

1. Product Data: For each joint-sealant product indicated.

2. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

3. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

4. Joint-Sealant Schedule: Include the following information:

   a. Joint-sealant application, joint location, and designation.

   b. Joint-sealant manufacturer and product name.

c. Joint-sealant formulation.

d. Joint-sealant color.

D. INFORMATIONAL SUBMITTALS

1. Qualification Data: For qualified Installer.

2. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

4. Field-Adhesion Test Reports: For each sealant application tested.

5. Warranties: Sample of special warranties.

E. QUALITY ASSURANCE

1. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

2. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

3. Product Testing: Test joint sealants using a qualified testing agency.

4. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

F. PROJECT CONDITIONS

1. Do not proceed with installation of joint sealants under the following conditions:

a. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).

b. When joint substrates are wet.

c. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

d. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

G. WARRANTY

1. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

   a. Warranty Period: Two (2) years from date of Substantial Completion.

2. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

   a. Warranty Period: Five (5) years from date of Substantial Completion.

3. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

   a. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.

   b. Disintegration of joint substrates from natural causes exceeding design specifications.

   c. Mechanical damage caused by individuals, tools, or other outside agents.

   d. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

A. MATERIALS, GENERAL

1. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

   a. Architectural Sealants: 250 g/L.

   b. Sealant Primers for Nonporous Substrates: 250 g/L.

   c. Sealant Primers for Porous Substrates: 775 g/L.

3. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

4. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

5. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

B. SILICONE JOINT SEALANTS

1. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

   a. Products: Subject to compliance with requirements, provide one of the following:

(1) Dow Corning Corporation; 790.

(2) GE Advanced Materials - Silicones; SilPruf LM SCS2700.

(3) May National Associates, Inc.; Bondaflex Sil 290.

(4) Pecora Corporation; 301 NS.

(5) Sika Corporation, Construction Products Division; SikaSil-C990.

(6) Tremco Incorporated; Spectrem 1.

b. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.

(1) Products: Subject to compliance with requirements, provide one of the following:

(2) Dow Corning Corporation; 790.

(3) May National Associates, Inc.; Bondaflex Sil 728 NS.

(4) Pecora Corporation; 301 NS.

(5) Tremco Incorporated; Spectrem 800.

C. LATEX JOINT SEALANTS

1. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

a. Products: Subject to compliance with requirements, provide one of the following:

(1) BASF Building Systems; Sonolac.

(2) Bostik, Inc.; Chem-Calk 600.

(3) May National Associates, Inc.; Bondaflex 600.

(4) Pecora Corporation; AC-20+.

(5) Schnee-Morehead, Inc.; SM 8200.

(6) Tremco Incorporated; Tremflex 834.

D. JOINT SEALANT BACKING

1. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

2. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

3. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

E. MISCELLANEOUS MATERIALS

1. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

3. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

A. EXAMINATION

1. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. PREPARATION

1. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

   a. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

   b. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

      (1) Concrete.

      (2) Masonry.

   c. Remove laitance and form-release agents from concrete.

   d. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

(1) Metal.

(2) Glass.

e. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

f. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

C. INSTALLATION OF JOINT SEALANTS

1. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

2. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

3. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

4. Do not leave gaps between ends of sealant backings.

5. Do not stretch, twist, puncture, or tear sealant backings.

6. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

7. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

8. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

   a. Place sealants so they directly contact and fully wet joint substrates.

   b. Completely fill recesses in each joint configuration.

   c. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

9. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

   a. Remove excess sealant from surfaces adjacent to joints.

   b. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

   c. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

      (1) Use masking tape to protect surfaces adjacent to recessed tooled joints.

D. FIELD QUALITY CONTROL

1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

   a. Extent of Testing: Test completed and cured sealant joints as follows:

(1) Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.

b. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

(1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

c. Inspect tested joints and report on the following:

(1) Whether sealants filled joint cavities and are free of voids.

(2) Whether sealant dimensions and configurations comply with specified requirements.

(3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

2. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be

considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

E. CLEANING

Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

F. PROTECTION

Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

G. JOINT-SEALANT SCHEDULE

1. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

    a. Joint Locations:

        (1) Isolation and contraction joints in cast-in-place concrete slabs.

    b. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.

    c. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

2. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

    a. Joint Locations:

        (1) Construction joints in cast-in-place concrete.

        (2) Control and expansion joints in unit masonry.

(3) Perimeter joints between materials listed above and frames of doors windows and louvers.

b. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.

c. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

3. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

a. Joint Locations:

(1) Isolation joints in cast-in-place concrete slabs.

b. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.

c. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

4. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

a. Joint Locations:

(1) Control and expansion joints on exposed interior surfaces of exterior walls.

(2) Perimeter joints of exterior openings.

(3) Vertical joints on exposed surfaces of walls and partitions.

(4) Perimeter joints between interior wall surfaces and frames of interior doors and windows.

b. Joint Sealant: Latex.

c. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

DIVISION 8 – OPENINGS

08110	Steel Doors and Frames
08331	Overhead Coiling Doors
08710	Door Hardware
08952	Fiberglass Sandwich Panel Assemblies

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SECTION 08110 STEEL DOORS AND FRAMES

PART 1 - GENERAL

A. RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SUMMARY

1. Section includes hollow-metal work.

2. Related Requirements:

a. Section 08710 "Door Hardware" for door hardware for hollow-metal doors.

C. DEFINITIONS

Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

D. COORDINATION

Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

E. ACTION SUBMITTALS

1. Product Data: For each type of product.

a. Include construction details, material descriptions, core descriptions, and finishes.

2. Shop Drawings: Include the following:

a. Elevations of each door type.

b. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.

c. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

d. Locations of reinforcement and preparations for hardware.

e. Details of each different wall opening condition.

f. Details of anchorages, joints, field splices, and connections.

g. Details of accessories.

h. Details of moldings, removable stops, and glazing.

i. Details of conduit and preparations for power, signal, and control systems.

3. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

F. DELIVERY, STORAGE, AND HANDLING

1. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

2. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

3. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

A. MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:

a. Amweld International, LLC.

b. Ceco Door Products; an Assa Abloy Group company.

c. Commercial Door & Hardware Inc.

d. Custom Metal Products.

e. Daybar.

f. Hollow Metal Inc.

g. MPI Group, LLC (The).

h. North American Door Corp.

i. Republic Doors and Frames.

j. Steelcraft; an Ingersoll-Rand company.

2. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

B. INTERIOR DOORS AND FRAMES

1. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

2. Standard-Duty Doors and Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule.

a. Physical Performance: Level C according to SDI A250.4.

b. Doors:

(1) Type: As indicated in the Door and Frame Schedule.

(2) Thickness: 1-3/4 inches (44.5 mm) .

(3) Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.032 inch (0.8 mm).

(4) Edge Construction: Model 1, Full Flush.

(5) Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocy-

anurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

c. Frames:

(1) Materials: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).

(2) Construction: Full profile welded.

d. Exposed Finish: Prime.

C. EXTERIOR HOLLOW-METAL DOORS AND FRAMES

1. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

2. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

a. Physical Performance: Level B according to SDI A250.4.

b. Doors:

(1) Type: As indicated in the Door and Frame Schedule.

(2) Thickness: 1-3/4 inches (44.5 mm.)

(3) Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A40 (ZF120) coating.

(4) Edge Construction: Model 1, Full Flush.

(5) Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

(a) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) 10 R-value when tested according to ASTM C 1363.

c. Frames:

(1) Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.

(2) Construction: Full profile welded.

d. Exposed Finish: Prime.

D. MATERIALS

1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

3. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

4. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

5. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

a. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

6. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

7. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

8. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

9. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufac-

tured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

10. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

E. FABRICATION

1. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

2. Hollow-Metal Doors:

   a. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.

   b. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).

   c. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.

   d. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.

   e. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

3. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide

alignment plates or angles at each joint, fabricated of same thickness metal as frames.

a. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

b. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

c. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

d. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.

e. Jamb Anchors: Provide number and spacing of anchors as follows:

    (1) Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:

        (a) Two anchors per jamb up to 60 inches (1524 mm) high.

        (b) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.

        (c) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.

        (d) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

    (2) Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

(a) Three anchors per jamb up to 60 inches (1524 mm) high.

(b) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.

(c) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.

(d) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

(3) Compression Type: Not less than two anchors in each frame.

(4) Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

f. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

(1) Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

4. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

5. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

a. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

b. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. STEEL FINISHES

1. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

   a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

A. EXAMINATION

1. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

2. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. PREPARATION

1. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

2. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

C. INSTALLATION

1. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

2. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

   a. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set.

After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

(1) Install door silencers in frames before grouting.

(2) Remove temporary braces necessary for installation only after frames have been properly set and secured.

(3) Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

(4) Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

b. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

(1) Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

c. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.

d. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

e. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.

f. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

g. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.

h. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

(1) Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

(2) Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.

(3) Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

(4) Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

i. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

j. Non-Fire-Rated Steel Doors:

(1) Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

(2) At Bottom of Door: 5/8 inch (15.8 mm) plus or minus 1/32 inch (0.8 mm).

(3) Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

D. ADJUSTING AND CLEANING

1. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

2. Remove grout and other bonding material from hollow-metal work immediately after installation.

3. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

4. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

5. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

6. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 08331 OVERHEAD COILING DOORS

PART 1 - GENERAL

A. RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SUMMARY

1. Section Includes:

a. Service doors.

b. Insulated service doors.

2. Related Requirements:

a. Section 05500 "Misc. Metals" for miscellaneous steel supports.

C. ACTION SUBMITTALS

1. Product Data: For each type and size of overhead coiling door and accessory.

a. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

b. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

2. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

a. Include plans, elevations, sections, and mounting details.

b. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

c. Include points of attachment and their corresponding static and dynamic loads imposed on structure.

d. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.

e. Include diagrams for power, signal, and control wiring.

3. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

a. Curtain slats.

b. Bottom bar with sensor edge.

c. Guides.

d. Brackets.

e. Hood.

f. Locking device(s).

g. Include similar Samples of accessories involving color selection.

D. INFORMATIONAL SUBMITTALS

Qualification Data: For Installer.

E. CLOSEOUT SUBMITTALS

Maintenance Data: For overhead coiling doors to include in maintenance manuals.

F. QUALITY ASSURANCE

1. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

a. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

PART 2 - PRODUCTS

A. MANUFACTURERS, GENERAL

1. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

   a. Obtain operators and controls from overhead coiling door manufacturer.

B. PERFORMANCE REQUIREMENTS

1. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

   a. Design Wind Load: See Structural drawings.

   b. Testing: Doors must meet State of Florida Product Approval.

   c. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

C. DOOR ASSEMBLY: 14’w X 16’h

1. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      (1) Alpine Overhead Doors, Inc.

      (2) ASTA Door Corporation.

      (3) C.H.I. Overhead Doors.

      (4) Cookson Company.

      (5) Cornell Iron Works, Inc.

      (6) McKeon Rolling Steel Door Company, Inc.

      (7) Metro Door.

      (8) Overhead Door Corporation.

(9) Raynor.

(10) Wayne-Dalton Corp.

2. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

   a. Include tamperproof cycle counter.

3. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. (0.406 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283 or DASMA 105.

4. Door Curtain Material: Galvanized steel.

5. Door Curtain Slats: Flat profile slats of2-5/8-inch (67-mm) center-to-center height.

6. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.

7. Curtain Jamb Guides: Galvanized steel] with exposed finish matching curtain slats.

8. Hood: Galvanized steel.

   a. Shape: Round.

   b. Mounting: Face of wall.

9. Electric Door Operator:

   a. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.

   b. Operator Location: Wall.

   c. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.

   d. Motor Exposure: Exterior, wet, and humid.

e. Emergency Manual Operation: Chain type.

f. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.

(1) Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.

g. Control Station(s): Interior mounted.

h. Other Equipment: Portable radio-control system.

10. Curtain Accessories: Equip door with weatherseals.

11. Door Finish:

a. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

b. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

D. DOOR ASSEMBLY: 14’w X 16’h

1. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

(1) Alpine Overhead Doors, Inc.

(2) ASTA Door Corporation.

(3) C.H.I. Overhead Doors.

(4) Cookson Company.

(5) Cornell Iron Works, Inc.

(6) McKeon Rolling Steel Door Company, Inc.

(7) Metro Door.

(8) Overhead Door Corporation.

(9) Raynor.

(10) Wayne-Dalton Corp.

2. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

   a. Include tamperproof cycle counter.

3. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. (0.406 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283 or DASMA 105.

4. Curtain R-Value: 5.0 deg F x h x sq. ft./Btu (0.881 K x sq. m/W).

5. Door Curtain Material: Galvanized steel.

6. Door Curtain Slats: Flat profile slats of2-5/8-inch (67-mm) center-to-center height.

7. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.

8. Curtain Jamb Guides: Galvanized steel] with exposed finish matching curtain slats.

9. Hood: Galvanized steel.

   a. Shape: Round.

   b. Mounting: Face of wall.

10. Electric Door Operator:

    a. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.

    b. Operator Location: Wall.

    c. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.

    d. Motor Exposure: Exterior, wet, and humid.

e. Emergency Manual Operation: Chain type.

f. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.

(1) Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.

g. Control Station(s): Interior mounted.

h. Other Equipment: Portable radio-control system.

11. Curtain Accessories: Equip door with weatherseals.

12. Door Finish:

a. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

b. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

E. MATERIALS, GENERAL

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. DOOR CURTAIN MATERIALS AND CONSTRUCTION

1. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

a. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.

b. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed

indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.

c. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm).

2. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

G. HOODS

1. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

a. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

H. CURTAIN ACCESSORIES

1. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

a. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.

b. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.

I. COUNTERBALANCING MECHANISM

1. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

2. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

3. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

4. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

5. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

J. ELECTRIC DOOR OPERATORS

1. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

   a. Comply with NFPA 70.

   b. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

2. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

3. Door Operator Location(s): Operator location indicated for each door.

    a. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.

4. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

    a. Electrical Characteristics:

        (1) Phase: 3 Phase.

        (2) Volts: 460V.

        (3) Hertz: 60.

    b. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.

    c. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

    d. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

5. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

6. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety

sensor capable of protecting full width of door opening.[For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

a. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

(1) Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

7. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

a. Interior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

8. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

9. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

10. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

11. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

12. Portable Radio-Control System: Consisting of two of the following per door operator:

    a. Three-channel universal coaxial receiver to open, close, and stop door.

    b. Portable control device to open and stop door may be momentary-contact type; control to close door shall be sustained- or constant-pressure type.

    c. Remote-antenna mounting kit.

K. GENERAL FINISH REQUIREMENTS

1. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

2. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

L. STEEL AND GALVANIZED-STEEL FINISHES

Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

A. EXAMINATION

1. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

2. Examine locations of electrical connections.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. INSTALLATION

1. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

2. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

3. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

C. STARTUP SERVICE

1. Engage a factory-authorized service representative to perform startup service.

   a. Perform installation and startup checks according to manufacturer's written instructions.

   b. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

D. ADJUSTING

1. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

   a. Adjust exterior doors and components to be weather-resistant.

2. Lubricate bearings and sliding parts as recommended by manufacturer.

3. Adjust seals to provide tight fit around entire perimeter.

E. MAINTENANCE SERVICE

1. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for

door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

a. Perform maintenance, including emergency callback service, during normal working hours.

F. DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 08710 DOOR HARDWARE

PART 1 - GENERAL

A. RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SUMMARY

1. Section includes:

a. Mechanical door hardware for the following:

(1) Swinging doors.

2. Related Sections:

a. Section 08110 "Steel Doors and Frames" for door silencers provided as part of hollow-metal frames.

3. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.

a. Permanent lock cores to be installed by Owner.

C. ACTION SUBMITTALS

1. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.

a. Sample Size: Full-size units or minimum 2-by-4-inch (51-by-102-mm) Samples for sheet and 4-inch (102-mm) long Samples for other products.

(1) Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

3. Other Action Submittals:

a. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

(1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

(2) Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.

(3) Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.

(4) Content: Include the following information:

(a) Identification number, location, hand, fire rating, size, and material of each door and frame.

(b) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.

(c) Complete designations, including name and manufacturer, type, style, function,

size, quantity, function, and finish of each door hardware product.

(d) Fastenings and other pertinent information.

(e) Explanation of abbreviations, symbols, and codes contained in schedule.

(f) Mounting locations for door hardware.

(g) List of related door devices specified in other Sections for each door and frame.

b. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

D. INFORMATIONAL SUBMITTALS

1. Qualification Data: For Installer].

2. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

3. Warranty: Special warranty specified in this Section.

E. CLOSEOUT SUBMITTALS

Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware schedule.

F. QUALITY ASSURANCE

1. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

a. Warehousing Facilities: In Project's vicinity.

b. Scheduling Responsibility: Preparation of door hardware and keying schedules.

2. Source Limitations: Obtain each type of door hardware from a single manufacturer.

3. Means of Egress Doors: Latches do not require more than 5 lbf (22.2 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

4. Accessibility Requirements: For door hardware on doors in an accessible route, comply with 2010 Florida Building Code Accessibility requirements.

   a. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).

   b. Comply with the following maximum opening-force requirements:

      (1) Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.

      (2) Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.

      (3) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

   c. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.

   d. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

G. DELIVERY, STORAGE, AND HANDLING

1. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

2. Tag each item or package separately with identification coordinated with the final door hardware schedule, and

include installation instructions, templates, and necessary fasteners with each item or package.

3. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

H. COORDINATION

1. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

2. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

I. WARRANTY

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fails in materials or workmanship within specified warranty period.

   a. Failures include, but are not limited to, the following:

      (1) Structural failures including excessive deflection, cracking, or breakage.

      (2) Faulty operation of doors and door hardware.

      (3) Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

   b. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

      (1) Manual Closers: 10 years from date of Substantial Completion.

J. MAINTENANCE SERVICE

Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

A. SCHEDULED DOOR HARDWARE

1. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

   a. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.

   b. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

2. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

   a. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

B. HINGES

1. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

   a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:

      (1) Baldwin Hardware Corporation.

      (2) Bommer Industries, Inc.

      (3) Cal-Royal Products, Inc.

      (4) Hager Companies.

      (5) IVES Hardware; an Ingersoll-Rand company.

(6) Lawrence Hardware Inc.

(7) McKinney Products Company; an ASSA ABLOY Group company.

(8) PBB, Inc.

(9) Stanley Commercial Hardware; Div. of The Stanley Works.

C. MECHANICAL LOCKS AND LATCHES

1. Lock Functions: As indicated in door hardware schedule.

2. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

   a. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.

   b. Deadbolts: Minimum 1-inch (25-mm) bolt throw.

3. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

4. Lock Trim:

   a. Description: Per manufacturer’s specifications.

   b. Levers: Cast.

   c. Knobs: Wrought.

   d. Escutcheons (Roses): Wrought.

5. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

6. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

   a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:

(1) Arrow USA; an ASSA ABLOY Group company.

(2) Best Access Systems; Div. of Stanley Security Solutions, Inc.

(3) Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.

(4) Falcon Lock; An Ingersoll-Rand Company.

(5) Marks USA.

(6) SARGENT Manufacturing Company; an ASSA ABLOY Group company.

(7) Schlage Commercial Lock Division; an Ingersoll-Rand company.

(8) Yale Security Inc.; an ASSA ABLOY Group company.

D. LOCK CYLINDERS

1. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

   a. Manufacturer: Same manufacturer as for locking devices.

2. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are removable; face finished to match lockset.

3. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 3 construction master keys.

E. KEYING

1. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

   a. Master Key System: Change keys and a master key operate cylinders.

F. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

   a. Notation: "DO NOT DUPLICATE."

2. Quantity: In addition to one extra key blank for each lock, provide the following:

   a. Cylinder Change Keys: Three.

   b. Master Keys: Five.

G. DOOR GASKETING

1. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

   a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:

      (1) Hager Companies.

      (2) M-D Building Products, Inc.

      (3) National Guard Products.

      (4) Pemko Manufacturing Co.; an ASSA ABLOY Group company.

      (5) Reese Enterprises, Inc.

      (6) Sealeze; a unit of Jason Incorporated.

      (7) Zero International.

H. THRESHOLDS

1. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:

(1) Hager Companies.

(2) M-D Building Products, Inc.

(3) National Guard Products.

(4) Pemko Manufacturing Co.; an ASSA ABLOY Group company.

(5) Reese Enterprises, Inc.

(6) Rixson Specialty Door Controls; an ASSA ABLOY Group company.

(7) Sealeze; a unit of Jason Incorporated.

(8) Zero International.

I. FABRICATION

1. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

a. Manufacturer's identification is permitted on rim of lock cylinders only.

2. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

3. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

a. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

J. FINISHES

1. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

3. 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 the same piece are not acceptable. 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.

PART 3 - EXECUTION

A. EXAMINATION

1. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. PREPARATION

Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

C. INSTALLATION

1. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

   a. Standard Steel Doors and Frames: ANSI/SDI A250.8.

2. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.

   a. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

   b. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

3. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

4. Lock Cylinders: Install construction cores to secure building and areas during construction period.

   a. Furnish permanent cores to Owner for installation.

5. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07920 "Joint Sealants."

6. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

7. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

D. ADJUSTING

Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

E. CLEANING AND PROTECTION

1. Clean adjacent surfaces soiled by door hardware installation.

2. Clean operating items as necessary to restore proper function and finish.

3. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

F. DOOR HARDWARE SCHEDULE

Door Hardware Set No. 1

Provide each SGL door(s) with the following:

Quantity	Item	Manufacturer	Product	Finish
3 each	Butts	STH	CB179 4 ½ x 4 ½	626
1 each	Panic Hardware	VON	98NL	626
1 each	Surface Closer	LCN	4041	689
1 each	Lock Set	CR	CL3557 - NZD	626
1 each	Kick Plate	TBM	K0050 x 12″	630
1 each	Threshold	PEM	2001AT	Alum
1 set	Seals	PEM	P243	-
1 each	Rain Drip	PEM	346C	Alum

Door Hardware Set No. 2

Provide each SGL door(s) with the following:

Quantity	Item	Manufacturer	Product	Finish
3 each	Butts	STH	CB179 4 ½ x 4 ½	626
1 each	Lock Set	CR	CL3557 - NZD	626
1 each	Kick Plate	TBM	K0050 x 12″	630

END OF SECTION

SECTION 08952 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

PART 1 - GENERAL

A. RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SUMMARY

1. Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panels as follows:

   a. Wall assemblies.

2. Related Sections:

C. ACTION SUBMITTALS

1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.

2. Shop Drawings: For panel assemblies. Include plans, elevations, sections, details, and attachments to other work.

   a. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.

3. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

4. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch (305-mm) lengths of full-size framing members and showing details of the following:

   a. Joinery.

   b. Anchorage.

   c. Expansion provisions.

d. Fiberglass-sandwich panels.

e. Flashing and drainage.

5. Delegated-Design Submittal: For panel assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. INFORMATIONAL SUBMITTALS

1. Qualification Data: For qualified manufacturer.

2. Field quality-control reports.

3. Warranties: Sample of special warranties.

E. CLOSEOUT SUBMITTALS

Maintenance Data: For panel assemblies to include in maintenance manuals.

F. QUALITY ASSURANCE

1. Manufacturer Qualifications: For fiberglass-sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICC-ES AC04, "Sandwich Panels," or ICC-ES AC177, "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems."

2. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of panel assemblies required for this Project.

3. Product Options: Information on Drawings and in Specifications establishes requirements for panel assemblies' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including

testing conducted by an independent testing agency and in-service performance.

a. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

4. Preconstruction Testing: Provide panel assemblies that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard panel assemblies by a qualified independent testing agency.

5. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

b. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. WARRANTY

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.

a. Failures include, but are not limited to, the following:

(1) Structural failures including, but not limited to, excessive deflection.

(2) Deterioration of metals, metal finishes, and other materials beyond normal weathering.

(3) Water leakage.

b. Warranty Period: Five years from date of Substantial Completion.

2. Special Fiberglass-Sandwich-Panel Warranty: Manufacturer's standard form in which manufacturer agrees to replace panels that exhibit defects in materials or workmanship.

   a. Defects include, but are not limited to, the following:

      (2) Fiberbloom.

      (3) Delamination of coating, if any, from exterior face sheet.

      (4) Color change exceeding requirements.

      (5) Delamination of panel face sheets from panel cores.

   b. Warranty Period: 20 years from date of Substantial Completion.

3. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

   a. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.

   b. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

A. MANUFACTURERS

1. Basis-of-Design Product: Subject to compliance with requirements, provide 4” Insulated Translucent Fiberglass Sandwich Panel Wall System by Kalwall Corporation or comparable product by one of the following:

   a. Major Industries, Inc.

   b. Skywall Translucent Systems; Vistawall Group (The).

   c. Structures Unlimited, Inc.

B. PERFORMANCE REQUIREMENTS

1. General Performance: Fiberglass-sandwich-panel assemblies shall withstand the effects of the following forces without failure due to defective manufacture, fabrication, installation, or other defects in construction:

   a. Structural loads.

   b. Thermal movements.

   c. Movements of supporting structure.

   d. Dimensional tolerances of building frame and other adjacent construction.

   e. Failure includes, but is not limited to, the following:

      (1) Deflection exceeding specified limits.

      (2) Water leakage.

      (3) Thermal stresses transferred to building structure.

      (4) Noise or vibration created by wind, thermal, or structural movements.

      (5) Loosening or weakening of fasteners, attachments, and other components.

2. Structural Loads:

   a. Wind Loads: See structural drawings

3. Deflection Limits:

   a. Vertical Panel Assemblies: Limited to 1/180 of clear span for each assembly component.

4. Structural-Test Performance: Provide panel assemblies tested according to ASTM E 330, as follows:

   a. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.

5. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).

    a. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water that is controlled by flashing and gutters and drained to the exterior, or water that cannot damage adjacent materials or finishes.

6. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

    a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

7. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC:

    a. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.65 Btu/sq. ft. x h x deg F (3.69 W/sq. m x K) as determined according to NFRC 100.

    b. Solar-Heat-Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.6 as determined according to NFRC 200.

    c. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. (1.50 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).

C. ALUMINUM FRAMING SYSTEMS

1. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

   a. Construction: One-piece, extruded aluminum.

2. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

   a. Sheet and Plate: ASTM B 209 (ASTM B 209M).

   b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).

   c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.

   d. Structural Profiles: ASTM B 308/B 308M.

3. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

4. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

   a. At closures, retaining caps, or battens, use ASTM A 193/A 193M, 300 series stainless-steel screws.

   b. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.

   c. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

5. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

6. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

7. Exposed Flashing and Closures: Aluminum sheet not less than 0.050 inch (1.27 mm) thick, finished to match framing.

8. Framing Gaskets: Manufacturer's standard.

9. Frame-System Sealants: As recommended in writing by manufacturer.

10. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

D. FIBERGLASS-SANDWICH PANELS

1. Description: Assembly of uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.

   a. Self-Ignition Temperature: 650 deg F (343 deg C) or more per ASTM D 1929.

   b. Smoke-Developed Index: 450 or less per ASTM E 84, or 75 or less per ASTM D 2843.

   c. Flame-Spread Index: Not more than 25 per ASTM E 84.

   d. Combustibility Classification: Class CC1 per ASTM D 635.

2. Panel Thickness: 4 inches.

   a. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of 7/16 inch (11.1 mm).

   b. Extruded Aluminum: ASTM B 221 (ASTM B 221M), in alloy and temper recommended in writing by manufacturer.

   c. I-Beam Construction: One-piece, extruded aluminum

   d. Grid Pattern: Inline rectangle, nominal 12 by 24 inches (305 by 610 mm).

3. Exterior Face Sheet:

a. Thickness: 0.070 inches (1.78 mm).

b. Color: Crystal.

c. Color Change: Not more than 3.0 units Delta E when measured according to ASTM D 2244, after outdoor weathering in southern Florida compliant with procedures in ASTM D 1435, with panels mounted facing south and as follows:

(1) Panel Mounting Angle: Not more than 5 degrees from horizontal.

(2) Exposure Period: 60 months.

a. Erosion Protection: Manufacturer's standard.

4. Interior Face Sheet:

a. Thickness: 0.060 inch (1.52 mm).

b. Color: Crystal.

5. Fiberglass-Sandwich-Panel Adhesive: ASTM D 2559.

a. Compatible with facing and core materials.

b. Tensile and shear bond strength of aged adhesive ensures permanent adhesion of facings to cores, as evidenced by testing tensile strength according to ASTM C 297 and shear bond strength according ASTM D 1002. Use accelerated aging procedures that comply with aging requirements for adhesives with high resistance to moisture in ICC-ES AC05, "Sandwich Panel Adhesives."

E. FABRICATION

1. Frame System Fabrication:

a. Fabricate components before finishing.

b. Fabricate components that, when assembled, have the following characteristics:

(1) Profiles that are sharp, straight, and free of defects or deformations.

(2) Accurately fitted joints with ends coped or mitered.

(3) Internal guttering systems or other means to drain water passing through joints, condensation occurring within components, and moisture migrating within assembly to exterior.

c. Fabricate sill closures with weep holes and for installation as continuous component.

d. Reinforce components as required to receive fastener threads.

2. Panel Fabrication: Factory assemble and seal panels.

a. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.

(1) White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every 40 sq. ft. (3.7 sq. m) of panel and limited in diameter to 3/64 inch (1.2 mm).

b. Fabricate with grid pattern that is symmetrical about centerlines of each panel.

c. Fabricate panel to allow condensation within panel to escape.

d. Reinforce panel corners.

F. ALUMINUM FINISHES

Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

A. EXAMINATION

1. Examine areas and conditions, with Installer present, for compliance with requirements for installation

tolerances and other conditions affecting performance of the Work.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. INSTALLATION

1. General:

a. Comply with manufacturer's written instructions.

b. Do not install damaged components.

c. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.

d. Rigidly secure nonmovement joints.

e. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.

f. Seal joints watertight unless otherwise indicated.

2. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

3. Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters.

4. Install components to drain water passing through joints, condensation occurring within aluminum members and panels, and moisture migrating within assembly to exterior.

5. Install components plumb and true in alignment with established lines and elevations.

6. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:

a. Alignment: Limit offset from true alignment to 1/32 inch (0.8 mm) where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding

element separates aligned surfaces by less than 3 inches (76 mm); otherwise, limit offset to 1/8 inch (3.2 mm).

b. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m), but no greater than 1/2 inch (13 mm) over total length.

C. FIELD QUALITY CONTROL

1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

   a. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies shall be tested according to AAMA 501.2 and shall not show evidence of water penetration.

2. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

3. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

4. Prepare test and inspection reports.

END OF SECTION

DIVISION 9 – FINISHES

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SECTION 09851 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

A. RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SUMMARY

Section includes shop-fabricated, fabric-wrapped panel units tested for acoustical performance, including:

1. Sound-absorbing wall panels.

C. DEFINITIONS

1. NRC: Noise Reduction Coefficient.

2. SAA: Sound Absorption Average.

D. ACTION SUBMITTALS

1. Product Data: For each type of fabric facing, panel edge, core material, and mounting indicated.

2. Shop Drawings: For sound-absorbing wall units. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge and core materials.

   a. Include elevations showing panel sizes and direction

3. Samples for Verification: For the following products, prepared on Samples of size indicated below:

   a. Core Material: 12-inch- (300-mm-) square Sample at corner.

   b. Mounting Devices: Full-size Samples.

E. INFORMATIONAL SUBMITTALS

1. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

   a. Items penetrating or covered by sound-absorbing wall units including the following:

      1) Lighting fixtures.

      2) Air outlets and inlets.

      3) Louvers

      4) Fiberglass sandwich panels

      5) Sprinklers.

      6) Access panels.

2. Product Certificates: For each type of sound-absorbing wall unit, from manufacturer.

3. Warranty: Sample of special warranty.

F. CLOSEOUT SUBMITTALS

Maintenance Data: For sound-absorbing wall units to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.

G. MAINTENANCE MATERIAL SUBMITTALS

1. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   a. Mounting Devices: Full-size units equal to 5 (five) percent of amount installed, but no fewer than 5 (five) devices, including unopened adhesives.

H. QUALITY ASSURANCE

1. Source Limitations: Obtain sound-absorbing wall units from single source from single manufacturer.

2. Fire-Test-Response Characteristics: Provide sound-absorbing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

   a. Surface-Burning Characteristics: As determined by testing per ASTM E 84.

   b. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction

I. DELIVERY, STORAGE, AND HANDLING

Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

J. PROJECT CONDITIONS

1. Environmental Limitations: Do not install sound-absorbing wall units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

2. Air-Quality Limitations: Protect sound-absorbing wall units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

3. Field Measurements: Verify locations of sound-absorbing wall units and actual dimensions of openings and penetrations by field measurements before fabrication.

K. WARRANTY

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-absorbing wall units that fail in materials or workmanship within specified warranty period.

   a. Failures include, but are not limited to the following:

1) Acoustical performance.

2) Warping of core.

2. Warranty Period:

1. The warranty period shall commence at the date of substantial completion of the Process 650 and last for duration of two (2) years.

PART 2 - PRODUCTS

A. SOUND-ABSORBING WALL UNITS

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:

a. Tectum Inc V-line Wall Panels

1) Material: aspen wood fibers bonded with inorganic hydraulic cemen

2) Thickness: 2 inches

3) Edge: Long edge beveled

4) Color: Custom Colors

2. General Requirements for Sound-Absorbing Wall Units: Units shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

3. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material.

a. Basis-of-Design Product: Tectum V-line Wall Panels

b. Mounting: Edge mounted with splines secured to substrate.

1) Finish Color at Exposed Edges: As selected by Architect from manufacturer's full range

c. Mounting: Back mounted with manufacturer's standard secured to substrate.

d. Core: Manufacturer's standard

1) Core-Face Layer: Manufacturer's standard

e. Reveals between Panels: Generally indicate facing material on Drawings or insert, in first subparagraph below, the drawing designation of facing material specified in "Materials" Article.

f. Panel Width: As indicated on Drawings

g. Panel Height: As indicated on Drawings

B. MATERIALS

General: Certified Wood: Fabricate products with wood-based components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

C. FABRICATION

1. General: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

2. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

a. Thickness.

b. Edge straightness.

c. Overall length and width.

d. Squareness from corner to corner.

e. Chords, radii, and diameters.

PART 3 - EXECUTION

A. EXAMINATION

1. Examine fabric, fabricated units, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing wall units.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. INSTALLATION

1. Install sound-absorbing wall units in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

2. Comply with sound-absorbing wall unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3. Align and level fabric pattern and grain among adjacent units.

C. INSTALLATION TOLERANCES

Variation from Plumb and Level:

D. CLEANING

1. Clip loose threads; remove pills and extraneous materials.

2. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

SECTION 09900 PAINTING AND COATING

PART 1 - GENERAL

A. Description

This section includes materials and application of painting and coating systems for the following surfaces:

1. Submerged metal.

2. Exposed metal, including galvanized metal.

3. Buried metal.

4. Concrete and masonry.

5. PVC and CPVC

6. Metal in contact with concrete.

7. Masonry

8. Exterior architectural coatings and finishes.

9. Interior architectural coatings and finishes.

10. Exposed Conduits and pipes.

It does not include coating steel water tanks and reservoirs.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit manufacturer's data sheets showing the following information:

a. Percent solids by volume.

b. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.

c. Recommended surface preparation.

d. Recommended thinners.

e. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.

f. Application instructions including recommended equipment and temperature limitations.

g. Curing requirements and instructions.

3. Submit color swatches.

4. Submit certificate identifying the type and gradation of abrasives used for surface preparation.

5. Submit material safety data sheets for each coating.

PART 2 - MATERIALS

A. Painting and Coating Systems

The following index lists the various painting and coating systems by service and generic type:

PAINT COATINGS SYSTEM INDEX

No.	**Title**	**Generic Coating**
Submerged Metal Coating Systems		
6.	Submerged Metal, Raw Sewage or Grit Slurries	Epoxy resin/ceramic
7.	Submerged Metal, Potable or Nonpotable Water	Epoxy
Exposed Metal Coating Systems		
10.	Exposed Metal, Corrosive Environment	High-build epoxy with polyurethane topcoat
15.	Exposed Metal, Atmospheric Weathering Environment	Alkyd enamel
17.	Exposed Metal, High Temperature	Silicon acrylic
18.	Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up	Organic zinc
Buried Metal Coating Systems		
21.	Buried Metal	Epoxy
22.	Buried Metal	Polyurethane

No.	Title	Generic Coating
24.	Buried Metal	Corrosion-resisting grease
Concrete and Masonry Coating Systems		
31.	Exposed Concrete and Masonry, Corrosive Environment	Polyurethane
32.	Exposed Concrete and Masonry, Atmospheric Weathering Environment	Acrylic
34.	Concrete Floors, Wet Environment	Epoxy
37.	Exposed Masonry or Concrete, Atmospheric Weathering Environment	Cement-based grouting
39.	Buried Concrete, Exterior Walls of Manholes	Coal Tar Epoxy
PVC and CPVC Coating Systems		
41.	PVC and CPVC, Ultraviolet Exposure	Polyurethane
Coating Systems for Nonferrous Metals		
51.	Aluminum Insulation from Concrete and Carbon Steel	Bituminous
52.	Exposed Metal, Galvanized Steel	Synthetic resin
55.	Repair of Galvanized Surfaces	Cold galvanizing compound
Plaster, Wood, Masonry, and Drywall Coating Systems		
66.	Fusion Epoxy-Coated Steel, Color Coding	Epoxy
Exterior Architectural Coatings and Finishes		
71.	Flat Finish on Exterior Concrete and Cement Plaster	Acrylic latex
72.	Semi-Gloss Finish on Exterior Metal	Acrylic latex
73.	Clear Sealer on Exterior Concrete and Masonry	Silane
Interior Architectural Coatings and Finishes		
81.	Semi-Gloss Finish on Concrete, Masonry, or Plaster	Vinyl acrylic

These systems are specified in detail in the following paragraphs. For each coating, the required surface preparation, prime coat, intermediate coat (if required),

topcoat, and coating thicknesses are described. Mil thicknesses shown are minimum dry-film thicknesses.

B. Submerged Metal Coating Systems

1. System No. 6--Submerged Metal, Raw Sewage or Grit Slurries:

Type: Two-component epoxy resin/ceramic having a 100% volume solids and having the following characteristics:

Tensile shear adhesion (ASTM D1002):	2,500 psi (min)
Shore D hardness (minimum):	85
Abrasion resistance (ASTM D4060):	0.8 mg (max) loss per 1,000 cycles

Service Conditions: For use as a lining for pump volutes, pump impellers, piping, valves, and heat exchanger tubes, subject to severe abrasion service.

Surface Preparation: SSPC SP-10.

Coating System: Apply two coats (of two different colors) to a minimum thickness of 10 mils per coat. Minimum total coating thickness shall be 20 mils. Product: THORTEX Cerami-Tech C.R. as applied by Western Industrial Technology, Inc., Fullerton, California, or Paragon Industries, Horsham, Pennsylvania; Belzona 1341; or equal.

2. System No. 7--Submerged Metal, Potable or Nonpotable Water:

Type: Epoxy.

Service Conditions: For use with structures, valves, piping, or equipment immersed in potable or nonpotable water. For potable water service, coating must comply with NSF 61.

Surface Preparation: SSPC SP-10.

Coating System: 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. Color of topcoat: white. Each coat shall be different color than the one preceding it.

C. Exposed Metal Coating Systems

1. System No. 10--Exposed Metal, Corrosive Environment:

Type: High-build epoxy intermediate coat having a minimum volume solids of 60%, with an inorganic zinc prime coat and a pigmented polyurethane finish coat having a minimum volume solids of 52%.

Service Conditions: For use with metal structures or pipes subjected to water condensation; chemical fumes, such as hydrogen sulfide; salt spray; and chemical contact.

Surface Preparation: SSPC SP-10.

Prime Coat: Self-curing, two-component inorganic zinc-rich coating recommended by the manufacturer for overcoating with a high-build epoxy finish coat. Minimum zinc content shall be 12 pounds per gallon. Apply to a thickness of 3 mils. Products: Carboline Carbozinc 11, 11VOC or 11HS, Tnemec 90-97, Sherwin-Williams Zinc-Clad II Plus, or equal.

Intermediate Coat: Carboline Carboguard 60, Tnemec 104, Sherwin-Williams Macropoxy 646 B58-600, or equal; 5 mils.

Finish Coat: Two-component pigmented acrylic or aliphatic polyurethane recommended by the manufacturer for overcoating a high-build epoxy coating. Apply to a thickness of at least 2 mils. Products: Carboline Carbothane 134HG, Tnemec Series 1075, Sherwin-Williams Acrolon Ultra, B65-800, or equal.

2. System No. 15--Exposed Metal, Atmospheric Weathering Environment:

Type: Semi-gloss acrylic having a minimum volume solids content of 46% with alkyd primer.

Service Conditions: For use on exterior metal and piping subject to sunlight and weathering.

Surface Preparation: SSPC SP-6.

Prime Coat: Carboline Carbocoat 115, Tnemec Primer Series V10, Sherwin-Williams Kem-Bond HS B50NZ series, or equal, applied to minimum dry-film thickness of 2 mils.

Finish Coat: Two coats of Carboline Carbocrylic 3359, two coats of Tnemec Series 1028, two coats of Sherwin-Williams DTM Acrylic B66 Series, or equal. Apply to a minimum dry-film thickness of 1.5 mils per coat.

3. System No. 17-Exposed Metal, High-Temperature Resistant (350°F):

   Type: Silicone acrylic with a minimum volume solids of 30% (ASTM D 2697) with inorganic zinc prime coat.

   Service Conditions: For use on exterior metal piping, such as air blower piping, having a maximum temperature of 350°F.

   Surface Preparation: SSPC SP-10.

   Prime Coat: Two-component inorganic zinc pigmented coating recommended by the manufacturer to be coated with a silicone acrylic topcoat. Minimum zinc content shall be 12 pounds per gallon. Apply to a thickness of 3 mils. Products: Carboline Carbozinc 11, 11VOC or 11 HS; Sherwin-Williams Zinc-Clad II Plus, B69-VZ12/B69-VZ15/B69-D11; Tnemec 90-96, or equal.

   Finish Coat: Carboline Thermaline 4900, Flame Control 600, or equal; 1.5 mils

4. System No. 18— Exposed Metal, Organic zinc primer for shop coating and field touch-up

   Type: Organic zinc primer having a minimum zinc content of 14 pounds per gallon.

   Service Conditions: For use as a shop-applied primer or field touch-up primer over inorganic zinc prime coatings on exposed metal.

   Surface Preparation: SSPC SP-10.

   Coating: Coating shall be of the two- or three-component converted epoxy, epoxy phenolic, or urethane type. Products: Carboline Carbozinc 859, Tnemec 90-97, Sherwin-Williams Corothane I GalvaPac B65G11, or equal; applied to a minimum dry-film thickness of 3 mils. Organic zinc primer shall be manufactured by the prime coat manufacturer.

D. Buried Metal Coating Systems

1. System No. 21--Buried Metal:

Type: High solids epoxy or phenolic epoxy having a minimum volume solids of 80% (ASTM D2697).

Service Conditions: Buried metal, such as valves, flanges, bolts, nuts, structural steel, and fittings.

Surface Preparation: SSPC SP-10.

Coating System: Apply three or more coats of Carboline Carboguard 891HS, Tnemec 104HS, Sherwin-Williams Tank Clad HS B62-W80/B60-V80, or equal; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

2. System No. 22--Buried Metal:

Type: Two-component polyurethane having the following characteristics:

a. Coatings shall contain no tar or hydrocarbon additives or solvent.

b. Hardness (ASTM D2240, Shore "D"): 65 to 85.

c. Abrasion Resistance (ASTM D4060, Taber CS-17): 25 mg (maximum) loss per 1,000 cycles or a maximum loss of 65 mg per ASTM C501.

Service Conditions: Buried metal, such as valves, flanges, bolts, nuts, structural steel, and fittings.

Surface Preparation: SSPC SP-10.

Coating System: Carboline Polyclad 767, Madison Chemical Industries, Inc. Corrocote Plus (CM), Sherwin-Williams Poly-Cote 115 or equal. Apply to a total thickness of 30 mils.

3. System No. 24--Buried Metal:

Type: Corrosion-resisting grease.

Service Conditions: Buried metal, such as bolts, bolt threads, tie rods, and nuts.

Surface Preparation: SSPC SP-3 or SP-6.

Coating: NO-OX-ID "GG-2" as manufactured by Sanchem, Inc. Apply to a minimum thickness of 1/4-inch.

E. Concrete and Masonry Coating Systems

1. System No. 31 - Exposed Concrete and Masonry, Corrosive Environment

Type: two-component, minimum 98% solids, polyurethane, with primer having the following characteristics.

Tensile Strength on Concrete:	2,500 psi (minimum) per ASTM D412
Flexibility:	No effect bending 0.50 mm plate with 30-mil coating over 1/8-inch mandrel per ASTM D1737 or no effect bending 180 degrees over 1-inch mandrel with 15-mil coating per ASTM D522
Elongation:	50% (minimum) recoverable, per ASTM D412
Surface Hardness:	60 minimum, Shore "D" per ASTM D2240
Abrasion Resistance:	Weight loss of 80 mg (maximum) on Taber abraser, CS-17 wheel, 1,000 grams, 1,000 cycles per ASTM D4060

Service Conditions: Buried concrete and concrete submerged in raw wastewater and exposed to an atmosphere containing up to 1,000-ppm hydrogen sulfide, saturated with water vapor.

Surface Preparation: Prepare surface in accordance with ASTM D4259 to create a surface profile equal to ICRI CSP 5 or greater.

Concrete Resurfacing: Apply Carboguard 510, Tnemec Series 218 Mortarclad or Sherwin-Williams Corobond 300 B58A310/B58V310/B58D310 to all surfaces at an average of 1/16-inch to fill voids and bugholes, restore surface to a paintable condition and to mitigate concrete outgassing.

Product: Carboline Primer (Self priming when concrete is dry. Use Carboguard 1340WB, Phenoline 311, Carboguard 690 or Plasite 4503 as primer when concrete is damp) with Carboline Reactamine 760; Sherwin-Williams Primer (Dura-Plate 235, B67-V235 Series) with Sherflex B65-V910 topcoat; Tnemec Series 27WB Primer with Tnemec Series 406 Elastoshield. Apply prime coat and finish coats to give a total dry coating thickness of at least 80 mils on walls and 125 mils on floor or ceiling slabs.

2. System No. 32--Exposed Concrete and Masonry, Atmospheric Weathering Environment:

   Type: Acrylic enamel or acrylic latex having a minimum volume solids of 36%.

   Service Conditions: Exposed concrete or masonry exposed to normal sunlight and weathering.

   Surface Preparation: In accordance with Part 3, subsection on "Preparation of Concrete and Masonry Surfaces To Be Coated."

   Prime Coat: Water-borne acrylic or cementitious acrylic emulsion having a minimum solids volume of 40%. Apply one coat of Carboline Sanitile 100 to fill all voids, pores, and cracks; Tnemec 1254 Masonry Filler; Sherwin-Williams Heavy Duty Block Filler B42W46; or equal to masonry only from 75-125 square feet per coat.

   Finish Coat: Two coats of Carboline Carbocrylic 3359, two coats Tnemec Series 6, Sherwin-Williams DTM Acrylic Coating Semi-Gloss B66-100 series, or equal. Apply to a thickness of 2 mils per coat.

3. System No. 34--Concrete Floors, Wet Environment:

   Type: Polyamide cured epoxy having a minimum volume solids of 53%.

   Service Conditions: Concrete floors subject to pedestrian traffic or exposure to water splashing from pump seal water, cleaning, etc.

   Surface Preparation: In accordance with Part 3, subsection on "Preparation of Concrete and Masonry Surfaces To Be Coated."

   Coating System: Two coats of Carboline Carboguard 890, two coats of Tnemec Series N69, two coats of Sherwin-

Williams Macropoxy 646 B58-600 series, or equal. Apply to a minimum dry-film thickness of 5 mils per coat.

4. System No. 37--Exposed Masonry or Concrete, Atmospheric Weathering Environment:

   Type: Cement-base, waterproofing grouting for concrete and masonry.

   Service Conditions: For use in waterproofing concrete, block, brick, stone, and other masonry.

   Surface Preparation: In accordance with Part 3, subsection on "Preparation of Concrete and Masonry Surfaces To Be Coated." Dampen surface immediately ahead of application with clean water. Follow manufacturer's instructions on mixing and application.

   Coatings: Apply two or more coats of Bonsal Sure-Coat to minimum total thickness of 1/16 inch or evenly distribute a base coat of Thoro Systems Products "Thoroseal" or equal, minimum 2 pounds per square yard. Then apply another coat at 1 pound per square yard for a total of 3 pounds per square yard.

5. System No. 39 — Buried Concrete, Exterior Walls of Sanitary Sewer Manholes, and Submerged Concrete, Raw Sewage, Mixed Liquor or Aerobically Digested Sludge:

   Type: High-build coal tar epoxy having a minimum volume solids of 72%.

   Service Conditions: For use in protecting exterior concrete.

   Surface Preparation: In accordance with Part 3.D.

   Coating System: One coat of Tnemec 46H-413 Hi-Build Tneme-Tar, 14 mils; one coat of Carboline Bitumastic 300M, 14 mils; two coats of PPG Coal Cat Resinous Cured Coal Tar Epoxy 97-640, 7 mils each; or Sherwin-Williams Targuard, 14 mils or equal.

F. PVC Coating Systems

1. System No. 41-Color Coding of PVC exposed to sunlight

   Type: Epoxy primer with a minimum volume solids of 54% and a pigmented polyurethane enamel having a minimum volume solids of 52%.

Service Conditions: Color coding of PVC exposed to sunlight.

Surface Preparation: SSPC SP-1. Then lightly abrade the surface with medium-grain sandpaper.

Prime Coat: One coat of Carboline Carboguard 60, Tnemec Series N69 Epoxoline, Sherwin-Williams Macropoxy 646 B58 series, or equal. Apply to a minimum dry-film thickness of 4 mils.

Finish Coat: One coat of Carboline Carbothane 134HG, Tnemec Series 1075, Sherwin-Williams Acrolon Ultra B65-800 series, or equal. Apply to a minimum dry-film thickness of 3 mils.

G. Coating Systems for Nonferrous Metals

1. System No. 51--Aluminum Insulation from Concrete and Carbon Steel:

Type: Bituminous paint having a minimum volume solids of 68% coal-tar pitch based.

Service Conditions: Coat areas of aluminum grating, stairs, structural members or aluminum fabrications, in contact with concrete or carbon steel with this system.

Surface Preparation: Solvent or steam cleaning per SSPC SP-1; do not use alkali cleaning. Then dust blast.

Prime Coat: No primer required for Carboline or Tnemec.

Finish Coat: Carboline Bitumastic 50, Tnemec 46-465, or equal. Apply two coats to a minimum dry-film thickness of 12 mils each.

2. System No. 52--Exposed Metal, Galvanized Steel:

Type: Synthetic resin or epoxy primer.

Service Conditions: Coat galvanized steel and aluminum surfaces with this system before applying topcoat.

Surface Preparation of Galvanized Steel: Surfaces shall be flat with no protrusions. Remove high spots and tears in the galvanizing with hand and power grinders. Comply with ASTM D6386, paragraph 5.2.1. Do not remove the galvanized coating below the specified thickness. Solvent clean galvanized surfaces per ASTM D6386,

paragraph 5.3.2. Then sweep blast per ASTM D6386, paragraph 5.4.1. Use one of the abrasive materials that is described in ASTM D6386, paragraph 5.4.1. Surface preparation for weathered and partially weathered galvanized steel shall be in accordance with ASTM D6386, paragraphs 6 and 7. Apply prime coating within one hour of the surface preparation.

Surface Preparation of Aluminum: Solvent clean or steam clean aluminum surfaces per SSPC SP-1; do not use alkali cleaning. Prime Coat: Carboline Galoseal WB, Tnemec N69-1211, Sherwin-Williams Macropoxy 646 B58-600 series, or equal. Apply to a minimum thickness of 4 mils or as recommended by coating supplier.

Intermediate and Finish Coats: Epoxy and polyurethane as described in System No. 10. Do not include the inorganic zinc prime coat described in that system.

3. System No. 55--Repair of Galvanized Steel Surfaces:

Type: Cold galvanizing compound consisting of paint containing oils, solvents, and zinc dust and complying with MIL-P-21035. Minimum metallic zinc content in the cured coating shall be 90%.

Service Conditions: Repair of damaged galvanized coatings on steel surfaces. Do not utilize if galvanized steel is being topcoated.

Surface Preparation: Clean damaged surfaces per SSPC SP-1 and SP-11.

Coating System: Apply Z.R.C. Galvanizing Compound, RAMCO Specialty Products "Zinckit," NuWave "Galv-Match-Plus," Devcon "Cold Galvanizing," Clearco "Cold Galvanizing Spray," or equal to a minimum dry-film thickness of 3 mils. Apply per ASTM A780, Annex A2.

H. Plaster, Wood, Masonry, and Drywall Coating System

1. System No. 66--Fusion Epoxy-Coated Steel, Color Coding:

Type: Epoxy having a minimum volume solids content of 60%.

Application: Color coding of pipe or steel surfaces already coated with fusion bonded epoxy.

I. Plaster, Wood, Masonry, and Drywall Coating System

1. System No. 66--Fusion Epoxy-Coated Steel, Color Coding:

Type: Epoxy having a minimum volume solids content of 60%.

Application: Color coding of pipe or steel surfaces already coated with fusion bonded epoxy.

Surface Preparation: SSPC SP-1. Then roughen the epoxy surface with power tool cleaning per SP-3 or a light sandblast per SP-7.

Prime Coat: None.

Finish Coat: One coat of Carboline Carboguard 890, Tnemec 104, Sherwin-Williams Macropoxy 646 B58-600 series, or equal. Apply to a minimum dry-film thickness of 5 mils.

J. Exterior Architectural Coatings and Finishes

1. System No. 71--Flat Finish on Exterior Concrete and Cement Plaster:

Type: Acrylic flat with minimum volume solids of 40% with an epoxy acrylic sealer prime coat.

Surface Preparation: In accordance with Part 3, subsection on "Preparation of Concrete and Masonry Surfaces To Be Coated."

Prime Coat: Carboline Sanitile 120 or equal; Tnemec Series 6; 2 to 3 mils.

Intermediate Coat: Carboline Sanitile 155 or Sherwin-Williams Loxon Conditioner, or equal; 2 mils.

Finish Coat: Two coats, 1.5 mils dry each, or one coat, 3 mils total, of Carboline Sanitile 155, Sherwin-Williams A-100 A6 series, Tnemec Series 6, or equal.

2. System No. 72--Semi-Gloss Finish on Exterior Metal:

Type: Acrylic semi-gloss enamel with minimum volume solids of 35% with an acrylic or water-based inorganic zinc silicate metal primer.

Surface Preparation: Exterior exposed galvanized surfaces shall be sweep abrasive blasted per ASTM D6286 to achieve a uniform anchor profile (1 – 2 mils).

Prime Coat: Carboline Carbocrylic 3358 (ferrous) and Galoseal WB (galvainized/non-ferrous), Tnemec Series 18, Sherwin-Williams Pro-Cryl Universal Primer B66W310, or equal; 3 mils.

Finish Coat: Two coats, 1.5 mils dry each, of Carboline Carbocrylic 3359, Tnemec Series 1029, Sherwin-Williams Metalatex B42-100, or equal.

3. System No. 73--Clear Sealer on Exterior Concrete and Masonry:

Type: Silane with minimum solids of 22%.

Surface Preparation: In accordance with Part 3, subsection on "Preparation of Concrete and Masonry Surfaces To Be Coated."

Prime Coat: One coat Carboline Carbocrete Sealer WB, one coat Prime-A-Pell, one coat Monochem Silane 20 Penetrating Sealer or Hydrozo Enviroseal 7, two coats Okon Block Plugger, one coat Rainstopper 140 or one coat of Sherwin-Williams Loxon 40% A31T40. Apply at 80 square feet per gallon.

Finish Coat: One coat Carboline Carbocrete Sealer WB, one coat Prime-A-Pell, two coats Hydrozo Enviroseal 7, one coat Okon W-2, one coat Rainstopper 140 or one coat of Sherwin-Williams Loxon 40% A31T40. Apply at 80 square feet per gallon.

K. Interior Architectural Coatings and Finishes

1. System No. 81--Semi-Gloss Finish on Concrete, Masonry, or Plaster:

Type: Acrylic semi-gloss enamel with minimum volume solids of 30% with an acrylic primer-sealer.

Surface Preparation: In accordance with Part 3, subsection on "Preparation of Concrete and Masonry Surfaces To Be Coated." Apply one coat of Carboline Sanitile 100 to fill all voids, pores, and cracks; Tnemec 1254 Masonry Filler; Sherwin-Williams Heavy Duty Block Filler B42W46; or equal to masonry only from 75-125 square feet per coat.

Prime Coat: Carboline Sanitile 120, Tnemec Series 6, Sherwin-Williams DTM Acrylic B66 Series or equal; 2 mils.

Finish Coat: Two coats, 1.5 mils dry each, of Carboline Carbocrylic 3359, Tnemec Series 1029, Sherwin-Williams DTM Acrylic B66 Series, or equal.

L. Abrasives for Surface Preparation

1. Abrasives used for preparation of ferrous (excluding stainless steel) surfaces shall be one of the following:

   a. 16 to 30 or 16 to 40 mesh silica sand or mineral grit.

   b. 20 to 40 mesh garnet.

   c. Crushed iron slag, 100% retained on No. 80 mesh.

   d. SAE Grade G-40 or G-50 iron or steel grit.

2. Abrasives used for preparation of copper and aluminum surfaces shall be one of the following:

   a. Crushed slag, 80 to 100 mesh.

   b. Very fine silica sand, 80 to 100 mesh.

3. Abrasives used for preparation of concrete and masonry surfaces shall be 16 to 30 or 16 to 40 mesh silica sand.

4. In the above gradations, 100% of the material shall pass through the first stated sieve size and 100% shall be retained on the second stated sieve size.

M. Organic Zinc Primer for Field Touch-Up and Shop Coating

Where shop-applied inorganic zinc primers cannot be used because of volatile organic compound (VOC) regulations, the organic zinc primer described in System No. 18 may be substituted for the specified inorganic zinc primers.

PART 3 - EXECUTION

A. Weather Conditions

1. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5°F above the dew point.

2. Do not apply paint when the relative humidity is above 85%.

3. Do not paint when temperature of metal to be painted is above 120°F.

4. Do not apply alkyd, inorganic zinc, silicone aluminum, or silicone acrylic paints if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours.

5. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60°F or expected to drop below 60°F in 24 hours.

B. Surface Preparation Procedures

1. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting.

2. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

3. Do not abrasive blast or prepare more surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day. Remove sharp edges, burrs, and weld spatter.

4. Do not abrasive blast PVC piping or equipment. Do not abrasive blast epoxy- or enamel-coated pipe that has already been factory coated, except to repair scratched or damaged coatings.

5. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Apply coatings within two hours of blasting or before any rust bloom forms.

6. Surface preparation shall conform with the SSPC specifications as follows:

Solvent Cleaning	SP-1
Hand Tool Cleaning	SP-2
Power Tool Cleaning	SP-3
White Metal Blast Cleaning	SP-5
Commercial Blast Cleaning	SP-6
Brush-Off Blast Cleaning	SP-7
Pickling	SP-8
Near-White Blast Cleaning	SP-10
Power Tool Cleaning to Bare Metal	SP-11
Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating	SP-12
Surface Preparation of Concrete	SP-13

7. Wherever the words "solvent cleaning," "hand tool cleaning," "wire brushing," or "blast cleaning" or similar words are used in these specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Steel Structure Painting Council), surface preparation specifications listed above.

8. Dust blasting is defined as cleaning the surface through the use of very fine abrasives, such as siliceous or mineral abrasives, 80 to 100 mesh. Apply a fine etch to the metal surface to clean the surface of any contamination or oxide and to provide a surface profile for the coating.

9. Brush-off blasting of concrete and masonry surfaces is defined as opening subsurface holes and voids and etching the surface for a coating to bond.

10. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be 2 to 3 mils. Verify the surface profile by measuring with an impresser tape acceptable to the Owner's Representative. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Owner's Representative. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Owner's Representative.

11. Do not apply any part of a coating system before the Owner's Representative has reviewed the surface preparation. If coating has been applied without this review, if directed by the Owner's Representative, remove the applied coating by abrasive blasting and reapply the coat in accordance with this specification.

12. Examine substrates, areas and conditions, with Applicator and factory representative present for compliance with requirements for paint application. Comply with procedures in PDCA P4.

    a. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

    b. Start of painting will be construed as Factory Representative and Applicator's acceptance of surfaces and conditions within a particular area.

    c. Factory Representative will provide documentation of acceptance of substrates prior to the application of coating.

13. On flanged pipe joints, trim excess gasket material and caulk joint prior to coating.

C. Abrasive Blast Cleaning

1. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.

2. After abrasive blast cleaning and prior to application of coating, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an eight-hour working day. Do not apply coating over damp or moist surfaces. Reclean prior to application of primer or touch-up coating any blast cleaned surface not coated within said eight-hour period.

3. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.

4. During abrasive blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

D. Preparation of Concrete and Masonry Surfaces To Be Coated

1. Surface preparation of concrete and masonry surfaces shall be in accordance with SSPC SP-13 and the following.

2. Do not apply coating until concrete has cured at least 30 days. Finish concrete surfaces per Section 03350. Do not use curing compound on surfaces that are to be coated.

3. Concrete and masonry surfaces on which coatings are to be applied shall be of even color, gray or gray-white. The surface shall have no pits, pockets, holes, or sharp changes of surface elevation. Scrubbing with a stiff-bristle fiber brush shall produce no dusting or dislodging of cement or sand. Sprinkling water on the surface shall produce no water beads or standing droplets. Concrete and masonry shall be free of laitance and slick surfaces.

4. Detergent clean the concrete or masonry surface with trisodium phosphate per ASTM D4258. Then sandblast surfaces (brush-off blast). Floor slabs may be acid etched per ASTM D4260 in lieu of sandblasting. After sandblasting, wash surfaces with water to remove dust and salts, per ASTM D4258 or D4261. The grain of the concrete surface to touch shall not be rougher than that of No. 10 mesh sand.

5. Prior to coating concrete, plaster, and masonry with System No. 31, 32, 34, or 39, determine the presence of capillary moisture per ASTM D4263, except as modified below. Tape a 4-foot by 4-foot sheet of polyethylene plastic to the concrete surface to be coated. Allow the plastic sheet to remain in place at least 24 hours. After the specified time has elapsed, remove the plastic sheet and visually examine both the underside of the plastic sheet and the concrete surface beneath it. There shall be no indication of moisture on either surface. If moisture is indicated, allow additional curing time for the concrete and then retest. Provide one test sheet for every 500 square feet of concrete surface to be coated.

For walls, provide one test sheet for each 10 feet (or fraction thereof) of vertical rise in all elevations starting within 12 inches of the floor or base slab.

6. Acceptance criteria for concrete surfaces shall be in accordance with SSPC SP-13, Table 1, "Severe Service."

7. Do not apply coatings to concrete when the concrete is outgassing. Apply coatings only when the concrete surface temperature is stable, not rising.

E. Procedures for Items Having Shop-Applied Prime Coats

1. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.

2. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.

3. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.

4. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

F. Field Touch-Up of Shop-Applied Prime Coats

1. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.

2. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate,

detergent, and water. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by means of scrubbing with a stiff bristle brush. Rinse scrubbed surfaces with clean water.

3. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.

4. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared per SSPC SP-11. Remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.

5. Use repair procedures on damaged primer that protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.

6. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.

7. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer per System No. 18 to cover scratches or abraded areas.

8. Other surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

G. Painting Systems

1. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.

2. Deliver paints to the jobsite in the original, unopened containers.

H. Paint Storage and Mixing

1. Store and mix materials only in areas designated for that purpose by the Owner's Representative. The area shall be well-ventilated, with precautionary measures taken to prevent fire hazards. Post "No Smoking" signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use. Store paint at an ambient temperature from 50°F to 100°F.

2. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

I. Procedures for the Application of Coatings

1. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.

2. Prior to painting, Contractor shall verify that conditions meet coating Manufacturer's weather conditions in presence of the Owner. Information form shall be completed daily and at four (4) hour intervals during the work day.

3. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.

4. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.

5. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.

6. Apply coating systems to the specified minimum dry-film thicknesses as determined per SSPC PA-2.

7. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.

8. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. Apply the brush coat prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

9. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer's recommendation.

10. Each coat shall cover the surface of the preceding coat completely, and there shall be a visually perceptible difference in applied shade or tint of colors.

11. Applied coating systems shall be cured at 75°F or higher for 48 hours. If temperature is lower than 75°F, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Owner's Representative.

12. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

J. Surfaces Not To Be Coated

Do not paint the following surfaces unless otherwise noted in the drawings or in other specification sections. Protect during the painting of adjacent areas:

1. Concrete walkways.

2. Mortar-coated pipe and fittings.

3. Stainless steel.

4. Metal letters.

5. Glass.

6. Roofings.

7. Fencing.

8. Electrical fixtures except for factory coatings.

9. Nameplates.

10. Grease fittings.

11. Brass and copper, submerged.

12. Buried pipe, unless specifically required in the piping specifications.

13. Fiberglass items, unless specifically required in the FRP specifications.

14. Aluminum handrail, stairs, and grating.

15. Insulated pipe.

K. Protection of Surfaces Not To Be Painted

Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during

surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

L. Surfaces To Be Coated

The exact coating to be applied in any location is not designated by the descriptive phrases in the coating system titles such as "corrosive environment," "buried metal," or "submerged metal." Coat surfaces with the specific coating systems as described below:

1. Coat mechanical equipment, such as pumps, blowers, clarifier mechanisms, as described in the various mechanical equipment specifications. Color of finish coat shall match the color of the connecting piping.

2. Coat aboveground and exposed piping or piping in vaults and structures as described and as shown in the Piping Schedule/flow stream identification in the drawings. Color of finish coat shall be as shown in the Piping Schedule/flow stream identification in the drawings.

3. Coat valves the same as the adjacent piping. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.

4. Coat aluminum surfaces in contact with concrete per System No. 51.

5. Coat buried flanges, nuts and bolts, valves, flexible pipe couplings, and valve boxes per System No. 21. Coat buried bolt threads, tie bolt threads, and nuts per System No. 24.

6. Coat exposed indoor electrical conduit per System No. 52. Color of finish coat shall be specified by Owner.

7. Coat metal doors and frames per Section 08110.

8. Coat gypsum wallboard as shown in the finish schedule in the drawings, system 81. Color of finish coat shall be as shown on the finish schedule in the drawings.

9. Coating Schedule:

The following coating schedule is a general table to aid the General Contractor in describing the coating system to be applied within the major structures. The Contractor shall be responsible to reference the remainder of the Contract Documents for all other areas that require coating. Not all structures to be coated are identified within the following table.

Process Number	Process Name	Surface or Item	Coating System No.
150	North Electrical Building	Interior	81
150	North Electrical Building	Exterior	71
650	Centrifuge Dewatering Building	Equipment Platform Floor	Refer to Structural Drawings
650	Centrifuge Dewatering Building	Truck Scale Pits	Refer to Structural Drawings
650	Centrifuge Dewatering Building	Exposed interior concrete surfaces	81
650	Centrifuge Dewatering Building	Clear Sealer on exterior concrete & masonry	73
650	Centrifuge Dewatering Building	Interior masonry surfaces	81
650	Centrifuge Dewatering Building	Exterior masonry surfaces	71
650	Centrifuge Dewatering Building	Exterior concrete surfaces	32

1. If no coating system is specified for new structures provide coatings in accordance with the following:

Surface or Item	Coating System No.
Exposed interior concrete surfaces	31
Exposed exterior concrete surfaces	32
Interior masonry surfaces	81
Exterior masonry surfaces	71
Clear Sealer on Exterior Concrete & Masonry	73

M. Dry-Film Thickness Testing

1. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Measure coating thickness specified for aluminum with an eddy-current type thickness gauge per ASTM D1400. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.

2. Test the finish coat of metal surfaces (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector, low-voltage, wet-sponge type. Provide measuring equipment. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide detector as manufactured by Tinker and Rasor or K-D Bird Dog.

3. Measure coating thickness specified for concrete or masonry surfaces in accordance with ASTM D4138. Test the finish coat of concrete and masonry surfaces in accordance with NACE RP-0188-90 or ASTM D4787. Patch coatings at the points of thickness measurement or holiday detection.

4. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.

5. For metal surfaces, make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or

detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80%, nor more than 120%, of the specified thickness. One of three readings which are averaged to produce each spot measurement may underrun by a greater amount as defined by SSPC PA-2.

6. For concrete surfaces, make five separate spot measurements spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80%, nor more than 120%, of the specified thickness.

7. Perform tests in the presence of the Owner's Representative.

8. All completed surfaces will be checked by the Owners Representative, and the Contractor shall provide the necessary properly calibrated gauges and the Contractor shall provide scaffolding and ladders as necessary for access to all coated areas. All nonferrous surfaces shall be checked for number of coats and thickness by use of a Tooke gauge. All ferrous surfaces shall be checked for film thickness by use of a magnetic dry film gauge properly calibrated. In addition, submerged tank linings and metals shall be tested for freedom from holidays and pinholes by use of a TinkerRasor Model # M1. All defects shall be corrected to the satisfaction of the Owners Representative. Contractor shall provide two (2) each of the following equipment with all appurtenances to be retained by the owner: Bacharach Sling Psychrometer, wet film thickness gauges appropriate to coating system thickness, TinkerRasor Holiday detector Model # M1, Tooke gauge and DeFelsko Positector No. 6000 or Elcometer dry film thickness gauge for ferrous metals with plastic shims.

N. Repair of Improperly Coated Surfaces

If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the

specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

O. Cleaning

1. During the progress of the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.

2. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.

3. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

END OF SECTION

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SECTION 09954 POLYETHYLENE SHEET ENCASEMENT (AWWA C105)

PART 1 - GENERAL

A. Description

This section includes materials and installation of a polyethylene sheet encasement for buried steel and iron pipe, fittings, and valves.

B. Submittals

1. Submit shop drawings in accordance with General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog literature and product data sheets describing the physical, chemical, and electrical properties of the encasement material.

PART 2 - MATERIALS

A. Polyethylene Wrap

1. The encasement shall consist of low-density polyethylene wrap of at least 8-mil thickness conforming to AWWA C105. The polyethylene wrap shall be colored per process, refer to flow stream identification in the drawings.

2. Polyethylene encasement for ductile-iron pipe shall be supplied as a flat tube meeting the dimensions of Table 1 in AWWA C105 and shall be supplied by the ductile-iron pipe manufacturer.

B. Plastic Adhesive Tape

1. Tape shall consist of polyolefin backing and adhesive which bonds to common pipeline coatings including polyethylene.

2. Minimum Width: 2 inches.

3. Products: Canusa Wrapid Tape; Tapecoat 35; Polyken 934; AA Thread Seal Tape, Inc.; or equal.

PART 3 - EXECUTION

A. Application of Moldable Mastic Filler to Irregular Adjacent Surfaces

When the adjacent joints are bell-and-spigot or mechanical joints and any associated welding specifications do not require an external full fillet weld, apply a moldable mastic filler (per Section 15050) at the step-down area prior to the application of the sheet encasement and tape.

B. Applying Sheet Coating to Buried Piping and Fittings

1. Apply wrapping per AWWA C105 as modified herein.

2. Apply a single wrapping.

3. Install the polyethylene to completely encase the pipe and fittings to provide a watertight corrosion barrier. Continuously secure overlaps and ends of sheet and tube with polyethylene tape. Make circumferential seams with two complete wraps, with no exposed edges. Tape longitudinal seams and longitudinal overlaps, extending tape beyond and beneath circumferential seams.

4. Wrap bell-spigot interfaces, restrained joint components, and other irregular surfaces with wax tape or moldable sealant prior to placing polyethylene encasement.

5. Minimize voids beneath polyethylene. Place circumferential or spiral wraps of polyethylene tape at 2-foot intervals along the barrel of the pipe to minimize the space between the pipe and the polyethylene.

6. Overlap adjoining polyethylene tube coatings a minimum of 1 foot and wrap prior to placing concrete anchors, collars, or supports. Hand wrap the polyethylene sheet, apply two complete wraps with no exposed edges to provide a watertight corrosion barrier, and secure in place with 2-inch-wide plastic adhesive tape.

C. Applying Sheet Coating to Buried Valves

1. Wrap flanges and other irregular surfaces with wax tape or moldable sealant. Press tightly into place leaving no voids underneath and a smooth surface under coating for polyethylene sheet.

2. Wrap with a flat sheet of polyethylene. Place the sheet under the valve and the flanges or joints with the connecting pipe and fold in half. Extend the sheet to the valve stem and secure the sheet in place with 2-inch-wide plastic adhesive tape. Apply a second layer and secure with tape. Make two complete wraps, with no exposed edges, to provide a watertight corrosion barrier. Secure the sheets with tape around the valve stem below the operating nut and around the barrel of the connecting pipe to prevent the entrance of water and soil. Place concrete anchor and support blocks after the wrap has been installed.

D. Applying Sheet Coating to Buried Flexible Pipe Couplings

1. Wrap irregular surfaces with wax tape or moldable sealant. Press tightly into place leaving no voids underneath and a smooth surface under coating for polyethylene sheet.

2. Apply two layers or wraps around the coupling. Overlap the adjoining pipe or fitting a minimum of 1 foot and secure in place with tape. Provide sufficient slack in polyethylene to allow backfill to be placed around fitting without tearing polyethylene. Apply tape around the entire circumference of the overlapped section on the adjoining pipe or fitting in two complete wraps, with no exposed edges, to provide a watertight corrosion barrier.

E. Repair of Polyethylene Material

Repair polyethylene material that is damaged during installation. Use polyethylene sheet, place over damaged or torn area, and secure in place with 2-inch-wide plastic adhesive tape.

F. Applying Sheet Coating to Existing Buried Piping

When connecting polyethylene-encased pipe or fittings to existing pipe, expose existing pipe, thoroughly clean the surface, and securely tape the end of the polyethylene to the existing as specified above. When the existing pipe is polyethylene encased, wrap new polyethylene encasement over the existing, with overlap of at least 2 feet. Tape securely as specified above.

G. Backfill for Polyethylene-Wrapped Pipe, Valves, and Fittings

Place sand backfill within 1 foot of the pipe, valves, and fittings wrapped with polyethylene encasement per Section 02223.

H. Repair of Polyethylene at Service Taps

1. Wrap two or three layers of polyethylene adhesive tape completely around the pipe to cover the area where the tapping machine and chain will be mounted.

2. Mount the tapping machine on the pipe area covered by the polyethylene tape. Then make the tap and install the corporation stop directly through the tape and polyethylene.

3. After making the direct service connection, inspect the entire circumferential area for damage and make repairs.

4. To minimize the possibility of dissimilar metal corrosion at service connections, wrap the corporation stop a minimum clear distance of 3 feet of copper service pipes with polyethylene or dielectric tape.

END OF SECTION

SECTION 09961 FUSION-BONDED EPOXY LININGS AND COATINGS

PART 1 - GENERAL

A. Description

This section includes materials, application, and testing of one-part, fusion-bonded, heat-cured, thermosetting, 100% solids epoxy linings and coatings on steel, cast-iron, and ductile-iron equipment, such as valves, slide gates, and structural steel.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following;

2. Submit manufacturer's catalog literature and product data sheets, describing the physical and chemical properties of the epoxy coating. Describe application and curing procedure.

3. Submit coating application test records for measuring coating thickness and holiday detection for each item or pipe section and fitting. Describe repair procedures used.

PART 2 - MATERIALS

A. Piping and Equipment Surfaces

1. The Contractor shall require the equipment suppliers to provide equipment that is free of salts, oil, and grease to the coating applicator.

2. The Contractor shall require pipe suppliers to provide bare pipe that is free of salts, oil, and grease to the coating applicator.

B. Shop-Applied Epoxy Lining and Coating

Lining and coating shall be a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin: Scotchkote 134 or 206N, Lilly Powder Coatings "Pipeclad 1500 Red, or equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (minimum)	Barcol 17 (ASTM D2583) Rockwell 50 ("M" scale)
Abrasion resistance (maximum value)	1,000 cycles: 0.05 gram removed
	5,000 cycles: 0.115 gram removed
	ASTM D1044, Tabor CS 17 wheel, 1,000-gram weight
Adhesion (minimum)	3,000 psi (Elcometer)
Tensile strength	7,300 psi (ASTM D2370)
Penetration	0 mil (ASTM G17)
Adhesion overlap shear, 1/8-inch steel panel, 0.010 glue line	4,300 psi, ASTM D1002
Impact (minimum value)	100 inch-pounds (Gardner 5/8-inch diameter tup)

C. Field-Applied Epoxy Coating for Patching

Use a two-component, 80% solids liquid resin, such as Scotchkote 306.

D. Painting and Coating of Grooved-End and Flexible Pipe Couplings

Line and coat couplings the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

PART 3 - EXECUTION

A. Shop Application of Fusion-Bonded Epoxy Lining and Coating--General

1. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per item or piece of equipment. Do not use any item, pipe, or piece of equipment in which these requirements cannot be met.

2. Remove surface imperfections, such as slivers, scales, burrs, weld spatter, and gouges. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

3. Uniformly preheat the pipe, item, or piece of equipment prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the surface temperature is at least 5°F above the dew point temperature during blast cleaning and inspection.

4. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.

5. After cleaning and surface preparation, test the surface for residual chloride concentration. If the residual chloride concentration exceeds 5 $\mu g/cm^2$, then apply a phosphoric acid wash to the surface after sandblasting. Apply a phosphoric acid wash to the pipe, item, or piece of equipment after sandblasting. The average temperature, measured in three different locations, shall be 80°F to 130°F during the acid wash procedure. The acid wash shall be a 5% by weight phosphoric acid solution. The duration in which the acid is in contact with the surface shall be determined by using the average temperature as tabulated below:

Surface Temperature (°F)	**Contact Time (seconds)**
80	52
85	45
90	36
95	33
100	28
105	24
110	21
130	10

After the acid wash has been completed, remove the acid with demineralized water having a maximum conductivity of 5 micromhos/cm at a minimum nozzle pressure of 2,500 psi.

6. Apply lining and coating by the electrostatic spray or fluidized bed process. Minimum thickness of lining or coating shall be 15 mils. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to coating. Do not permit surfaces to flash rust before coating.

B. Shop Application of Fusion-Bonded Epoxy Lining and Coating to Pipe--Additional Requirements

1. Apply lining and coating per AWWA C213 except as modified herein.

2. Grind 0.020 inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.

C. Shop Application of Fusion-Bonded Epoxy Lining and Coating to Joint Areas of Ductile-Iron and Cast-Iron Fittings--Additional Requirements

Limit the protective coating thickness in the joints of ductile-iron and cast-iron fittings to maintain a leak-proof joint. However, the coating thickness in the joint area shall not be less than 4 mils.

D. Quality of Lining and Coating Applications

The cured lining or coating shall be smooth and glossy, with no graininess or roughness. The lining or coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

E. Factory Testing of Coating--General

1. Test linings and coatings with a low-voltage wet sponge holiday detector. Test pipe linings and coatings per AWWA C213, Section 5.3.3. If the number of holidays or pinholes is less than one per 20 square feet of coating surface, repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of pinholes and holidays exceeds one per 20 square feet of coating surface, remove the entire lining or coating and recoat the item or pipe.

2. Measure the coating thickness at three locations on each item or piece of equipment or pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value. Where individual measured thickness values are less than the specified minimum thickness, measure the coating thickness at three additional points around the defective area. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. If a

section of the pipe, item, or piece of equipment does not meet these criteria, remove the entire lining or coating and recoat the entire item or piece of equipment.

F. Factory Testing of Lining and Coating of Pipe--Additional Requirements

Check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.

G. Field Repairs

Patch scratches and damaged areas incurred while installing fusion-bonded epoxy coated items with a two-component, 80% solids (minimum), and liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the coating or lining on the sides of the damaged area before applying the liquid epoxy coating. Apply a two-part epoxy coating to defective linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 0.5 inch. If a defective area exceeds 20 square inches, remove the entire lining and coating and recoat the entire item or piece of equipment. Apply the liquid epoxy coating to a minimum dry-film thickness of 15 mils.

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DIVISION 10 – SPECIALTIES

10200	Fixed Louvers
10881	Truck Scales

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SECTION 10200 FIXED LOUVERS

PART 1 - GENERAL

A. Description

This section describes materials and installation of fixed louvers.

B. Submittals

Submit shop drawings in accordance with the General Conditions, and the following:

1. Submit dimensional drawings and manufacturer's catalog data for louvers.

2. Submit manufacturer's specifications; catalog cut sheets; certified test data, where applicable; and installation instructions for required products, including finishes.

3. Submit drawings for fabrication and erection of louver units and accessories. Include plans, elevations, and details of sections and connections to adjoining work. Indicate materials, finishes, fasteners, joinery, and other information to determine compliance with specified requirements. Submit color chart for selection by Owner.

4. Manufacturer shall demonstrate compliance with the Florida Product Approval requirements of the Florida Building Code.

C. Quality Control

1. Performance Requirements: Where louvers are indicated to comply with specific performance requirements, provide units whose performance ratings have been determined in compliance with AMCA 500.

2. AMCA Certification: Where indicated, provide a louver with AMCA Certified Ratings Seal evidencing that product complies with above requirement.

3. Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details,

and installation procedures, except as otherwise indicated.

4. Field Measurements: Verify size, location, and placement of louver units prior to fabrication, wherever possible.

5. Shop Assembly: Coordinate field measurements and shop drawings with fabrication and shop assembly to minimize field adjustment, splicing, mechanical joints, and field assembly of units. Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

PART 2 - MATERIALS

A. Manufacturers

Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include the following:

1. Airolite Company.

2. Ruskin Mfg. Co.

3. Greenheck

B. Type 1 Louver: Stationary Extruded Drainable Aluminum Wall Louvers

1. Horizontal blade louvers shall be 6 inches deep, constructed of extruded aluminum Alloy 6063-T5.

2. Extrusion Thickness: Not less than 0.081 inch for fixed blades and frames.

3. Water Penetration: Not more than 0.01 ounce per square foot of free area at the specified intake airflow free area velocity.

4. Free Area: Not less than 50% based on a 48-inch by 48-inch sized louver.

5. Airflow Through Free Area: 600-fpm maximum free air velocity.

6. Static Pressure Loss: Not more than 0.15 inch of water gauge at the specified airflow free air velocity.

7. AMCA Certification: Furnish units bearing AMCA Certified Ratings Seal.

8. Florida product approved for high wind speed up to 150 mph.

C. Fastenings

Use same materials as items fastened, unless otherwise indicated. Fasteners for exterior applications must be stainless steel. Provide types, gauges, and lengths to suit unit installation conditions. Use Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Anchors and Inserts

Use stainless steel anchors and inserts for exterior installations. Use Type 316 stainless steel expansion bolt devices for drilled-in-place anchors. Provide inserts to be set into concrete or masonry work.

E. Fabrication

1. Fabricate frames and sills with tolerances for installation, including application of sealants in joints between louvers and adjoining work.

2. Include supports, anchorages, and accessories required for complete assembly.

3. Provide sill extensions and loose sills made of same material as louvers for drainage to exterior.

4. Provide vertical mullions of type and at spacings indicated but not further apart than recommended by manufacturer or 72 inches on center, whichever is less. At horizontal joints between louver units, provide horizontal mullions except where continuous vertical assemblies are indicated.

5. Join frame members to one another and to stationary louver blades by welding, except where indicated otherwise or where field-bolted connections between frame members are made necessary by size of louvers. Maintain equal blade spacing, including separation

between blades and frames at head and sill, to produce uniform appearance.

F. Louver Screens

1. Provide removable bird screens of 1/2-inch square mesh, 0.063-inch stainless steel wire for exterior louvers.

2. Fabricate screen frames of same metal and finish as louver units to which secured, unless otherwise indicated.

3. Provide screen mounted in extruded aluminum U-frame placed on interior face of louver with sheet metal screws.

G. Metal Finishes

1. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory after products are assembled. Protect finishes on exposed surfaces with protective covering prior to shipment. Remove scratches and blemishes that are visible after completing finishing process from exposed surfaces.

2. Aluminum Finishes: Medium matte etched finish with 0.7-mil minimum thick anodic coating, AA-C22-A42 clear anodized.

PART 3 - EXECUTION

A. Preparation

Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Service Conditions

1. Louver service conditions shall be as shown below.

2. Louvers:

Type:	1
Maximum airflow through free area:	600-fpm free air velocity
Width:	See Schedule on Drawings
Depth:	See Schedule on Drawings
Height:	See Schedule on Drawings
Minimum free area:	50%
Static pressure loss:	See Schedule on Drawings

C. Installation

1. Locate and place louver units plumb, level, and in proper alignment with adjacent work.

2. Use concealed anchorages wherever possible. Provide washers fitted to screws to protect metal surfaces and to make a weathertight connection.

3. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers.

4. Repair finishes damaged by cutting, welding, soldering, and grinding operations required for fitting and jointing. Restore finish so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make alterations, and refinish entire unit or provide new units, at Contractor's option.

D. Painting and Coating

Coat nonferrous metal surfaces in contact with concrete, masonry, or dissimilar metals.

END OF SECTION

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SECTION 10881 TRUCK SCALES

PART 1 – GENERAL

A. Description

1. Section includes:

a. Furnishing all labor, material, equipment and performing all operations necessary for installation of a completed pit-type, fully electronic concrete platform truck scale system, ready for use as specified and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by the Engineer.

b. The system shall be manufactured, provided, and installed by a scale company that has a minimum of five years of experience installing and servicing similar truck scale systems.

c. The Contractor will coordinate supply of any software required for the scale tracking system to connect with the County’s computer system and will make it fully operational with the County’s computer operating system. Omission of a specific item obviously necessary for the proper functioning of this system shall not relieve the Contractor of the responsibility of furnishing and installing the item as a part of the Contract.

d. Before final payment of scale is made to the Contractor, the Scale system shall be demonstrated by the Contractor to be fully operational and turnkey ready (All inspection shall be completed and state inspection with certification to operate the scale).

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

a. Manufacturer's detailed construction drawings of scale platform, including but not limited to:

(1) Model number, capacity, and size of scale.

(2) Loads which will be imposed on pit and platform.

(3) Material specifications for materials used in platform.

b. Scale pit drawings to include:

(1) Dimensions of walls, floors, anchor bolt locations, and cast-in-steel requirements.

(2) Fulcrum pier location, elevation, and reinforcement.

c. Instrumentation:

(1) Wiring diagrams and locations.

(2) Catalog cut or specifications for instrumentation.

d. Sample weight ticket showing printing specified.

2. Operations and Maintenance Data (O&M).

a. Provide operations & maintenance in accordance with Section 01300.

C. Quality Assurance

1. Scale shall be of latest design of manufacturer regularly engaged in production of electronic motor truck scales. Scale weighbridge and scale electronics shall be of one supplier with parts and service warranties being furnished by supplier directly to the Owner. Supplier shall be responsible for system compatibility and warranty compliance.

PART 2 - PRODUCTS

A. Manufacturers

1. Mettler-Toledo International, Inc.

2. Cardinal Scale Manufacturing Co.

3. Fairbanks Scales, Inc.

B. Weighbridge Specification

1. The scale weighbridge shall be constructed of a single or multiple (up to three) prefabricated scale modules, with a nominal width of 11' and totaling 50’ long.

2. The prefabricated scale modules shall be so designed to enable field pouring of the concrete without additional field forming.

3. The scale deck shall be poured and constructed of concrete with a minimum strength of 4,000 psi at a 28-day cure with 5 to 7% air entrainment.

4. The concrete deck shall be supported by an integral steel structure of sufficient design and construction to meet the loading and life expectancy as specified in Section 1 of this specification.

5. All welding shall be completed in accordance with the American Welding Society (AWS) D1.1 Structural Welding Code.

6. All welding shall be performed by welding operators who have been certified to the AWS D1.1 Structural Welding Code.

7. The weighbridge shall be designed to allow access to load cell cables, base plates, and all foundation anchor bolts.

8. The weighbridge shall be designed to allow man access through three (3) – one (1) per weighbridge section manhole access ways.

C. Load Cell Design

1. Each load cell shall have a minimum capacity of 25 tons.

2. Load cells shall be certified by National Type Evaluation Program (NTEP) and meet the specifications as set forth by NIST H-44 for Class IIIL devices. The manufacturer upon request shall provide a Certificate of Conformance to these standards.

3. Load cells shall be of electronic analog type.

4. The load cell assembly shall be constructed to accommodate either compression or beam type analog load cells.

5. Junction boxes, summing boards, gathering boards and gathering boxes, totalizers, external analog to digital converter boxes and sectional controller boxes shall be water resistant and made of corrosion resistant material.

6. The load cell shall be of stainless steel construction and hermetically sealed with a minimum NEMA 6P / IP67 (submersible) rating, or engineer accepted equal.

7. The load cell summing boxes shall protect the load cell components from voltage and current surges.

8. Load cell cables shall be hard wired directly to the load cell.

9. Load cells shall be of electronic analog design: Mettler-Toledo, Inc., Fairbanks, or Cardinal.

D. Scale Instrument Specifications

1. The scale instrument shall be designed for use in vehicle scale weighing applications. It shall be capable of performing basic weighing operations including but not limited to:

   a. Inbound/outbound two-weighment operations.

   b. Single weighment operations where vehicle tare weights are known either through preset tares which are stored in the scale instrument memory or manually entered tare values which are entered through the keyboard.

2. During normal weighing operations the instrumental display will incorporate the following elements:

   a. Weight

   b. Time and Date

   c. Center of Zero

   d. Mode of Operation (Gross or Net)

   e. Weighing Unit (lb or kg)

   f. Selected Scale

3. The scale instrument shall have the following keyboard operations:

   a. 0-9 Numeric Keys

   b. . (Decimal Point)

   c. Clear

   d. Tare

   e. Zero

   f. Print

   g. Enter

4. The operator shall be capable of entering alphanumeric characters through the terminal using either an on-screen or external keyboard.

5. The scale instrument shall have the following operational parameters:

   a. Capable of powering up to 5 pairs of load cell assemblies with the ability to expand to 12 pairs, if required.

   b. Ability to digitally filter the signal sent from the load cells and updating the instrument’s weight display 15 or more times per second.

   c. The scale instrument shall be capable of being programmed for sign-corrected net weighing so that all net weights are positive.

   d. The scale instrument shall have a transaction counter to automatically assign sequence numbers to transactions.

   e. The scale instrument shall have automatic zero capture on power-up selectable to capture zero at 2% or 10% of the full-scale capacity.

   f. The scale instrument shall have adjustable digital filtering.

   g. The scale instrument shall have adjustable automatic zero maintenance selectable for ± 0.5, ± 1, or ± 3 displayed increments.

   h. The scale instrument shall have push-button zero selectable for ± 2% or ± 20% of full-scale capacity.

i. Tare, Zero, and Print functions shall be inhibited while the weight display is changing. Motion detection shall be selectable for ± 0.5, ± 1.0, ± 2.0, or ± 3.0 increments.

6. The scale instrument shall have the following service characteristics:

   a. Set-up and navigation through all phases of set-up, calibration, and testing.

   b. Capable of performing calibration, span and zero.

   c. Entry of information shall be accomplished through the instrument's keyboard.

7. The scale instrument shall be NTEP certified and meet or exceed the specifications set forth by NIST H-44 for Class II, III, and IIIL Devices. The manufacturer upon request shall provide a Certificate of Conformance to these standards.

8. The scale instrument shall be housed in a Type 316 stainless steel, NEMA 4x rated enclosure that is suitable for or wall or pedestal mounting. If external keyboard is provided, provide space within enclosure for keyboard storage.

9. The scale instrument shall have flexible storage capability with a minimum of 4.5 Mbytes of flexible memory in which to store pertinent vehicle, transactional, and weight information automatically or enabling the operator to assign a memory location to the weight manually.

10. The operator shall be able to enter up to 12 digits of alphanumeric ID through the instrument or external keyboard.

11. The scale instrument shall have gross/net weight switching.

12. The scale instrument shall have the following data communications capabilities:

    a. Two bi-directional com ports - RS232

    b. One 4-20 mA output

    c. One bi-directional 20 mA output

13. The scale instrument shall output the following information:

    a. Gross, Tare, and Net Weight

    b. ID

    c. Transaction Counter

    d. Time and Date

14. Scale instrument shall have the ability to connect with external PC software to allow configuration, and data backup and restore.

15. The weight indicator shall be located in a Type 316 Stainless Steel Enclosure and will also have a 4-20 mA output.

E. Ticket Printer

1. The ticket printer shall interface with the scale instrument and not require modifications either to the instrument or to the printer for proper operation.

2. The printer shall be capable of printing all information sent from the scale in duplicate including gross, tare and net weights; time and date; transaction number; 12 digit alphanumeric ID, or engineer accepted equal.

F. Scoreboard

1. Each scale shall include one (1) remote display scoreboard.

    a. Minimum Character Height: 5-inches

    b. Power Input: 110 V

    c. Interface with scale: 4-20 mA, RS232, RS422/485, fiber optic or Ethernet

    d. Display capacity: -99999 to 999999

    e. Enclosure Rating: NEMA 4X

    f. Enclosure Construction: Type 316 Stainless Steel

    g. Ambient Temperature: 30 to 90 F

    h. Ambient Humidity: 5 to 95%

G. Painting and Coating

1. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, per System 10 in accordance with Section 09900.

2. Alternatively, all ferrous surfaces may be fusion-bonded epoxy coated in accordance with Section 09961 or powder coated with epoxyde cross-linked polyester.

PART 3 - EXECUTION

A. Scale And Scale Pit Installation

1. Scale pit construction shall comply with accepted submittals.

2. Refer to Structural drawings for painting and coating of pit.

B. Field Quality Control

1. Testing:

a. Test vehicle scale in accordance with manufacturer’s recommendations.

2. Supplier's or Manufacturer's Services:

a. Supplier's or manufacturer's representative for equipment specified herein shall be present at job site or classroom designated by the Owner for minimum mandays indicated, travel time excluded, for assistance during scale construction, scale startup, and training of Owner's personnel for equipment operation. Include minimum of:

(1) One (1) manday for Installation Services.

(2) Two (2) mandays for Instructional Services.

(3) One (1) manday for Post Startup Services.

b. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, and troubleshooting.

C. Warranty

1. The Manufacturer shall furnish a written warranty covering materials and workmanship for the equipment provided for a period of three (3) years. The warranty period shall begin at the date of substantial completion of the respective process in which the equipment is installed.

2. The manufacturer shall furnish, deliver, and install new parts to replace the defective parts. The manufacturer shall furnish all supervision, labor, equipment, and materials to repair or replace components which have failed as defined by the warranty at no cost to the Owner.

D. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

E. 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.

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DIVISION 11 – EQUIPMENT

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SECTION 11311 NONCLOG CENTRIFUGAL PUMPS (WAS)

PART 1 - GENERAL

A. Description

1. Scope of Work:

Furnish all labor, materials and equipment, and incidentals required and install, complete and ready for operation constant speed, horizontal non-clog waste activated sludge (WAS) pumps, as shown on the Contract Drawings and as specified herein.

B. General Design:

1. Equipment specified herein is intended to be standard equipment for pumping return and waste activated sewage sludge and aeration tank mixed liquor.

2. Specific design information is provided in Part 3.C.

C. QUALITY ASSURANCE

1. Material Service Requirements: The pumps, motors and all related equipment shall be suitably constructed of materials to withstand the operating conditions which will be experienced during the pump's performance and outdoor environment.

2. Balancing: Pump impellers shall be statically and dynamically balanced. The vibration allowance in the units shall not exceed the upper limits as established by the Hydraulic Institute Standards.

3. Unit Responsibility: The entire pump, motor assembly, base, coupling and guard shall be supplied by the pump manufacturer to insure unit responsibility. Pump and motor shall be aligned at the factory prior to shipment.

D. SUBMITTALS

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit dimensional drawings.

3. Submit manufacturer's catalog data. Show materials of construction by ASTM reference and grade.

4. Submit pump curves from manufacturer's catalog data on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Show NPSH required.

5. Submit motor data per Section 16150.

6. Submit manufacturer’s catalog data and detail drawings showing packing type and material and mechanical seal design and parts. Describe material of construction by specification (such as AISI, ASTM, SAE, or CDA) and grade or type. Identify each mechanical seal and type of packing by the tag number of the associated pump to which the catalog data and detail sheets pertain.

7. A list of spare parts that are to be supplied with the project in accordance with this specification.

8. Submit manufacturer's reports on hydrostatic tests and performance tests.

9. Submit manufacturer's sample form for reporting the performance test results at least two weeks before the tests. The test form should contain the data presented in the sample form in Section 6 of the ASME PTC 8.2 or ANSI/HI 1.6.

10. Each pump shall be performance tested per HI standards at the manufacturer’s facility. Data shall be recorded for a minimum of five (5) test points and shall include flow, total head, horsepower and efficiency. Test results shall be submitted for approval by the Engineer prior to shipment of the equipment.

11. Operation and Maintenance Manuals per Section 01300 with installation instructions, operation and start-up procedures including lubrication requirements and a complete bill of materials for all equipment.

12. Submit six copies of a written report prepared by the manufacturer certifying that the equipment has been properly installed, lubricated, and test run.

E. Product Delivery, Storage and Handling

1. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is complete.

2. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

3. Finished surfaces of all exposed pump openings shall be protected by wooden blanks.

4. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

5. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage, and handling.

6. Each box or package shall be properly marked to show its net weight in addition to its contents.

7. Pump shall be shipped and handled in such manner as to prevent damage. At the job site, pumps and motors shall be stored in clean, dry, and protected locations.

F. Tools and Spare Parts

1. One (1) set of all special tools required for normal operation and maintenance shall be provided. All such tools shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.

2. Spare Parts: Furnish for each pump (total of 2 pumps), the recommended spare parts, properly boxed and labeled for each pump, which are to include, as a minimum, the following:

   a. 1 - complete sets of gaskets for each pump supplied (including case and hand-hole gaskets).

   b. 1 - complete sets of mechanical seals for each pump supplied.

c. 1 - complete sets of wear rings, wear ring machine screws, 316 series shaft sleeves, keys and accessories for each pump supplied.

d. Five (5) tubes recommended grease

3. All spare parts shall be protected for long periods of storage and packed in containers, which are clearly identified with indelible markings as to the contents.

PART 2 - PRODUCTS

A. Materials and Equipment

General:

1. The equipment covered by these Specifications is intended to be similar in quality to the existing WAS pumps already in service and to be standard pumping equipment of proven ability as manufactured by reputable concerns having long experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practice and methods and shall operate satisfactorily when installed as shown on the Contract Drawings.

2. Equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation and without excessive vibration or strain.

3. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs and adjustments.

4. The pump base shall be rigidly and accurately anchored into position, precisely leveled and aligned, so that the completed installation is free from stress or distortion. All necessary foundation bolts, plates, nuts and washers shall be furnished and installed by the Contractor to conform to the recommendations and instructions of the manufacturers. Anchor bolts, nuts and washers shall be Type 316 stainless steel.

Grouting under bases after the equipment is set is included as work under this section.

5. Stainless steel nameplate giving the name of manufacturer, the rated capacity, head, speed and all other pertinent data shall be attached to the pump.

6. Stainless steel nameplate giving the name of the manufacturer, serial number, model number, horsepower, speed, voltage, amperes an all other pertinent data shall be attached to the motor.

7. The nameplate ratings of the motor shall not be exceeded, nor shall the design factor be reduced when its pump is operating at any point on its characteristic curve at maximum speed.

B. Pumps

1. General:

a. The pumps shall be of the centrifugal, non-clog, solids handling type for outdoor installation.

b. The pumps shall be of standard dimensions, built to limit gauges or formed to templates, such that parts will be interchangeable between like units.

c. The pumps shall conform to all requirements stipulated in Part 3.C.

2. Pump Construction:

a. Pump Casings:

1) The pump casings shall be constructed of close-grained cast iron, ASTM-A-48, Class 30 of sufficient thickness to withstand all stresses and strains of service at full operating pressure. The pump casings shall be equipped with double radial type replaceable 420 stainless steel HT with minimum 50BHN difference wear rings.

2) Suction and discharge connections shall be 125 lb. ANSI Standard flat-face flanges positioned as indicated on the Contract Drawings.

3) Casings for the pumps shall be given a certified hydrostatic test in accordance with HI standards with no evidence of leakage. Test results shall be sealed by a registered Engineer or certified by a factory test engineer and shall be submitted prior to approval.

4) Large volute clean out port shall be provided.

b. Suction and Back Heads:

1) The volute casings shall be provided with cast suction and back heads of the same material as the volute, cast separately from the volute, and shall be built to allow for complete removal of the bearings, shaft and impeller by simply unbolting the back head. The back head and suction head shall shoulder fit to the volute casing to assure accurate alignment. The back head shall be designed to support the head frame and shall be designed to support the seal box or contain an integral seal box.

2) Seal Box:

(a) The seal box shall be engineered for the specified mechanical seals. The seal box shall be designed for the compressed seal length and shall not require any adjustments. The seal housing shall be extra large to provide excellent circulation of clear sealing liquid. The mechanical seal shall be provided with a flushing tap on the gland to permit a clear water flush to the pump seal at a rate of ½ gpm, dead-end flow, into the seal cavity.

(b) The seal box shall have a bronze Chesterton, Spiral Trac, Series 4, throat bushing installed in the bottom of the seal box for the exclusion of solids and provide for operation if flush water fails..

(c) The manufacturer shall provide a shaft sleeve in 316 series, stainless steel material for the cartridge seal to be mounted over.

3) Seals: Provide a split style, cartridge type, single, inside mechanical seal with silicon carbide rotating and silicon carbide stationary sealing faces, and EPDM elastomers. Provide all metal parts in 316 series or hasteloy- C materials. Seals shall be Chesterton Model 442.

c. Pump Impellers:

1) The pump impeller shall be of the non-clogging type and shall be of the same material as the casing and shall be statically and dynamically balanced. The pump manufacturer shall be fully responsible for the vibration-free operation of the pumping unit throughout the entire operating range.

2) The impeller shall be of the enclosed type. The impeller shall be of cast iron, ASTM A-48, Class 30, and shall be securely fastened to the shaft by means of a stainless steel key and impeller locknut or bolt. The impeller shall be equipped with a replaceable stainless steel wear ring. Axial adjustment of the impeller shall be external through integral jackscrews or radial wear rings made be provided in lieu of jackscrews.

d. Pump Shaft:

Each pump shaft shall be 1045, AISI 1144 steel or better, accurately machined and ground to size. Where shafts pass through stuffing boxes or where exposed directly to sewage, they shall be protected by readily renewable, snug fitting 400 Series stainless steel wearing sleeves internally ground to approved tolerances and positively secured to the shaft so as to prevent relative rotation. Passage of water from pump casing between shaft and sleeve shall be prevented by "O-Ring" packing or other approved means. The shaft sleeve shall extend from the impeller hub through the seal box. Factory certified calculations showing deflection of less than or equal to 0.002 mils will be

provided in the submittal. Shafts with greater deflection will not be accepted.

e. Bearings:

1) The pump bearing frame shall be equipped with a bearing system designed to provide a separate bearing to accept all thrust loadings imposed by the pump impeller and a minimum of two separate bearings for the radial loads imposed by the pump impeller. All bearings shall be designed for a 10-year average life for any point within the pump operating conditions as defined under service conditions. The pump manufacturer shall submit certified calculations showing at least 100,000 hours of life at design conditions.

2) The minimum bearing span of the pumps shall be no less than 70 percent of the maximum impeller diameter that can be placed in the pump casing. The cantilever portion of the pump shaft between the inboard radial bearing and the impeller shall not be greater than the span between the radial bearings. The diameter of the pump shaft between the span of the radial bearings shall be no less than 20 percent of the diameter of the maximum impeller that can be placed in the pump casing.

3) All bearing grease fittings shall be accessible while the pump is in operation. The bearings shall be grease lubricated, and a relief shall be provided so that excessive grease pressure will not damage the bearings.

4) For protection of bearings during shipment and installation, the bearings shall be properly processed with a high quality rust preventative. Each bearing frame shall be designed so that the complete rotating element can be removed from the casing without disconnecting the suction and discharge piping.

5) The bearing support frame shall be of cast-iron construction and shall be designed to provide a

self-centering and self-indexing fit with the wetted end of the pump to ensure proper alignment of the bearings and stuffing box.

f. Pump Support:

1) Each pump shall be mounted on a fabricated steel pump support base of sufficient size and strength to support all loads to which it may be subjected. Each frame shall be designed to mount on the concrete pads as shown on the Contract Drawings. Bases shall be reinforced and shall have large, readily accessible openings for installation of grout. The bases will have air escape holes at each end to insure proper grout filling. Open channel bases will not be acceptable. The bases will have drip rim with NPT connections. The OSHA coupling guard will be a non-metallic hinged lockable type. All pump case and mounting fasteners shall be 316 series stainless steel.

2) Pump shall be designed for connection to the motor and shall be furnished complete with coupling guards and shall be furnished complete with a 1.20 service factor coupling. The coupling will be a spacer type T.B. Woods or Martin spacer coupling with a Neoprene or rubber split ring sleeve.

g. Pump Suction and Discharge Gauges: The contractor shall furnish and install for each pump tapped holes in the suction and discharge piping complete with pipe nipples and isolation valves for use in connecting pressure gauges. Nipples shall be of such length and provided with elbows if necessary so that a pressure gauge may be easily installed and read. The suction and pressure gauges will be diaphragm type with upper and lower stainless steel seal housing and bolts. The diaphragm will be for sludge applications. The housing will be 4-1/2 inch face with non-metallic body. The nipple and valves will be stainless steel construction.

h. Pump Coatings: Provide the pump and pump base with a minimum coating of 6 mils DFT, high solids epoxy

factory prime coating for intermediate and finish coating by the Contractor.

i. The pump manufacturer shall provide a seal flush piping system which shall take plant process water and meter it to each pump on a continuous basis at 0.5 GPM and have an incoming isolation ball valve, pressure regulating valve, upstream and downstream pressure gauges, stainless steel needle valve, Dwyer 0 to 1.0 gpm rotameter, bronze check valve and outflow connection isolation ball valve. Mount all piping arrangement on an aluminum, power coated sub panel for the contractor to mount near the pump unit. Connect the seal water from the metering panel to the seal gland with a poly tubing fitting the connections on the gland.

C. Motors

1. General:

a. All motors shall be compliant with Section 16150.

b. The motors for the pumps shall be of the horizontal TEFC design as required by the pump arrangement.

c. All motors shall be built in accordance with latest NEMA, IEEE, ANSI and AFBMA Standards where applicable.

d. The pump motors shall also be suitable for use with variable speed drives utilizing PWM technology as specified and shall be inverter duty.

e. Motors shall be as manufactured by Reliance Electric, Westinghouse, U.S. Electrical Motors or approved equal.

2. Performance Requirements:

a. Motors shall be rated for operation on a 480 volt, three-phase, 60 Hz power supply.

b. Each motor shall have a 1.15 service factor.

c. Motors shall be premium efficiency type.

d. Motors shall be free of objectionable noise and vibration. Units shall operate with a maximum

sound level not to exceed 90 dBA as measured 5 feet from any surface.

e. Maximum temperature rise of motor windings shall not exceed 80°C, as measured by resistance, when motor is operated continuously at service factor horsepower, rated voltage and frequency in ambient air temperature of 40°C.

f. Nameplate horsepower shall not be exceeded during pump operation at any point on characteristic curve for impeller furnished.

3. Construction:

a. Motors shall be Corro-Duty suitable for operation in moist air with hydrogen sulfide gas present. Motors shall be provided with manufacturer's standard coating for Corro-Duty service.

b. Motor frames and end shields shall be of cast-iron construction of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.

c. The motors shall be of totally enclosed fan cooled construction. Motors shall have Class F non-hygroscopic epoxy sealed insulation but shall be limited to Class B temperature rise. The motor shall be suitable for outdoor weather conditions.

d. Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibration.

e. The shaft shall be made of high-grade machine steel or steel forgoing of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating.

f. Stator and rotor cores shall be made of low loss, non-aging electrical sheet steel with insulated laminations. Stator coils shall be random wound and of size, shape, insulation and number of turns required. Coils shall be epoxy sealed after fabrication.

g. Motors shall be equipped with bearings made of AFBMA Standards, and be of ample capacity of the motor rating. Bearings shall be grease lubricated and shall have a minimum B10 bearing life of 100,000 hours.

h. Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all motors. Enclosures shall have stainless steel screen and shall be protected from corrosion, fungus and insects.

i. All fittings, bolts, nuts and screws shall be plated to resist corrosion. Bolts and nuts shall have hex heads. Conduit boxes shall be gasketed. Lead wires between motor frame and conduit box shall be gasketed.

j. All motors greater than 7.5 HP shall be supplied with space heaters to prevent accumulation of moisture. Space heaters shall be rated 120 volt single phase.

k. All motors to have a normally open internal thermal switch.

l. Provide grounding lug in Conduit box.

D. Controls

Controls are specified in Division 13.

PART 3 - EXECUTION

A. Installation:

1. Installation of pumping equipment shall be in strict accordance with the respective manufacturer's instructions and recommendations in the locations shown on the Contract Drawings. Equipment shall be installed by experienced and mechanically skilled workmen with previous experience in similar installations. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

2. All necessary piping, fittings, valves, air relief valves, vents, concrete foundation, anchor bolts, grouting, etc. shall be provided to insure a complete and satisfactory installation of the pumping equipment including pump, electric motor, electrical connections and piping connections.

3. Install pressure gauges on the pump suction and discharge piping as shown on the Contract Drawings, including an isolation valve and pressure gauge at each location.

4. Hardware: All anchor bolts, nuts and washers shall be Type 316 stainless steel. All brackets and the hardware items shall be Type 316 stainless steel.

5. Install piping, fittings, valves and other appurtenances to the pump installation in accordance with the manufacturer's installation instructions, the requirements of referenced sections included with these specifications and as shown on the Contract Drawings. Equipment shall be installed in a workmanlike manner so that individual equipment will function properly and freely and no individual parts shall be strained.

6. Noise and Vibrations: All equipment containing moving parts shall be installed level and plumb, unless otherwise indicated, and shall be anchored securely in order that noise be suppressed to a minimum and that vibrations do not cause damage while in operation.

B. Field Painting

Provide The pump and pump base with a minimum coating of 6 mils DFT, high solids epoxy factory prime coating for intermediate and finish coating by the Contractor. Intermediate and finish coating shall be System No. 10 per Specification Section 09900. Contractor to properly coordinate intermediate and finish coats for compatibility with factory prime coat.

C. Service Conditions

1. Pump hydraulic performance conditions and design data shall be as shown below.

2. Pump Tag Numbers: 610-P-1 and 610-P-2.

Liquid Pumped:	Waste Activated Sludge (WAS)
Service:	Outdoors environmental temperature range of 20°F to 110°F
Elevation:	90 feet above mean sea level
Relative Humidity:	Up to 100%
Fluid Temperature Range:	50°F to 90°F

Pump Data

Capacity (gpm)	**Pump Total Dynamic Head (ft)**	**Min Hydraulic Efficiency (at design point)**	**Max $NPSH_{RE}$ (at design point)**
Primary: 450	20	63%	9 ft
Secondary: 540	15	56%	11 ft

Maximum motor full load speed:	1170
Suction/Discharge size (inches)	4
Minimum sphere size passed (inches)	3
Minimum pump shut-off head (ft)	29
NPSH Available:	23 ft
Motor type:	Horizontal, heavy duty, TEFC per Section 16150. Motor shall be rated for continuous duty at an ambient temperature of 40° Celsius.

Variable frequency drive required per 16370	No
Motor Horsepower:	5
Manufacturers and Models:	Chicago (Grundfos) Type 2111, Aurora 651 4x4x9B or Morris

D. Factory Service Representative

1. For each pump supplied, the Contractor shall arrange for the services of a qualified factory service representative. The period of service shall be one day for each pump supplied.

2. The duties of the service representative shall be as follows: After the equipment has been installed but before it is operated by others, the representative shall inspect the completed installation for soundness (no damaged or cracked components), completeness, and correctness of setting and alignment, and for the adequacy and correctness of mechanical seal alignment and lubricants. The service representatives shall start-up the equipment and instruct the Owner's personnel in proper operation and maintenance procedures. The responsibility of the Contractor with regard to start-up shall be fulfilled when the start-up is completed, the equipment is functioning properly and has been accepted by the Owner.

3. The service representative shall submit to the Engineer six (6) copies of a signed report of the result of his inspection, adjustments and start-up. The report shall include descriptions of the inspection, adjustments made, and the start-up. The report shall also include a statement that the equipment is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void. Final payment shall not be made to the Contractor until this report has been submitted to and approved by the Engineer.

E. Inspection and Testing

1. After pump has been completely installed, the Contractor shall conduct, in the presence of the

Engineer, testing of all mechanical equipment and piping to demonstrate capacity, correct alignment, smooth operation, proper adjustment, and freedom from noise, vibration, over-heating and leaking, and to ensure satisfactory compliance with the specifications. All defects shall be corrected. The Contractor shall supply all oil, grease, electric power, water and all other material necessary to complete the field tests.

2. If the pump performance does not meet the Specifications, corrective measures shall be taken by the Contractor, or pump shall be removed and replaced with a pump which satisfies the conditions specified.

3. Motor Field Testing: Motor shall be disconnected from the pump and run for four (4) hours. Following the run-in test, reconnect the motor to the pumping equipment and reinstall all coupling guards.

4. Pump Field Testing:

   a. Upon completion of all the mechanical work, the Contractor shall conduct testing as specified herein to demonstrate that the equipment performs in accordance with all specifications.

   b. The Contractor shall perform initial testing of the equipment to insure himself that the tests listed in the Demonstration Test paragraph below can be completed.

   c. Demonstration Test shall demonstrate that all items of these Specifications have been met by the equipment, as installed, and shall include the following tests:

      1) That the pump can deliver the specified pressure and discharge flow at rated efficiency.

      2) That the pump controls perform satisfactorily.

3) That the pump has been successfully field Laser aligned with report from a certified testing firm.

4) The pump has been vibration tested in compliance with the Hydraulic institute standards for horizontal rotating assemblies.

5) A dba sound test.

d. In the event that the equipment does not meet the Demonstration Test, the Contractor shall, at his own expense, make such changes and adjustments in the equipment which he deems necessary and shall conduct further tests until written certification is received from the Engineer.

e. See Section 01664 (System Start-up and Testing) for additional requirements.

F. Warranty

The Manufacturer shall furnish a written warranty covering materials and workmanship for the equipment provided for a period of three (3) years. The warranty period shall begin at the date of substantial completion of the respective process in which the equipment is installed.

The manufacturer shall furnish, deliver, and install new parts to replace the defective parts. The manufacturer shall furnish all supervision, labor, equipment, and materials to repair or replace components which have failed as defined by the warranty at no cost to the Owner.

G. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

H. 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.

END OF SECTION

SECTION 11315 PROGRESSING CAVITY PUMPS

PART 1 - GENERAL

A. Scope Of Work

1. Furnish all labor, materials, equipment and appurtenances required and install complete and make ready for operation of three variable speed, progressing cavity polymer feed pumps, as shown on the Drawings and as specified herein. Each of the three pumps is replacing an existing pump, being mounted on an existing skid, and is connecting to existing piping. Contractor shall verify compatibility with the existing skid system and control panel prior to ordering the pumps.

2. Electric motors shall be furnished as part of the work of this Section and shall be as specified in Section 16150.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

a. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

b. Descriptive literature, bulletins and/or catalogs of the equipment.

c. Data on the characteristics and performance of the pumps. The data shall include guaranteed performance curves, based on actual shop tests of like pumping units, which show that they meet the specified requirements for head, capacity and horsepower per Paragraph D.

d. Motors in accordance with Section 16150.

e. Complete master wiring diagrams and control schematics.

f. All information required by Section 16150.

g. The total weight of the equipment, including the weights of the larger components.

h. A complete total bill of materials for all equipment.

i. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item (as a minimum, see paragraph E.1.a). Include gaskets, etc, on the list. List bearings by the bearing manufacturer's numbers only.

j. Calculations to show the required life is provided.

k. Complete description of surface preparation shop prime and finish painting.

2. Operation and Maintenance Data

a. Operating and maintenance instructions shall be furnished to the Owner. The instructions shall be prepared specifically for this installation and shall include all cuts, drawings, equipment lists, descriptions, etc that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

b. Provide services of factory-trained service engineer, specifically trained on type of equipment specified. Man-day requirements listed are additive. These hours are exclusive of travel time and do not relieve the Contractor of the obligation to provide sufficient service to place the equipment in satisfactory operation.

(1) One labor day for each service listed in the subsection on "Service Conditions" to check the installation and advise during start-up, testing, and adjustment of the equipment.

(2) One labor day to instruct the Owner's personnel in the operation and maintenance of the equipment. Owner will videotape all training sessions. Owner reserves all rights for video reproduction and distribution of videotaped training sessions.

(3) The supplier shall include one site visit after six months of operation to verify proper operation and make adjustments.

3. In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

C. Reference Standards

1. American National Standard Institute (ANSI)

2. American Bearing Manufacturers Association (ABMA)

3. National Electrical Manufacturers Association (NEMA)

4. American Gear Manufacturers Association (AGMA)

5. Occupational Safety and Health Administration (OSHA)

6. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

D. Quality Assurance

1. The pumps to be furnished under this Section shall be furnished by a single manufacturer and shall be progressing cavity pumps for polymer service as manufactured by Seepex.

2. To assure unity of responsibility, the motors, pumps, and all pump accessories shall be furnished and coordinated by the pump manufacturer. The Contractor and Manufacturer shall assume responsibility for the satisfactory installation and operation of the entire pumping system including pumps, motors, appurtenances, etc. as specified.

3. Should equipment which differs from this Section be offered and determined to be equal to that specified, such equipment shall be acceptable only on the basis that any revisions in the layout and construction of the structures, piping and appurtenant equipment, electrical work, etc., required to accommodate such a substitution shall be made at no additional cost to the Owner and be as approved by the Owner.

4. Pumps, drive units and motors shall be furnished by the pump manufacturer and be capable of being mounted on the existing inline pump configuration base plate of fabricated steel.

E. System Description

1. Three polymer feed pumps shall pump polymer to the centrifuges.

   a. Each pump shall have a maximum design capacity of 32 gpm and minimum flowrate of 7.49 gpm.

b. The pump drive shall consist of a C-face AC motor and C-face gear reducer coupled to pump shaft by flexible coupling.

c. The pump gear motor shall be a maximum 5 Hp.

d. Provide a liquid sensing ring for insertion into the suction piping of each pump to signal the presence of a liquid. This device will be tied into the pump control circuit by the Contractor to prevent the pump from running unless a liquid is present in the pump suction. See drawings for size.

F. Maintenance

1. Tools and Spare Parts

a. One set of all special tools required for normal operation and maintenance shall be provided.

b. One (1) spare pump

c. The following spare parts shall be provided:

(1) One (1) set of packing for each pump.

(2) One (1) set of gaskets for each pump.

(3) One (1) rotor and one (1) stator for each model pump.

(4) Two (2) sets of shaft universal joints for each model pump.

(5) One (1) pressure gauge for each model pump.

(6) One (1) pressure switch assembly for each model pump.

(7) One (1) set of gear joint seals for each model pump.

d. Special tools and spare parts shall be furnished in accordance with Section 01600.

PART 2 - PRODUCTS

A. General

1. The equipment specified herein is intended to be standard pumping equipment of proven ability as manufactured by a reputable firm having experience in the production of such equipment. The equipment

furnished shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings.

2. All parts shall be so designed and proportioned as to have liberal strength and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs and adjustment.

3. All necessary foundation bolts, plates, nuts and washers shall be furnished by the equipment manufacturer and shall be of Type 316 stainless steel.

4. Brass or stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed and any other pertinent data shall be attached to each pump.

5. The manufacturer shall supply all motors and drives and factory-mount them on a common base plate with the pumps.

6. The nameplate rating of the motors and drives shall not be exceeded, nor shall the motor design service factor be reduced when its pump is operating at any point on its characteristic curve.

7. Pumps and pump bases shall have suitable provisions to collect leakage and permit it to be drained away.

B. Drive Train

The drive shall be of the positively sealed and lubricated pin-joint type. Construct the pins and bushings from air-hardened tooled steel of 57 to 62 HRc, bushings will be provided in the rotor head coupling rod and shaft quill. The joint shall be grease lubricated by a high-temperature (450°F), PTFE-filled synthetic grease, covered with Buna-N or Hypalon sleeve and positively sealed with high-pressure clamps constructed of Type 304 stainless steel. Provide a Type 316 stainless steel shell to cover the universal joint assembly and protect the elastomer sleeve.

C. Motors

Motors for the polymer feed pumps shall be a maximum, 5 Hp, totally enclosed, fan cooled, severe duty gear motors, inverter duty rated and shall be as specified in Section 16150.

D. Couplings

The motor, drive and pump shaft shall be connected by flexible couplings, complete with coupling guards in conformance with OSHA.

E. Base

The pump motor shall be mounted on the existing common base of welded steel arranged to collect drainage to a pipe-away drain.

F. Seal Chamber

Five rings (minimum) of packing plus a lantern ring and replacing space. Provide fittings for external clear water seal lubrication. Packing shall be one of the following non-asbestos products:

1. Regular braid, square cross-section, graphite-lubricated, and impregnated non asbestos packing, such as Garlock Style 8909, Phelps Style 2075 or equal.

2. Teflon-impregnated non-asbestos packing with lubricant, such as Phelps Style 2075, Garlock Style 8922, or equal.

G. Run-Dry Protection

Provide one (1) thermistor configured to monitor the stator temperature. The thermistor shall be the manufacturer's standard product, integral to the stator material and installed at the factory. The thermistor shall provide a dry-contact indicating when the stator material exceeds an adjustable value. High temperature set point shall be set at the factory and shall not be adjusted unless by a certified manufacturer's representative.

H. Materials of Construction

Materials of construction shall be as listed below.

Component	Material	Specification
Body/Bearing Hsg	Cast iron	ASTM A48 or A126
Rotor	Tool steel Duktil coated	Coating 1250 Vickers hardness
Stator	NBR-Buna Nitrile or HNBR - Therban and TSE	---
Drive shaft and connecting rod	Stainless steel	AISI 420 or 440C hardened to 450 Brinell

Component	Material	Specification
Lantern ring	Bronze, stainless steel, or Teflon	ASTM B584, Alloy C83600 or C83800 or AISI Type 316
Universal joints	Tooled steel	---
Baseplate	Steel	ASTM A36

I. Painting and Coating

1. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, per System No. 10 in accordance with Section 09900.

2. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

3. Provide additional shop pain coating for touch-up to all surfaces after installation and testing is completed and equipment is accepted.

PART 3 - EXECUTION

A. Installation

1. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. The pump assemblies shall be installed under supervision of a representative of the manufacturer supplying the equipment. This supervision is in addition to the services of the factory representative specified in PART 1. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Set anchor bolts in accordance with the manufacturer's recommendations.

2. Two of the three pumps shall remain in service during replacement of the third pump.

A. Service Conditions

1. Pump hydraulic performance conditions and design data shall be as shown below.

2. Description: Polymer Feed Pumps

a. No. of Units: Three (3)

b. Tag Numbers: 630-P-6, 630-P-7 and 630-P-8

c. Location: Existing Biosolids Handling Building

3. Design Criteria:

Service:	Polymer Feed Pumps
Liquid Pumped:	Dilute, aged polymer
Minimum Number of Stages:	1
Suction Flange	2-1/2 inch PVC 150 lb
Discharge Flange:	2-1/2 inch PVC 150 lb
Maximum Capacity:	32 gpm
Minimum Capacity	7.5 gpm
Maximum Pump Speed at Maximum Capacity:	85 rpm
Differential Pressure at Maximum Capacity:	80 psi minimum
Motor Horsepower (Minimum):	5
Motor Type	TEFC
Run-Dry Protection	Yes
Over-Pressure Protection	Yes
Type of Drive:	Existing VFD
Manufacturer and Model:	Seepex Model BN 10-6L

B. Inspection And Testing

1. Furnish the services of a factory representative as specified in PART 1 who has complete knowledge of proper operation and maintenance to inspect the final installation and supervise a test run of the equipment.

2. After all pumps have been completely installed, the Contractor, under the direction of the manufacturer's factory representative, shall conduct in the presence of the Owner, such tests as are necessary to ensure that each pump discharge conforms to the performance requirements specified in PART 1. Field tests shall include all pumps furnished under this Section. The Contractor shall supply all electric power necessary to complete the field tests. Pumps shall be operated for at least 24 hours prior to acceptance.

3. If a pump performance does not meet the requirements specified, corrective measures shall be taken by the Contractor, or if not successful the pump shall be removed and replaced with a pump which satisfies the conditions specified.

4. In conjunction with the above tests, it shall also be demonstrated that the pumps' speed controls are properly installed and calibrated to provide the specified control. Any deficiency in the controls or their installation shall be corrected without additional compensation.

C. Warranty

1. The Manufacturer shall furnish a written warranty covering materials and workmanship for the equipment provided for a period of three (3) years. The warranty period shall begin at the date of substantial completion of the respective process in which the equipment is installed.

2. The manufacturer shall furnish, deliver, and install new parts to replace the defective parts. The manufacturer shall furnish all supervision, labor, equipment, and materials to repair or replace components which have failed as defined by the warranty at no cost to the Owner.

D. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

E. 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.

END OF SECTION

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SECTION 11330 IN-LINE GRINDERS AND APPURTENANCES

PART 1 - GENERAL

A. Description

Provide and test in-line grinders, controls and appurtenances as indicated and specified.

B. References

1. American Society for Testing and Materials (ASTM):

   a. A395: Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

   b. A536: Specification for Ductile Iron Castings.

2. American National Standards Institute (ANSI):

   a. S1.11: Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets.

3. National Electrical Manufacturers Association (NEMA):

   a. MG1: Motors and Generators.

4. Underwriters' Laboratories, Inc. (UL):

   a. 508: Industrial Control Equipment

C. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

   a. Certified shop and erection drawings. Contractor shall submit electronic files of the proposed equipment in the capacity, size and arrangement as indicated and specified.

   b. Data regarding grinder, gear reducer and motor characteristics and performance:

      (1) Prior to fabrication and testing, provide guaranteed performance curves based on actual shop or field tests of mechanically duplicate

equipment, showing they meet indicated and specified requirements for capacity, pressure drop and horsepower.

(a) For units of same size and type, provide curves for a single unit only.

(2) Results of shop performance tests as specified.

(3) Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch sheets, one curve per sheet.

c. Shop drawing data for accessory items.

d. Certified setting plans, with tolerances, for anchor bolts.

e. Manufacturer's literature as needed to supplement certified data.

f. Operating and maintenance instructions and parts lists.

g. Listing of reference installations as specified with contact names and telephone numbers.

h. Certified results of hydrostatic testing.

i. Bearing temperature operating range for the service conditions specified.

j. List of recommended spare parts other than those specified.

k. Shop and field inspection reports.

l. Bearing Life: Certified by the grinder manufacturer. Include design data.

m. Grinder shop test results.

n. Motor shop test results.

o. Qualifications of field service engineer.

p. Recommendations for short and long-term storage.

q. Shop testing procedures and equipment to be used including the details of all equipment and testing set up.

r. Field testing procedures and equipment to be used including the details and calibration certificated of all equipment and portable flow meter locations.

s. Special tools.

t. Number of service person-days provided and per diem field service rate.

u. Schematic control and power wiring diagrams.

v. Manufacturer’s product data and specifications for painting.

w. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

x. The latest ISO 9001 series certification.

y. Provide a scaled drawings showing the equipment, motors, hoists and bridge cranes including equipment weights, lifting attachments, slings and clearance for equipment removal and maintenance.

z. Material Certification:

(1) Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

(2) Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

D. Spare Parts

1. Provide spare parts that are identical to and interchangeable with similar parts installed.

a. For each grinder:

(1) One complete set of gaskets.

b. For each set of grinders of the same size and performance.

(1) One set of all special tools required.

c. Provide one spare rotating assembly with motor, which includes a spare cutter cartridge and complete drive assembly, which includes the gear reducer, motor and associated couplings.

d. Provide a steel flanged spool piece to replace grinder or blind flange to seal grinder body when internals are removed.

E. Quality Assurance

1. Equipment specified shall be the product of one manufacturer.

2. Equipment shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

3. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

4. Shop tests as specified.

5. The Contractor shall obtain the grinders, motors, gear reducers and controls, from a single grinder manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

6. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

   a. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

   b. One (1) person day: Installation and Functional Testing.

      (1) Inspect location of anchor bolts; pump setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connections:

      (2) Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

   c. Two (2) person days (One each for daytime and nighttime crews) Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   d. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

   e. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

7. Manufacturer of grinders shall have a minimum of five (5) operating installations with grinders of the size specified and in the same service as specified operating for not less than five (5) years.

8. If equipment proposed is heavier or taller, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural and mechanical revisions at no additional cost to the Owner.

PART 2 - PRODUCTS

A. System Description

1. Grinder capacities and operating data are indicated in the Grinder Schedule herein.

2. Waste Activated Sludge (WAS): Grinders will be on pump discharge pumping WAS from WAS holding tanks to centrifuge dewatering building with solids concentration of up to 3 percent.

B. Manufacturers

1. JWC

2. Franklin-Miller

3. Or acceptable equal

C. Grinder Construction

1. In-Line Grinders:

a. Type:

(1) Vertical, two shaft design with counter-rotational parallel-shaft cutter and spacer assemblies with stacks of intermeshing cutters arranged in helical formation around shafts.

(2) Provide shafts driven through planetary gear reducer, with differential rotational speeds for shafts, one shaft rotating at approximately two-thirds the speed of second shaft.

b. Capable of operating with or without flow and without an external water source.

2. Housing:

a. One piece, flanged capable of remaining in-line when the cutter cartridge and drive assembly removed.

b. Provide a covered gasketed access port for equipment inspection.

c. Inside profile of housing to be concave to follow the radial arc of the cutters. Maintain a clearance not to exceed 5/16-inch between the major diameter of the cutter and the concave arc of the side rails.

d. Provide access to stack tightening nuts from the top of the housing.

3. Bearings and Seals:

a. Provide four sealed, oversized deep groove-type ball bearings to bear all radial and axial loads of the shaft.

b. Provide labyrinth type device and end face mechanical seals.

c. Face materials: Tungsten carbide to tungsten carbide not requiring any external flushing or any type of lubrication.

d. Products requiring lubrication or flushing are not acceptable.

e. Mechanical seal rating: 90 psi continuous duty by seal manufacturer.

f. Housing: Replaceable cartridge that supports and aligns bearings and seals. Housing to provide protection of the shafts and end housings.

g. Provide integrity of seal independent of stack tightness.

(1) O-rings: Buna-N.

4. Cutters and Spacers:

a. Provide a cutter cartridge and drive assembly that is removable from the housing as a complete unit.

b. Provide shafts comprised of 7-tooth or 11-tooth cam cutters.

c. Tooth height not to exceed 1/2-inch above the root diameter.

d. Cutter root diameter overlap not less than 1/16-inch or greater than 1/4-inch.

e. Provide cutter to exert a minimum of 450 lbs force per HP continuously and 1,430-lbs per HP at momentary peak loads at the tooth tip.

f. Provide hexagonal inside configuration.

g. Provide a two stage bushing deflector incorporated in the cutter cartridge end housing. Provide the deflector designed to protect the seal labyrinth while guiding particles directly into the cutting chamber.

5. Grinder drive and driven shafts: Treated Hexagon Steel with a tensile-strength rating of not less than 135,000 PSI. Each shaft hex shall be a minimum of 2 inches and supported at both ends by four sealed oversize deep-groove ball bearings.

6. Couplings: Direct connect the high speed shaft with the reducer using a two piece coupling.

7. Materials:

a. Shafts: AISI 4140 heat treated hexagon steel.

b. Housings, flanges and covers: ASTM A536 Ductile Iron.

c. Side rails: ASTM A536 ductile iron.

d. Bushing deflector: ASTM A395 ductile iron.

e. Cutters: AISI 8620 heat treated alloy steel, surface ground for uniformity and through-hardened to a minimum 60-65 Rockwell C.

f. Spacers: AISI 8620 heat treated alloy steel, ground for uniformity and through-hardened to a minimum of 32-38 Rockwell C.

g. Cutter cartridge seal housings and cover: 17-4 PH Stainless Steel.

8. Driver:

a. Planetary or Cycloidal reduction gear. Minimum 1.25 service factor based on motor nameplate rating, load classification rating for heavy stock. Reversible.

b. Reduction Rating: Nominal 29:1

c. Running Torque:

d. Manufacturer: Sumitomo

(1) Continuously: 1,000 in-lbs minimum.

(2) Momentary Peak: 6,089 in-lb/HP.

9. Control Panels:

a. Provide a control panel for each grinder specified.

b. Provide a Siemens S7-300 programmable logic controller with ladder logic programming.

c. Provide thermal motor overload protection and single phase protection.

d. Furnish all controls for operation of unit, circuit breaker, motor starter, control transformer, pushbuttons and relays.

e. Provide the following control functions:

(1) Hand-Off/Reset-Auto switch.

(2) Control logic that restricts resetting an overload condition from a remote location.

(3) Start/Stop pushbutton.

(4) Motor heater coils as an integral part of an adjustable overload relay.

(5) Overload relay to detect single phase and phase imbalance with motor full load amps adjustable so that the range selected includes the full load amp rating and service factor.

(6) When overload and power failure occur, design system for overload indicators to reactivate when power resumes.

f. Jam Condition:

(1) When a jam condition occurs, design controller to stop the grinder and reverse its rotation.

If the jam is cleared the controller will return to normal operation.

(2) If a jam condition is not cleared after the first reversal, design controller to go through two additional reversing cycle within 30 seconds prior to signaling a grinder jam.

(3) Overload to shut down grinder and activate fail contact, an alarm relay (dry contact).

(4) Power Failure:

(a) If while the grinder is running, the grinder shall only resume running upon receiving signal that the Centrifuge pumps have resumed running.

(b) If the grinder is stopped due to an overload condition and a power failure occurs, the overload indicator shall reactivate when power is restored.

g. Provide one free digital input and one output each capable of interfacing with the monitored functions and full programmable capabilities of the PLC.

h. Provide the following indicating lights:

(1) Power on (WHITE)

(a) Forward

(b) Reverse

(2) Run (RED)

(3) Fail Condition (AMBER)

i. Provide momentary contact stop/Reset and Start pushbuttons.

j. Provide an auxiliary overload relay for remote, overload and/or alarm indication.

k. Enclosure:

(1) Provide NEMA 4X Type 316 stainless steel

(2) Comply with UL 508 Standards.

l. Provide a reversing motor starter, full voltage reversing type.

m. Provide lamp test button.

D. Motors

1. Provide in accordance with Section 16150.

2. Motor enclosure and motor speed: As indicated in the Grinder Equipment Schedule.

3. In addition to the requirements for bearings specified under Electric Motors in Section 16150, provide equipment motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

4. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

5. Operate without overheating at the speeds specified and indicated.

6. Service Factor: 1.15.

7. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

8. Rating: 460V, 3 PH, 60 Hertz.

9. Insulation: Class F with Class B temperature rise, 40 degrees C ambient.

10. Site Altitude: Less than 3,300 feet above sea level.

E. Painting and Coating

1. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, per System No. 10 in accordance with Section 09900.

2. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

3. Provide additional shop pain coating for touch-up to all surfaces after installation and testing is completed and equipment is accepted.

F. Factory Testing

1. Grinder Tests:

   a. Test casings under a hydrostatic head of at least 75 psi.

   b. Test all functions of each controller.

   c. Repeat tests until specified results are obtained.

2. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

G. Equipment Schedule

SERVICE: Biosolids Handling Building	
Tag No.:	630-GD-3, 630-GD-4 and 630-GD-5
Location:	Biosolids Handling Building
Solids Concentration:	0.5 percent to 3 percent dry solids by weight
Design Flow, gpm:	600
Pressure Drop, max, inches @ design flow:	30
End Connections:	Flanged, 6-inch
Motor hp:	3
Motor Enclosure:	TEFC
Motor RPM, max:	1,800

PART 3 - EXECUTION

A. Installation

1. Install items in accordance with manufacturer’s printed instructions, as indicated and specified.

2. Install grinders on a concrete pad and align thereon.

   a. Set base on metal shims placed directly under the part of the base carrying the greatest weight and spaced close enough to provide uniform support.

3. After alignment is correct, grout using high grade non-shrink grout.

   a. Do not imbed leveling nuts in grout.

B. Field Testing

1. Test piping connections to prove the grinder nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with the grinder nozzles.

2. After installation of grinders, and after inspection, operation, testing and adjustment have been completed by the manufacturer’s field service technician, conduct running test for each grinder in presence of the Owner to determine its ability to:

   a. Deliver its rated capacity under specified conditions.

   b. Operate within the vibration and temperature limits specified.

   c. During tests, observe and record pressure drop, flow, and motor inputs.

   d. Immediately correct or replace all defects or defective equipment revealed by or noted during tests, at no additional cost to the Owner, and repeat tests until specified results and results acceptable to the Owner are obtained.

   e. Contractor to provide all labor, piping, equipment, flowmeters, test gauges and materials for conducting tests.

(1) Contractor shall provide calibrated test gauges for all gauges and portable calibrated flow meters for all systems even in those cases where permanent flow meters and gauges are installed.

(2) The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational.

f. Motor Temperature:

(1) Run each grinder for minimum 30 minutes prior to taking temperature readings of the gears and motors.

g. Test Duration: Determined by the Owner, but not less than one hour of continuous operation at each condition specified and indicated.

3. Make all adjustments necessary to place equipment in specified working order at time of above tests.

4. Test on product only. If product is not available, test with water. Water for testing furnished by Contractor.

C. Field Touch-Up Painting

After installation and testing acceptable to the Owner. Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting per Section 09900, System No. 10.

D. Contract Closeout

Provide in accordance with Section 01700.

E. Warranty

1. The Manufacturer shall furnish a written warranty covering materials and workmanship for the equipment provided for a period of three (3) years. The warranty period shall begin at the date of substantial completion of the respective process in which the equipment is installed.

2. The manufacturer shall furnish, deliver, and install new parts to replace the defective parts. The manufacturer

shall furnish all supervision, labor, equipment, and materials to repair or replace components which have failed as defined by the warranty at no cost to the Owner.

F. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

G. Certifications

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.

END OF SECTION

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SECTION 11336 SLUDGE THICKENING EQUIPMENT – BRIDGE SUPPORTED

PART 1 - GENERAL

A. Description

1. Provide and test two (2) sludge thickening mechanisms suitable for installation in existing circular tanks together with appurtenances as indicted and specified. This section includes materials, installation, and testing of bridge supported sludge thickening and removal mechanisms in existing circular concrete tanks. The sludge removal mechanisms shall include scrapers, collection arms, pickets, torque tube, feed well, center drive platform, access bridge with handrails, drive, motor, Local Control Panel located in the center of the bridge, effluent weir plates and scum baffle.

2. The Contractor shall be responsible for coordinating all activities between the existing equipment and the sludge thickening equipment manufacturer required for a complete installation. Activities requiring extensive coordination would include but not be limited to field verification of existing conditions (i.e. tank dimensions, access/clearance, obstructions, etc.), shop drawing submittals, and items required to connect to existing equipment. It shall remain the Contractor's sole responsibility to resolve any errors or conflicts arising during construction due to improper coordination between the existing field conditions, existing equipment and the sludge thickening equipment manufacturer and installer.

B. References

1. AISC Specification: Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

2. American National Standards Institute (ANSI) and American Gear Manufacturers Association (AGMA) Standards and Publications:

a. 2001-D04: Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.

b. 908/B89: Information Sheet-Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical and Herringbone Gear Teeth.

c. 2004-B89: Gear Materials and Heat Transfer Manual.

d. 6034-B92: Practice for Enclosed Cylindrical Worm Gear Speed Reducers and Gear Motors.

3. American Society for Testing and Materials International (ASTM):

a. A36/A36M: Specification for Carbon Structural Steel.

b. A48/A48M: Specification for Gray iron Castings

c. All galvanized steel shall conform to the requirements of ASTM A123, ASTM A143, ASTM A384 and ASTM A385.

4. American Welding Society (AWS):

a. AWS Welding Code.

5. The Society for Protective Coatings (SSPC):

a. SP 6: Surface Preparation No. 6 for Commercial Blast Cleaning

b. SP 10: Surface Preparation No. 10 for Near-White Blast Cleaning

C. Submittals

1. Submit the following shop drawings in accordance with the General Conditions, Section 01300, and the following:

a. Submit dimensional drawings. Show materials of construction by ASTM reference and grade. Show coatings. Show thicknesses of steel plates, angles, and channels.

b. Submit manufacturer’s installation instructions. Submit dimensions and arrangement for connecting the influent pipe to the clarifier feed well.

c. Submit structural design calculations for walkway and drive platform.

d. Submit ANSI/AGMA 2001-D04 gear calculations for the main gear set. Calculations shall confirm that both the surface durability and bending strength of the main gear and pinion exceed the continuous torque values specified herein.

e. Motor data and schematic wiring diagrams. This shall include information on the Local Control Panel in accordance with the submittal requirements defined in Specification Section 13300.

f. Operating and maintenance instructions and parts list.

g. Certificate of design, signed by registered professional engineer, prior to

h. Coating (Painting) data sheets.

i. List of recommended spare parts other than those specified.

j. Shop and field inspection reports.

k. Bearing Life: Certified by the equipment manufacturer. Include design data.

l. Shop test results.

m. Qualifications of field service engineer.

n. Recommendations for short and long-term storage.

o. Field testing procedures, set up and equipment to be used.

p. Special tools.

q. Number of service person-days provided and per diem field service rate.

D. Spare Parts

1. Furnish and deliver to owner at site the following spare parts, all identical and interchangeable with similar

parts installed in work. Provide for each collector so equipped:

a. One (1) set of oil seals.

b. One (1) set of skimmer wiper blades.

2. Furnish the following spare parts for use in any of the sludge collectors:

a. One (1) set of turntable base ball bearings if so equipped.

b. One (1) set of ball raceway liners if so equipped.

3. Provide spare parts in accordance with Section 01010.

E. Quality Assurance

1. Equipment specified shall be the product of one manufacturer.

2. Equipment specified shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

3. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

4. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

a. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

b. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

c. One (1) person-day – Preliminary Matters, per Section 01664: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

d. One (1) person-day – Start-Up System Testing, per 01664 : Field performance test equipment specified.

e. One (1) person-day – System Testing, Per 01664: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

f. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

g. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

5. Manufacturer of specified equipment shall have a minimum of five (5) operating installations with equipment of the size specified and in the same service as specified operating for not less than ten (10) years.

F. Delivery, Storage And Handling

Comply with the requirements specified in Section 01600.

PART 2 - PRODUCTS

A. System Description

1. Equipment Type: Bridge supported, center feed peripheral overflow type with a central driving mechanism supported (including its structural members and walkway) from a structural steel mechanism support spanning tank and rotating a vertical shaft with two rake arms attached thereto at a speed suitable for material to be collected.

2. Equipment purpose: Concentrate and move settled material in tank to sludge hopper. Skimming devices to convey floating materials into a scum trough.

B. Manufacturers

1. Ovivo USA (formerly EIMCO Water Technologies).

2. WesTech.

3. Or acceptable equal.

C. Materials

1. Galvanized Steel: ASTM A123, ASTM A143, ASTM A384 and ASTM A385.

2. Structural Steel: ASTM A36/A36M.

3. Iron Coatings: ASTM A48/48M.

4. All anchor bolts and fasteners shall be 316 stainless steel unless otherwise noted.

D. Equipment Design

1. Torque:

a. Maximum continuous operating torque: the highest center drive output torque at which unit is expected to operate continuously during life of equipment. Base the ANSI/AGMA and AGMA calculations for strength, durability, and life ratings of component parts on this maximum continuous operating torque rating.

b. Stalled torque: the maximum instantaneous torque unit can withstand without physical damage to equipment.

c. Design drive mechanism for maximum continuous operating torque specified in schedule of equipment.

d. Design drive mechanism capable of withstanding a stalled torque of not less than twice maximum continuous operating torque specified.

e. Set torque overload alarm at approximately 75 percent of maximum continuous operating torque. Make torque overload device capable of shutting unit down at 110 percent of maximum continuous operating torque.

2. Stresses:

a. Do not exceed maximum allowable stresses on structural steel members as permitted by AISC

specifications. At stall torque, stress in steel members shall not exceed 90 percent of yield strength of metal.

3. Load for Rake Arms:

   a. A combined uniform load and 200-lb. Point load located 5 ft. from the outside extremity of one rake to obtain the maximum continuous operating torque load specified.

4. Gears:

   a. Design gears for use in center mechanism and drive unit to conform to AGMA standards as follows:

   b. Spur gearing:

      (1) ANSI/AGMA 2001-D04.

      (2) AGMA 908-B89.

      (3) AGMA 2004-B89.

   c. Worm gearing:

      (1) ANSI/AGMA 6034/B92.

   d. Gears endurance and strength ratings: 1,000,000 cycles or 20 years, whichever is greater.

5. All anti-friction bearings: An L-10 life rating of not less than 100,000 hours, except for lower bearing of the pinion shaft and the bearing drive end of worm shaft which, if required, shall have an average life of 85,000 hours.

6. Make unit of sufficient strength to screed concrete fill in tank bottom as specified hereinafter, without damage to any of its components.

7. Steel plates and shapes: A minimum thickness of 1/4-inch, bolts: a minimum diameter of 1/2-inch, except as otherwise specified.

8. Shop assemble and photograph structural assemblies including center cages, rake arms and walkways and ship in sections as large as feasible to minimize field erection.

E. Mechanism Support

1. Support mechanism with two galvanized steel beams or trusses, with ends resting on bearings or slide plates at tank wall. Design bearings to allow for expansion and contraction. Design beams or trusses of sufficient strength to support all loads simultaneously, and lay parallel to provide a walkway 3 feet-0 inch wide. Securely fasten aluminum grating between beams to make walkway, and provide a 1-1/2-inch double aluminum pipe handrail 3 feet-6 inch high for both sides of walkway. Extend rail around center platform. Design walkway for a live load of 50 psf. Omit railings where walkway trusses provide equal safety to handrail specified. Design railings and gratings to conform to requirements set forth under Section 05500.

F. Drive Unit

1. Mount drive unit above and secure to mechanism support. Include a cycloidal, planetary or an external tooth worm or spur gear reduction unit driven by a gear motor or a separate motor and reduction gear through a #60 roller chain protected by a stainless steel chain guard provided with service openings. Integrally fabricate worm or spur from nodular iron, centrifugally cast bronze or alloy steel, hardened to give necessary physical and mechanical properties required to meet torque requirements. Support gear and rotate either on an annular ball race using replaceable strip liners, precision bearing, or on a pair of heavy-duty tapered roller bearings.

2. Enclose gearing in a high-grade cast-iron or fabricated steel housing with a removable inspection cover. Provide an oil dipstick or sight glass.

3. Provide output shaft with a flanged connection for vertical shaft driving rake arms.

4. All gear bearings: Either roller or ball bearings shall operate in an oil bath. Oil circulation by pumps will not be acceptable. Thrust of worm shaft shall be taken by a thrust bearing.

G. Motor:

1. Compliant with specification section 16150, horizontal, totally enclosed (TENV), squirrel-cage induction type motor suitable for Class 1, Division 2 hazardous area. Motor shall 480 volt, 3 phase.

2. If a gear motor is used, design gear head with an AGMA Class II rating. Design separate gear reducers to have an AGMA service factor of 1.50 and antifriction bearings.

3. Provide mechanical overload sensing device with each drive. Mechanical devices shall indicate load on mechanism at all times and be provided with no fewer than two electric contacts to activate an alarm in case of an impending overload and to shut the motor down if load increases further. Mechanical overload device shall incorporate worm thrust bearing to allow axial movement of worm shaft. Mechanical overloads shall include a shear pin in the event the electrical switches fail to engage.

4. Provide mechanical overload device with a weather-proof housing designed to resist maximum thrust from worm shaft and with means to indicate load on mechanism at all times. Place overload indicator so it may be read from walkway.

H. Local Control Panel

1. The Local Control Panel (LCP) shall be a NEMA 4X 316 Stainless Steel enclosure mounted in the center of the walkway.

2. The LCP shall be constructed in accordance with the requirements defined in Specification Section 13300.

3. The LCP shall include the drive motor starter, all associated power distribution, transformation and conversion equipment, incoming power surge suppression, and the following front panel mounted controls and indicators:

   a. HAND/OFF slect switch.

   b. Pending High Torque alarm indicator.

c. High Torque shut-down alarm indicator.

d. Motor starter thermal overload shut-down indicator.

e. Shut down reset pushbutton.

f. Elapsed Time Meter for motor run time.

4. The LCP shall provide dry contact ouputs of the following conditions for remote monitoring:

a. Motor Running.

b. Pending High Torque.

c. Fault shutdown.

I. Influent Well

1. Influent well: An open-end vertical galvanized steel cylinder of minimum diameter and depth listed in schedule. Stiffen with upper and lower rim angles to maintain uniformity.

2. Locate top edge above liquid level of tank but submerge balance of cylinder. Locate bottom edge at an elevation not more than 6-inch above top of rake arm truss. Include no fewer than two 4-inch x 12-inch wide scum ports at liquid level to permit escape of floating material. Each port shall include a baffle to prevent short circuiting.

3. Hang influent well from mechanism support.

4. Support influent well on vertical shaft by means of a structural steel spider and bearing. Design bearing to support weight of influent pipe without permitting influent well to tilt.

J. Vertical Shaft And Rotating Rake Arms

1. Rigidly connect vertical shaft to worm gear, or direct couple to drive, and design with ample strength to support and rotate rake arms. No shaft bottom bearing will be allowed.

2. Rigidly connect two galvanized structural steel arms (conforming to slope of tank floor) to vertical shaft and provide with galvanized steel blades to scrape

settled sludge along tank bottom to central sludge pocket. Provide a scraper in sludge pocket. Furnish adjustable spring brass or Type 316 stainless steel squeegees not less than 1/32-inches thick for all blades, projecting 1-1/2 inch below bottom of blade and secured by bolts and nuts.

3. Design rake blade setting similar for each arm with rake blades so spaced that entire tank bottom is scraped twice for each revolution of mechanism.

4. Attach vertical stirring blades of galvanized steel angles to rake arms in picket-fence arrangement. Stagger blades on each arm.

K. Skimming Devices

1. Provide collector with an automatic skimming device and scum trough. Design skimming device to collect and automatically convey floating material into a scum trough. Support skimming device from center shaft consisting of fixed and hinged skimming blades. Have fixed blade cover radius of tank from influent well to hinged blade. Make hinged blade of galavanized steel, the width of scum trough with a galvanized steel or acceptable equivalent wearing plate on its outer edge, and with neoprene wipers on bottom, inner and outer edges to properly seal entrapped scum and water when discharging into trough. Make hinged blade constantly press against scum baffle of tank by a spring arrangement to keep scum baffle effectively scraped clean. Enclose spring in a suitable housing to protect it from weather. Hinged blade shall trail scum arm by not less than 18-inches. And be adjustable to vary quantity of liquid discharged with scum or to raise hinged blade above tank water surface in event skimming is not desired. In addition, include spring device to press hinged scum blade against scum baffle.

2. Fabricate scum trough of galvanized steel plate adequately supported from tank wall and scum baffle. Locate top of beach 1/2- to 3/4-inch above maximum water surface indicated on drawings. Provide a 6 in. Standard flanged outlet connection at low point on sloping trough bottom for scum discharge pipe to match existing outlet pipe.

3. The trough shall be equipped with an auto flush valve assembly. The valve shall be activated by each pass of the skimmer blade and release flushing water into the scum collection box. Duration of the flushing cycle shall be adjustable. The valve body shall be cast bronze and include a Buna-N seal assembly to ensure a watertight seal.

4. Coordinate work of scum baffle and scum trough suppliers.

L. Shop Painting

1. All fabricated steel surfaces shall be hot-dip galvanized after fabrication in accordance with ASTM A123, A143, A384 and A385. Prior to hot dip galvanizing, all welds shall be ground to remove all weld spatter and slag. All sharp edges and corners shall be rounded to a smooth contour by grinding.

2. Coat submerged steel (that is not galvanized) and iron per Section 09900, System No. 7. Apply coating in field.

3. Coat exposed steel (that is not galvanized) and iron per Section 09900, System No. 10. Apply the specified prime and intermediate and finish coats at the place of manufacture. Color of finish coat shall be coordinated with the Owner’s Representative.

M. Shop Treatment Of Unpainted Surfaces

Apply a heavy shop coat of grease or other suitable rust-resistant coating to gears, bearing surfaces, and other similar surfaces not to be painted. Maintain coating to prevent corrosion during period of storage and erection up to time of final test, in a manner satisfactory to Owner’s Representative.

N. Lubricants

Furnish all lubricants of the quantity and type as recommended by the manufacturer.

PART 3 - EXECUTION

A. Installation Of Concrete Floor Fill

The complete mechanism shall be of sufficient strength to sweep in a 2-inch grout topping on the thickener tank bottom. Grouting shall be done in strict accordance with the manufacturer's instructions.

B. Effluent Weir And Scum Baffle

1. Provide effluent weir and scum baffle in accordance with the drawings and the specifications below.

2. Effluent weir plates shall consist of FRP sections fastened to the tank wall using stainless steel anchor bolts hex nuts and FRP washers, allowing for vertical adjustment. To prevent leakage all surfaces between the launder walls and weir plates shall be given a seal coat of suitable mastic by the erection contractor.

3. The scum baffle plates shall consist of FRP sections supported from the tank wall by FRP angle brackets secured with stainless steel anchor bolts and hex nuts, allowing for vertical and radial adjustment. In the area of the scum box the baffle shall extend 24 inches deep starting approximately 6 feet before and ending 6 feet after the scum box.

4. Set effluent weirs within +/- 0.005 feet of elevation indicated on drawings.

C. Field Testing:

1. After installation of equipment, and after completion of the services of manufacturer's representative and when plant influent is available, operate each unit to demonstrate its ability to operate continuously without vibration, jamming, or overheating. Operate each unit for five complete revolutions.

2. Conduct a torque test on each mechanism in presence of Owner’s Representative and under supervision of manufacturer's representative to demonstrate ability of mechanism to meet maximum continuous operating torque rating requirements, and to set torque overload alarm and shutdown settings.

3. Test Procedure:

   a. Secure rake arms by cables to anchor bolts in tank floor at recommended locations.

   b. Attach cables at the outer 20 percent of the rake arms.

   c. Insert a force measuring device and a device to apply torque in each cable system between the anchor bolt and the rake arm.

   d. Apply increasing torque and establish torque overload alarm and drive shut down settings.

4. Inspect entire collector for any damage or malfunction. Correct or replace all defects and defective equipment.

5. Remove anchor bolts used for tests and make all final adjustments necessary to place equipment in satisfactory working order.

D. Schedule Of Equipment

1. Secondary Sludge Thickening Equipment description:

   a. Number of units – 2 (620-TM-1 and 620-TM-2)

   b. Diameter, feet – 30-feet

   c. Side Water Depth, feet-inches – 12-feet 2-inches

   d. Depth at Center Column, feet-inches – 15-feet 3-inches

   e. Design Solids Loading, lbs/ft^2-day – 68 lbs/ft^2-day

   f. Design Average Flow, gpm – 400 gpm

   g. Design Peak Flow, gpm – 600 gpm

   h. Collector mechanism:

      (1) Maximum continuous operating torque, foot-pounds – 12,000 ft-lbs

      (2) Maximum peripheral speed, ft./min. – 10 fpm

   i. Center column:

(1) Minimum diameter, inches – 6-inches

j. Center drive mechanism:

(1) Motor Horsepower, minimum Hp – ¾ Hp

k. Influent well:

(1) Minimum diameter, feet – 6-feet

(2) Minimum depth, inches – 49-inches

l. Scum trough:

(1) Minimum width, feet – 3-feet

E. Contract closeout:

Provide in accordance with Section 01700.

F. Warranty

1. The Manufacturer shall furnish a written warranty covering materials and workmanship for the equipment provided for a period of three (3) years. The warranty period shall begin at the date of substantial completion of the respective process in which the equipment is installed.

2. The manufacturer shall furnish, deliver, and install new parts to replace the defective parts. The manufacturer shall furnish all supervision, labor, equipment, and materials to repair or replace components which have failed as defined by the warranty at no cost to the Owner.

G. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

H. 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.

END OF SECTION

SECTION 11371 CENTRIFUGES AND APPURTENANCES

PART 1 - GENERAL

A. Description

1. Provide and test centrifuges, main drive, back drive, motors, gear reducers, valves, sludge conditioning devices and, variable frequency motor controllers, controls and control panel and appurtenances as indicated and specified.

2. Furnish all labor, materials, equipment and incidentals required to manufacture, assemble, shop test, and deliver complete, three (3) centrifuges for dewatering unthickened waste activated sludge (WAS). The three centrifuges shall be furnished by the same manufacturer.

   a. The centrifuges shall be provided with backdrives/scroll drives to infinitely vary the speed of the conveyor to optimize sludge dewatering. A solids diverter gate shall be included for the solids chute to divert the solids during various operational modes of the centrifuges that do not produce cake. The solids from the dewatering centrifuges shall discharge into a screw conveyor.

3. Each centrifuge system (3 total) shall be complete in every detail and shall include but not be limited to:

   a. An electric main motor drive assembly.

   b. A variable speed VFD controlled, motor scroll drive system installed in the Centrifuge Starter Panel.

   c. An external oil lubrication system for the rotating assembly's main bearings.

   d. A PLC based Centrifuge Control Panel.

   e. A remotely located remote I/O with OIT local operator panel.

f. Vibration isolators for the centrifuge and main motor.

g. A centrate chute.

h. A solids chute (complete with automatic electrically controlled solids diverter gate).

i. All flexible connections.

j. Auxiliary and accessory devices, equipment, or materials necessary for system operation, or to interface equipment provided under this Section with equipment provided under other Sections, shall be included whether specified or not.

k. Auxiliary and accessories devices, equipment or materials where not specified shall be as recommended by the manufacturer of the primary equipment.

B. References

1. American Bearing Manufacturers' Association (ABMA):

   a. 15: Ball Bearings. Local Bearings and Fatigue Life

2. American Gear Manufacturers Association (AGMA)

3. American National Standards Institute (ANSI):

   a. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.

   b. S1.11: Standard Octave-Band and Fractional-Octave-Band and Digital Filters.

4. American Society for Testing and Materials (ASTM):

   a. A36: Standard Specification for Carbon Structural Steel.

   b. A48: Specification for Gray Iron Castings.

   c. A480: Specification for Flat-Rolled Stainless and Heat Resisting Steel Plate, Sheet and Strip.

d. A500: Specification for Cold-Formed Welded and Seamless Steel tubing in Rounds and Shapes.

e. G65: Standard Practice for Conducting Dry Sand/Rubber Wheel Abrasion Tests (Procedure A).

5. American Welding Society (AWS). ASME (SOK):

6. Institute of Electrical and Electronics Engineers (IEEE)

a. 85: Test Procedures for Airborne Sound Measurements on Rotating Electric Machinery.

7. Instrument Society of America (ISA)

8. National Electrical Code (NEC)

9. National Electrical Manufacturers' Association (NEMA):

a. MG1: Motors and Generators.

10. Steel Structures Painting Council (SSPC):

a. SP10 Near White Blast Cleaning

11. Underwriters Laboratories Inc. (UL)

12. Standard Methods for Examination of Water and Wastewater.

C. Submittals

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested

deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract mechanical process, structural, electrical and instrumentation drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

3. Certificate of Unit Responsibility attesting that the manufacturer has assigned, and that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.

4. In order to demonstrate satisfactory experience and qualifications, provide an installation list for a minimum of twenty-five (25) operating installations with equipment of the equivalent size and similar service conditions as specified herein operating for not less than five (5) consecutive years from final completion of the respective project of the installation. The installations must be within the contiguous lower forty-eight (48) States of the United States of America. At a minimum the reference information shall include the following;

   a. Current Owner Reference Contact Information

   b. Installation Service Conditions

   c. Equipment Model Numbers

d. Date of Final Completion of the Project

5. Submit the following shop drawings in accordance with Section 01300:

a. Data regarding centrifuge equipment motor characteristics and performance:

(1) Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate dewatering equipment, showing they meet specified requirements for capacity, performance and horsepower.

(2) Results of shop performance tests as specified.

b. Shop drawing data for accessory items.

c. Typical system description of operations. List component identification on schematic diagrams. Identify all input/outputs to PLC and identify all deviations from those shown on the contract drawings.

d. Sales bulletins or other general publications are not acceptable as submittals for review. Submittal only to provide supplemental technical data.

e. Operating and maintenance manuals. Operating and maintenance manuals shall be specific to equipment purchased and crossing out of non-applicable items is not acceptable.

f. All drawings and data marked to show only items applicable to work. Show all data, bill of materials, rated capacities, material of construction and layout of all components showing all feed and discharge piping arrangements. Show details of construction dimensions, and anchor bolt locations in English dimensions.

g. Recommend cleaning instruction, procedures and safety precautions for equipment. Provide detailed cleaning instructions for particular cleaning system as specified.

h. Test Reports that certify that all abrasion resistant materials supplied are in accordance with ASTM G65, Procedure A. Provide all test reports in English and include:

(1) Actual material analysis

(2) ASTM standards

(3) Date of manufacture

(4) Place of Manufacture

(5) Manufacturer's name

i. Weights and lifting points of all equipment and sub-assemblies. Identify any special handling requirements.

j. Minimum clearance distances around equipment required to access equipment for service, repair, and removal.

k. Typical centrifuge sound pressure level ratings outlined in AMCA Standard 301, or EN ISO 4871 and EN 12547 including backdrive at manufacturing location and at speed specified.

l. Electrical power demand at specified rate.

m. Equipment list including static loads, dynamic loads, vibrations loads and performance specifications of all items of equipment.

n. Detailed drawings and specifications of all items of equipment showing all dimensions, parts, and construction details and materials, and installation details and requirements.

o. Performance specifications of all items of equipment.

p. Controls:

(1) Provide instrumentation and control submittals in accordance with the requirements set forth in Specification Section 13300, "Instrumentation and

Controls", in addition to the specific requirements to be provided as follows:

(a) Front elevation of control panel with and without doors.

(b) Instrument layout of control panels.

(c) Wiring diagrams in accordance with NEMA ICS 1 using NEMA designations and symbols.

(d) Provide instrumentation and control and wiring diagrams of instrumentation, control, and electrical components as follows:

i. Motor control, alarms, and power to motors and accessories such as analytical instruments, etc.

ii. Include termination points in panels with every circuit assigned a number and every wire assigned a wire number. Show both termination point number (including wire number) and terminal strip identifier on the schematics for each wiring termination.

iii. Complete electrical, instrumentation, and control schematics of control panels and field junction boxes. Complete ISA 5.4 STD Loop Drawings as specified in Specification Section 13300.

(e) Equipment interconnecting drawings.

(f) Bill of materials and catalog cuts of purchased components.

(g) Nameplate schedule.

(h) Clarifications and exceptions.

(i) Written description of instrumentation and controls.

(j) Including list of functions monitored, controlled, and alarmed.

(k) Centrifuge serial communication I/O listings.

q. Certified setting plans, with tolerances, for anchor bolts.

r. Performance curve for residuals feed pressure drop in centrifuge with value at specified design flow

s. Manufacturer's literature as needed to supplement certified data.

t. Operating and maintenance instructions and parts lists.

u. Listing of reference installations as specified with contact names and telephone numbers.

v. Bearing temperature operating range for the service conditions specified for each bearing.

w. List of recommended spare parts other than those specified.

x. Shop and field inspection reports.

y. Bearing Life: Certified by the equipment manufacturer. Include design data.

z. Centrifuge shop test results.

aa. Motor shop test results.

bb. Qualifications of field service engineer.

cc. Recommendations for short and long-term storage.

dd. Special tools.

ee. Number of service person-days provided and per diem field service rate.

ff. Recommended location of in-line mixing device.

gg. Manufacturer's product data, specifications and color charts for shop painting.

hh. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

ii. The latest ISO 9001 series certification.

jj. Provide a scaled drawing showing the entire centrifuge assembly, hoists and bridge cranes including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.

kk. Material Certification:

(1) Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated herein. Provide proposed materials at no additional cost to the Owner.

(2) Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

D. SPARE PARTS:

1. Comply with the requirements specified in Section 01600.

2. Furnish a one year's supply of lubricants and fluids for all equipment.

3. Furnish the following spare parts:

   a. Two sets of main drive belts.

   b. Two sets main drive bearings and seals

   c. Two sets conveyor bearings.

   d. Two sets of scroll drive belts

   e. Two sets of scroll bearings and seals

   f. One complete set of parts for the bearing lubrication system to include a spare pump, three of each type of flow and temperature switches, control boards, etc.

   g. Two complete sets of gaskets, O rings and seals for all components.

   h. Six lubricating oil filter cartridges.

   i. Two grease guns.

   j. Control system spares in accordance with the requirements set forth in Specification Section 13300, “Instrumentation and Controls”.

   k. All spare parts recommended by the manufacturer in addition to those listed above.

4. Furnish one set of special tools and accessories required for repair, adjustment and proper maintenance, including at least the following as applicable:

   1. Tension bar nut wrench (if applicable).

   a. Pillow block bearing nut wrench (if applicable).

   b. Plate dam removal wrench (if applicable).

   c. Bearing puller (thrust bearing) (if applicable).

   d. Pillow block bearing remover (hydraulic).

   e. Wrenches and tools necessary for centrifuge disassembly.

f. Scroll extracting tool.

g. Turbocoupling dismount tool (if applicable).

h. Bowl truck.

i. Bowl lifter.

j. Scroll lifter.

k. Electronic readouts for main and scroll drives.

5. Tools and test equipment shall be furnished in suitable steel tool chests complete with lock and duplicate keys.

E. Quality Assurance

1. Comply with the requirements specified in Section 01410.

2. Centrifuges shall be the product of one manufacturer.

3. Centrifuges shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

4. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

5. Shop tests as specified.

6. The Contractor shall obtain the centrifuges, main drive, back drive, motors, gear reducers, sludge conditioning devices, valves, variable frequency motor controllers, controls and control panels and appurtenances from the centrifuge manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

   a. Provide variable frequency motor controllers in accordance with Section 16370.

7. Electrical Equipment Labeling Requirements:

   a. Provide equipment labeled by a nationally recognized testing company where standards have

been established. Where equipment is not available with label, provide service of a nationally testing company to examine the equipment and certify in writing that it complies with its safety standards. Tests and inspections of equipment shall be at no additional cost to Owner.

8. Provide fabrication in compliance with all applicable ASTM standards or equivalent international standards.

9. Welding: In accordance with section IX of ASME Pressure Vessel Code

    a. Qualifications for welders: Provide certification that welders to be employed in work have satisfactorily passed qualifications tests. If recertification of welders is required, retesting is the contractor's responsibility at no additional cost to the Owner. Manufacturer shall submit welder's qualifications with drawings.

    b. Visually inspect welding while the operators are making the welds and again after the work is completed. After the welding is completed, hand or power wire brush welds and clean them before the inspector makes the check inspection. Inspect welds under light for surface cracking, porosity, and slag inclusions: excessive roughness: unfilled craters: gas pockets: undercuts: overlaps: size: and insufficient throat and concavity.

10. Services of Manufacturer's Representative as stated in Section 01664 and as specified herein.

11. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

    a. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

    b. Preliminary Matter, per Section 01664: Inspect grouting, location of anchor bolts; setting,

leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

(1) 3 person-day.

c. System Start-Up Testing, per Section 01664: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

(1) 10 person-days.

d. Sludge Optimization: Sludge Optimization of Equipment.

(1) 15 person-days

e. System Testing, per Section 01664: Field performance test equipment specified.

(1) 3 person-days.

f. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

(1) 7 person-days.

g. Service inspections during first two years of operation, for use at Owner's request, and exclusive of repair, malfunction or other troubleshooting service calls.

(1) 10 person-days, 10 trips

h. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

i. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

12. As of the date in which Bids are submitted, the manufacturer of centrifuges shall have a minimum of twenty-five (25) operating installations with equipment of the equivalent size and similar service conditions as specified herein operating for not less than five (5) consecutive years from final completion of the respective project of the installation. The installations must be within the contiguous lower forty-eight (48) States of the United States of America.

13. If equipment proposed is heavier, longer, wider or taller, or different discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

    a. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

F. Delivery, Storage And Handling

1. Comply with the requirements specified in Section 01600.

PART 2 - PRODUCTS

A. SYSTEM DESCRIPTION:

A. Centrifuge capacity and operating data are indicated in the Centrifuge Equipment Schedule in Part 2.E.

2. Equipment Limitations:

    a. Centrifuge Assembly:

        (1) Maximum Total Weight:

            (a) Centrifuge: 38,100 lbs. dry, 41,600 lbs. operating.

            (b) Loads to Structure at Support Points: 9,600 lbs. dry, 10,400 lbs. operating.

(2) Maximum Assembly Overall Length x Width: 272 in. x 60 in

(3) Maximum Assembly Overall Height: 101 in.

(4) Minimum Height to Discharge: 36 in.

3. Coordinate centrifuge equipment dimensions and weights with bridge cranes as specified in Section 14370 and prefabricated metal buildings as specified in Section 13121.

B. Manufacturers

1. Centrifuges:

a. Andritz - Model:D7LL

b. Westfalia - Model:CD755

c. Alfa-Laval - Model:G2-120

C. Centrifuge Construction

1. General:

a. Centrifuge Type: Solid bowl, horizontal, continuous feed, scroll type, specifically designed for dewatering waste active sludge (WAS) with the addition of polymers.

(1) Like items of equipment shall be the product of one manufacturer to achieve standardization of operation, spare parts, maintenance and manufacturer's service.

(2) Manufacturer's standard equipment sizes shall be used.

(3) The equipment provided shall be complete in all respects including, but not limited to, lubricants, components, calibration, alignment, and adjustments to place the equipment in operation to perform its intended functions

b. Provide the centrifuge designed and constructed to operate continuously.

c. Provide the design to facilitate lubrication, adjustment or replacement of all parts.

d. Provide the centrifuge assembly designed for disassembly of the unit including removal of the rotating assembly, within the space and headroom provided and with the hoisting equipment specified.

2. Components and Appurtenances:

a. All equipment to be furnished by the manufacturer of the centrifuge; however, all equipment need not be manufactured by a single manufacturer.

b. All components, including but not limited to the following, shall be considered as part of the centrifuge package and become the responsibility of the centrifuge equipment manufacturer:

(1) Centrifuge Assembly

(2) Bowl (Main) Drive System

(3) Scroll Drive (Backdrive) System

(4) Starter Panel

(5) Control Panel

(6) Local operator Panel

(7) Flexible Connectors, Residuals and Centrate Chutes

(8) Polymer injection port

(9) Spare Parts and Special Tools

c. All equipment, components and appurtenant items shall be provided as complete assemblies, with interconnecting wiring, piping, valves and control devices needed for a complete and operable installation. The inter-connecting wiring, conduit, piping and components shall be provided by the Contractor.

3. Arrangement:

a. The contract drawings indicate the required general arrangement and layout of the centrifuge.

b. Changes to the arrangement to accommodate the selected equipment are the responsibility of the Contractor and shall be at no additional cost to the Owner.

D. Conditions of Service

1. Provide all equipment and appurtenances designed for exposure to splash and spill conditions, 0-95 percent non-condensing humidity, and temperatures ranging from 40 to 110 degrees F.

2. Provide the equipment and appurtenances designed to receive, condition and dewatering the feed residuals and discharging the residuals cake as specified and indicated.

3. Provide all equipment and appurtenances designed for operating continuously for 24 hours per day, seven days per week and designed to operate under conditions where it is started and stopped frequently in short time intervals as specified.

E. DESIGN CRITERIA:

1. Residuals Dewatering:

a. The centrifuges shall be capable of dewatering sludge having the following characteristics:

Sludge Characteristics	
Type Sludge:	Municipal
Sludge Composition	Waste Activated
Sludge Feed Concentration (percent dry solids by weight)	0.5 – 2.0

2. The centrifuges shall be manufactured to meet or exceed the following physical parameters:

Dewatering Centrifuges	
Number of Dewatering Centrifuges (Duty + Standby)	3(2+1)
Minimum bowl diameter, (in)	29

Minimum bowl length, (in)	118
Minimum centrifugal force (g)	2700
Maximum horsepower draw, all drives, backdrive and auxiliary systems, not nameplate horsepower (Hp)	300
Maximum Sludge Feed Rate (gpm):	350 gpm @ 1.0% dry solids
Maximum Sludge Feed Rate (lb/hr dry weight)	2700
Guaranteed Percent Cake Solids (percent dry solids by weight):	18
Guaranteed Polymer Dosage (lbs. of active polymer/dry ton feed solids, maximum):	22
Guaranteed Centrifuge Solids Capture[1] (percent min)	95

[1] Capture shall be defined as:

$$\text{Percent Capture} = T \times \frac{F-C}{F} \times \frac{100}{T-C}$$

Where:
- T = Thickened residuals total solids concentration (mg/L).
- F = Feed residuals total suspended solids concentration (mg/L).
- C = Centrate total suspended solids concentration (mg/L).

3. The above performance requirements are the minimum acceptable limits at the specified feed residuals characteristics. The addition of conditioning chemicals for the Dewatering Centrifuge will be allowed, up to the maximum stated in the "Design Criteria" Section above, to achieve the performance requirements.

4. Failure to meet the specified performance requirements shall constitute the basis for equipment rejection, unless otherwise noted.

F. Materials of Construction

1. Unless otherwise specified all parts of the centrifuge in contact with the residuals shall be made of Type 316 or 317 stainless steel, except o-rings, seals or abrasion resistant materials.

2. Specific centrifuge components:

   a. Bowl: Stainless steel, Type 316

   b. Scroll: Stainless steel, Type 316

   c. Scroll tips: Tungsten carbide: maximum loss of three cubic millimeters when tested in accordance with ASTM G-65, Procedure A.

   d. Feed tube: stainless steel AISI 316.

   e. Base and lower casing: material of construction shall be fabricated steel with 316 stainless steel cladding in all discharge areas on all wetted parts.

   f. Casing cover: stainless steel AISI 316, if case is integrated into cover. Fiberglass is permitted if only acting as a guard.

   g. Guards: stainless 316L or fiberglass

   h. Feed compartment: stainless steel AISI 316

   i. Feed compartment axial wall: field replaceable urethane 480U or flame sprayed tungsten carbide

   j. Residuals feed nozzle: field replaceable tungsten carbide port

   k. Solids discharge port: field replaceable tungsten carbide

   l. Fasteners: stainless steel AISI 316 in process contact areas

   m. Anchor bolts: stainless steel AISI 316 (by the installing contractor)

   n. Solids chute Stainless steel, Type 316L

   o. Centrate chute Stainless steel, Type 316L

3. The o-ring and seals shall be manufactured of the following:

   a. O-Rings: Buna-N

b. Lip type seals: Buna-N

c. Feed tube seals: Rulon or Teflon

d. Casing seal: Neoprene

4. All equipment guards shall be constructed of painted steel or fiberglass, and shall be attached using Type 316 stainless steel hardware.

G. Centrifuge Assembly

1. Centrifuge Bowl:

a. Minimum Length: As specified

b. Beach: 11 degree beach with an inside diameter of 14 inches in the cylindrical section, including a conical beach extension.

c. Cast Type 316 stainless steel. All cast materials shall be inspected for cracks, shrinkage, porosity or other defects by means of a liquid penetrant test.

(1) Nominal bowl thickness in the cylindrical and conical sections: minimum of 0.47 inches.

(2) Provide the front and rear bowl centrifugally cast with a nominal thickness of 1.26 inches and 0.79 inches respectively. Welded bowls are not acceptable.

d. The pool depth in the bowl shall be adjustable by the use of weir plates at the large diameter end of the bowl where liquid is discharged. Solids shall be discharged from the small diameter end of the bowl.

2. Bearings: Provide the main bearings with an ABMA L10 rating without adjustment factors of 100,000 hours at the specified operating condition. Provide the main bearings housed in one-piece pillow blocks. Provide the scroll with anti-friction bearings with grease lubrication.

3. Scroll Conveyor: The Centrifuge shall include a horizontal scroll conveyor installed concentrically within the bowl. The scroll shall utilize a differential speed to convey residuals solids to the discharge end of the bowl without clogging and with a minimum of disturbance to the pool to take maximum advantage of the variable speed backdrive as described herein. The scroll conveyor blades shall have tips having extreme wear and abrasion resistant characteristics. The edge and the face of the flights over the entire conveyor shall be protected by a series of welded on tile assemblies consisting of a stainless steel backup holder and a tungsten carbide wear part. Each insert shall be individually replaceable and shall include an ability to monitor wear by means of a visual inspection of a built-in gauge.

    a. The tile assembly must extend 0.50 inch beyond the radial edge of the conveyor flight. The feed zone shall be provided with a field replaceable accelerator protected by urethane 480U or a flame sprayed accelerator. The feed zone shall be protected by six field replaceable feed nozzles containing solid tungsten carbide liners. Certification of composition and properties of all the tungsten carbide components shall be finished in accordance with ASTM G-65. Procedure A. with a volume loss of less than 3.0 cubic millimeters.

4. Bases: Provide the centrifuge unit component mounted on a base. The main drive motor base shall be of the sliding adjustable type with jacking screws to permit movement of the motor without the need to realign the motor after its sheaves and belts have been changed. The belt tensioning shall be by a sliding motor base plate. Centrifuge cover must be removable with drive motor in position. Centrifuge cover and guards to have lifting eyes to facilitate maintenance. Provide machine surfaces where loads are transferred to base.

5. Cases: The cake and centrate discharge ends shall be enclosed in a fabricated case. The case shall consist of a removable stainless steel upper cover and stainless steel centrate and residuals discharge compartments of the frame and casing. The case shall also be designed to act as a protective guard and to

provide a complete enclosure to minimize noise. The bottom of the case shall contain flanged centrate and residuals cake discharge connections.

6. Provide replaceable urethane 480U to protect the solids discharge. Provide equipment to limit splashing and air leaking including: Cross-linked polyethylene type seals where the bowl hubs intersect the casing: a neoprene gasket on the machined flanges where the upper and lower casings join: a teflon or rubber lip seal on the feed tube.

7. Scroll conveyor drive unit shall control the differential speed between the centrifuge bowl and conveyor. The gear unit shall have a continuous torque capacity of at least 220,000 inch pounds and a maximum instantaneous capacity of 1.5 times the continuous capacity as required to meet the specified service conditions. Each gear unit shall be protected from damage due to high torque overload. A thermal overload protection system on the drive motor shall not be considered as providing sufficient protection for the gear unit.

8. Each pillow block shall be provided with threaded female connections to permit use of lifting eye look in order to facilitate inspection and maintenance of main bearings if the bearing weighs less than 50-lbs. then the threaded connection is not required. Lubrication of the conveyor seals and external thrust bearings shall be through grease fittings suitably located. The gearbox shall have a self-lubrication system.

H. Bowl (Main) Drive System

1. Drive System: The bowl drive system shall consist of an electric motor and a belt drive system with belt guards. The belt drive system shall consist of multiple belts to provide full load capacity and also to withstand full starting torque of the system. The drive system shall use one motor for the bowl drive and a variable speed brake for the backdrive system.

   a. Main drive motor: Squirrel cage induction motor, inverter duty starting. Standard long shaft for v-belt drive.

2. With the motor at ambient temperature, it shall be capable of making two (2) complete starts in succession with coasting-to-rest between starts. The motor shall also be capable of at least one restart within one hour after any shutdown.

I. Scroll Drive (Backdrive) System

1. Each centrifuge shall be equipped with a backdrive system to allow the adjustment of the differential speed between the centrifuge bowl and conveyor during operation. The backdrive system shall utilize an AC/VFD arrangement meeting the following requirements:

2. The scroll drive shall incorporate all energy saving devices possible to include but not be limited to generating the energy used during the breaking process back to the main drive.

J. Lubrication System

1. The two main pillow block bearings on the centrifuge shall be lubricated by separate forced oil lubrication systems. The scroll bearings shall be permanently grease lubricated with a lithium saponified grease. The gears shall be oil filled with suitable gear oil. Each oil lubrication system shall consist of a oil reservoir, circulation pump, oil return flow sensors. oil reservoir level switch, water-to-oil heat exchanger. sight gauge. temperature indicators, oil filter, oil pressure relief valve, oil pressure supply and return hoses, and instrumentation junction box.

K. Noise And Vibration

1. The centrifuge shall be designed such that the average noise level measured at 1 meter around the periphery of the complete centrifuge assembly shall not exceed 85 dbA when tested at the manufacturing facility without feed and with the inlet and discharges closed.

2. The centrifuge, when running without feed, shall be measured for vibration in the manufacturing facility. The vibration velocity shall be less than 7.0 mm/s when measured under dry shop test conditions.

L. Vibration Isolators

1. The centrifuge unit shall be mounted on visco-elastic type isolators, springs in viscous medium. The number capacity and vibration constant of the isolators shall be recommended by the isolator manufacturer for the load and impact resulting from operation of the centrifuge provided. The isolator shall be designed such that the dynamic load does not exceed 1.05 times the static load. Each isolator shall be provided with lateral forces in all direction.

2. The vibration monitoring system shall consist of five solid-state sensing devices mounted on each centrifuge and wired to the control panel. The system shall consist of five vibration sensing transducers: two mounted to or near each of the two main bearings to measure horizontal displacement, two mounted to or near each of the two main bearing to measure vertical displacement, and the fifth mounted to or near either main bearings to measure axial displacement. Each transducer shall send a signal of vibration to a remote mounted indicating monitor with LCD display and two SPDT relays with adjustable set point for each signal. Monitor shall be panel mounted on the System Control Panel and shall be similar to Bently-Nevada Corp., Series 3300 or equal with velocity sensors similar to Bently-Nevada Corp., Catalog No. 16699 or equal. The vibration monitor shall measure vibration velocity in in/sec, have a full scale range of 0 to 3 in/sec and transmit a 4-20 mA output signal to the centrifuge's PLC. Vibrations reaching the preset values will initiate an alarm warning and a centrifuge shutdown. Actual setpoints for individual alarm and shutdowns shall be as recommended by the centrifuge manufacturer. The monitor shall verify the condition of the monitor, transducer, and field wiring. Monitor shall have LED indicators to indicate the monitor, transducer, and wiring is OK or NOT OK; an ALARM/ALERT condition; and a DANGER/SHUTDOWN condition. Enclosure for the vibration monitoring system shall be rated NEMA 4X. Power supply shall be 110 Volt, single phase.

M. Connectors and Chutes

1. Flexible centrate and cake discharge connectors shall be provided of black molded neoprene, two ply fabric reinforced with polyester cord and complete with stainless steel back-up flanges and hardware. Flexible connectors shall have a minimum face-to-face flange distance of 6-in.

2. A minimum 1/8-in thick, Type 316 stainless steel centrate and solids chutes shall be provided for each centrifuge unit. Each chute shall have dimensions, connections and general shape as required by the centrifuge unit. Each chute shall be provided with a flange suitable for bolting to the flexible connector. Hinged, quick-opening inspection openings with gasketed watertight covers using De-Sta-Co type latches shall be provided on the side of each chute in accessible locations. Openings shall be reinforced to prevent leakage. The juncture of all joints in plates shall be continuously seal welded inside and out so that the chute is watertight. Stiffeners shall be provided as required to limit stresses and deformation in plates during shipping, installation and operation. The chutes shall be supported from the structures and not the centrifuge. All hardware shall be Type 316 stainless steel.

3. Provide grab sampling ports with quick disconnect cap and chain for both centrate and solids chutes located on the same building floors as the dewatering centrifuges.

4. The dewatering centrifuge solids chute shall contain an electric motor powered solids diverter knife gate for the purposes of diverting all liquids discharged into the solids chute to the centrate chute during centrifuge start-up and coast down. The gate shall be manually/automatically operated, timer controlled with controls located at the local control panel. Adjustment of time setting shall be provided. A resilient rubber seal shall be provided around the gate opening to form a watertight seal when the gate is closed. The seal shall be replaceable. The solids chute shall be provided with a water spray pipe with spray nozzles. The chute shall be constructed to provide a recess for the valve shaft and disc in the open position and for the spray pipe

as shown on the Drawings. The centrifuge manufacturer shall be responsible for the dewatering centrifuge solids chutes from the centrifuges to the bottom of the solids diverter gates. The recesses shall provide for an unobstructed discharge from the centrifuge. The spray pipe shall be replaced without removing the chute. The spray pipe shall be Type 316L stainless steel. Spray nozzles are to be UniJet by Spraying Systems Co., Wheaton, IL, or equal and sized and configured to completely clean and chute. The nozzles shall be Type 316 stainless steel and mounted to a stainless steel manifold.

5. The vent connection shall be sloped to the chute to drain free moisture and located and mounted per the manufacturer's recommendations to prevent the build-up of solids. An additional quick opening hatch shall be provided on the chute directly opposite from the vent connection. The centrate chute should be independently supported so as to not impose weight on the centrifuge casing flange.

6. Centrifuge manufacturer to provide for isolation of the centrifuge from the building structure. Flexible connectors to include the liquid discharge connector, and solids discharge connector.

7. Polymer feed and washwater casing flush flexible connections shall be made of black neoprene hose. All other flexible connections shall be flanged and fabricated from neoprene. All flanged flexible connectors shall be furnished with Type 316 stainless steel bolts and retainer plates at each end.

8. The centrate discharge chutes shall match the flange of the flexible liquid discharge connection from the centrifuge. The chute shall be provided with a 6 or 8 inch flanged connection for the centrate piping. The chute shall maintain the shape of the centrifuge casing discharge connection. Connection shall have a centrate sampling connection.

9. The residuals discharge chute to be a rectangular extension of centrifuge solids discharge outlet. Discharge chute shall have a residuals sampling port.

10. Chutes and hoppers: Fabricated of Type 316L stainless steel.

N. Starter Panel

1. Provide factory wired panel with all necessary appurtenances for proper operation with the following:

   a. NEMA 1 Painted steel freestanding panel to be mounted on a 4" concrete housekeeping pad.

   b. Externally operated main circuit breaker.

   c. Control power transformers with 480v primary and 120V secondary fusing.

   d. Bowl (main) drive VFD as specified under Section 16370.

   e. Scroll (back-drive) drive VFD as specified under Section 16370.

   f. Control relays with 120V coils and 10-amp contacts.

   g. Terminal blocks for external connections.

   h. Ventilation fan, filters, and thermostat control.

   i. Power Meter: Each Starter Panel shall be equipped with a digital-metering device capable of communication on the network of choice. Meters shall be General Electric Co.'s. Type PQMII Power Quality Meter, or approved equal. The meter shall have Ethernet connectivity. Through the use of communication user shall be able to read/write set-points, read actual values, execute commands and read device status loop-back test.

      The meter shall provide continuous monitoring of all three phases. The meter shall measure current, voltage, real and reactive power, energy use, cost of power, power factor and frequency.

      Power analysis features shall include an event recorder, waveform capture, trace memory, harmonic spectrum display (through the 62nd harmonic with total harmonic distortion) and a data logger function. The meter shall be able to sample harmonic spectrum at 256 samples per

cycle. All analysis data shall be non-volatile. The meter shall automatically generate log for alarms, triggers and input/output events. 150 events records with time stamp shall be stored in the meter.

O. Control Panel

1. General:

a. Provide factory wired Centrifuge Control Panel, Centrifuge Starter Panel and Centrifuge Local Operator Panel to include all necessary components required to provide a complete and operating system configured as indicated on the contract drawings.

b. The Centrifuge Control Panel and Starter Panel shall be NEMA 1 Type Painted steel freestanding panel to be mounted on a 4" concrete house keeping pad. Refer to Section 13300 for detail requirements for panel. The control panel shall include the following major elements as further defined in Specification Section 13300 "Instrumentation and Control":

(1) A Seimens S7-300 Programmable Logic Controller (PLC) equipped with an Ethernet communications module for interconnection with the Plant SCADA system.

(2) An Uninterruptible Power Supply.

c. The Centrifuge local operator panel shall be a NEMA 4X stainless steel freestanding control panel and shall include the following major elements as further defined in Specification Section 13300 "Instrumentation and Control":

(1) A Seimens S7-300 series remote I/O rack equipped with a Profibus communications module for interconnection with the control panel PLC.

(2) Input/Output modules

(3) The vibration monitoring system

(4) A Seimens 15” Operator Interface Terminal (OIT) connected to the Profibus network.

(5) An Uninterruptible Power Supply.

d. Refer to the instrumentation contract drawings for input, output, control and display requirements.

e. The Centrifuge Control System Shall be configured into the plant wide control system architecture as shown on the plans. Provide all components that are necessary to be located within the control panel to achieve the architecture shown on the P&ID drawings.

f. Provide PLC and OIT as specified in Section 13300.

g. Centrifuge controls to be integrated into the plant-wide control system Via Profibus data highway, to provide remote monitoring and control.

(1) All monitoring, control, alarming, screens, etc. that are provided on the Operator Interface Terminal (OIT) of this control panel are to be available on the Operator Work Stations in the main control room in the operations building.

(2) This requirement is the same for the other PLC controlled equipment with the project. As such, modify the PLC and OIT programming as dictated by the existing Plant HMI system to achieve reasonable programming/configuration uniformity in areas such as:

(a) Color conventions (run, stop, alarm, etc).

(b) Symbols.

(c) Addressing of libraries.

(d) Alarm generation and handling.

(e) System diagnostics (Commutations status, PLC health, etc).

(f) Other necessary areas in configuration.

h. Provide the supplier of Section 13300 with electronic versions of necessary programming information (screens, libraries, PLC code, etc) for their integration into the plant wide control system.

P. Controls

1. PLC controls and OIT graphics requirements shall be as defined in Specification Section 13300, "Instrumentation and Control"

2. General:

a. Controls pertinent to the operation of the centrifuge and associated equipment will be performed in the centrifuge PLC. Associated equipment will be accessible via the Plant HMI and the centrifuge OIT.

3. Scroll (Back) Drives:

a. Operator shall select to run the drive in the delta rpm mode or the torque mode via the HMI. In the delta rpm mode, the backdrive speed is automatically adjusted to maintain constant delta rpm. In the torque mode, the backdrive speed is automatically adjusted to maintain constant torque, compensating for varying feed characteristics while optimizing residence time and separation.

4. Centrifuge OIT:

a. OIT Programming Philosophy.

(1) Software switches shall be easily adjustable via the OIT and via password security.

(2) Software timers shall be adjustable via the OIT and via password security.

(3) Software set points (controllers, etc.) shall be easily adjustable via the OIT and via password security.

(4) Alarms shall be prioritized.

(5) Reports shall be printed on the report printer.

(6) Continuous measurements shall be trended.

(7) Flows shall be totaled, and reset daily at midnight and transferring the total to another register. The daily totals for the current month and the previous month shall be displayed. The daily totals for the past 12 months shall be capable of being retrieved and printed.

(8) Motors shall have an accumulated runtime indicator.

(9) Software controllers shall have an adjustable deviation alarm.

(10) Continuous measurements shall have a minimum of four adjustable set points to be used for interlocking and alarming.

(11) PLC controls and local controls are shown on the P&IDs. Straight forward interlocks are shown on the P&IDs, and interlocks which need additional description are described herein.

(12) The OIT shall indicate in real time the dry pounds of sludge being fed and the polymer dose in dry pounds per dry pound of sludge being fed. This screen shall also indicate totals for the values above.

b. An individual OIT is required for each Centrifuge Local Operator Panel. OIT shall have a minimum the following displays:

(1) Scroll drive Hand-Off-Auto (HOA) selector.

(2) Scroll drive mode selector: Delta RPM/Torque, which is enabled when the HOA is in Auto.

(3) Scroll drive speed.

(4) Bowl speed.

(5) Scroll drive delta speed controller.

(6) Bowl drive motor load in percent FLA and backdrive motor load in percent FLA.

(7) Residuals flow rate controller. In auto the controller output shall control through a PID loop, the speed of the centrifuge feed pump based on flow. In manual, the operator shall adjust the set point to directly set the speed of the residuals feed pump.

(8) Centrifuge feed pump – HOA selector. In the Hand or Auto mode the pump shall start and ramp to minimum speed, then seek the speed desired by the residuals flow rate controller.

(9) Centrifuge feed pump On/Off status.

(10) Polymer flow ratio controller, which is ratio controlled to the residuals flow. In auto the controller output shall set the speed of the polymer feed pump based on residuals flow. In manual, the operator shall adjust the set point to directly set the flow rate of the polymer feed pump.

(11) Conveyor On/Off status.

(12) On-Off selector for wash-water valve.

(13) On-Off selector for centrifuge wash-water valve.

(14) Centrifuge HOA selector. In the hand mode the centrifuge shall bypass the Auto logic. In Auto, centrifuge shall start if the conveyor is running.

(15) Centrifuge vibration.

(16) Bowl drive On/Off status.

(17) Scroll drive On/Off status.

(18) Bowl drive Local/Remote status.

(19) Scroll drive Local/Remote status.

(20) Bowl drive accumulated run time indicator.

(21) Scroll drive accumulated run time indicator.

(22) Totaled residuals flow.

(23) Centrifuge feed pump Local/Remote status.

(24) Local/Remote status.

(25) Centrifuge feed pump accumulated run time indicator.

(26) Centrifuge feed pump seal water flow switch status.

(27) Conveyor accumulated run time indicator.

(28) Conveyor HOA selector.

(29) Conveyor Local/Remote status.

c. OIT shall have a minimum the following alarms:

(1) Centrifuge feed pump fault.

(2) Centrifuge bowl drive fail.

(3) Centrifuge scroll drive fail.

(4) Centrifuge high vibration.

(5) Centrifuge bowl speed deviation high.

(6) Centrifuge scroll speed deviation high.

(7) Conveyor safety shutdown.

d. OIT shall have a minimum the following shutdown alarms:

(1) Centrifuge feed pump VFD trouble.

(2) Centrifuge feed pump high temperature.

(3) Centrifuge feed pump high discharge pressure.

(4) Low residuals flow to centrifuge.

(5) Centrifuge water valve fail.

(6) Centrifuge bowl drive high temperature.

(7) Centrifuge scroll drive high temperature.

(8) Centrifuge bowl VFD fault.

(9) Centrifuge scroll VFD fault.

(10) Centrifuge high high vibration.

(11) Centrifuge bowl speed deviation high high.

(12) Centrifuge scroll speed deviation high high.

(13) Conveyor Nos. 1, 2, 3 overload.

(14) Conveyor Nos. 1, 2, 3 high torque.

5. Control System Operation:

a. The centrifuge shall be able to be started automatically or manually. To automatically start the centrifuge, select AUTO on the HOA selector switch.

b. The PLC will issue a “run” command to the centrifuge main drive motor and the bowl will begin to accelerate. The polymer and feed systems shall be interlocked with the centrifuge controls to prevent their operation at this time.

c. Backdrive to run at a pre-programmed start-up speed as set in the PLC to provide maximum scrolling of residual solids from the bowl.

After a pre-set, timed interval, the feed and polymer pumps shall start automatically. As process requirements vary, the Centrifuge OIT/PLC backdrive speed shall be infinitely adjustable via the Plant HMI/PLC System.

d. After stable operation has been achieved, the auto-torque mode may be selected. In this mode, the backdrive torque shall be maintained while the speed is allowed to vary, within pre-set limits, in order to maximize the residence time. If torque begins to rise above the set point, the differential speed shall be increased to scroll solids out of the bowl at a faster rate, thereby lowering the torque back to the set point.

e. The centrifuge shall be able to be started manually as well, by selecting the appropriate graphic symbols as prompted by the OIT.

f. Upon stopping the centrifuge by pressing the "Auto Stop" key on the OIT, or via a fault condition, the feed and polymer is stopped. The main drive motor will stop allowing the bowl to coast to rest. The backdrive shall again be automatically set to a minimum speed to provide maximum scrolling of residual solids from the bowl during coast down. The backdrive shall be automatically de-energized at the end of the coast down by a shutdown timer. An auto flush valve will also be opened for a pre-determined time during shutdown.

g. In the event that a fault condition occurs, the sounding of an alarm horn will take place, the machine will shut down and an alarm message will be displayed on the OIT to facilitate trouble shooting. An Alarm Acknowledge display selected will flash when a fault condition occurs. Then the horn shall be silenced and the flashing shall turn solid. When the alarm is reset, the solid light shall be turned off.

h. Each centrifuge control panel at the centrifuge shall contain at least one mushroom head Emergency Stop (E-Stop) maintained pushbutton switch readily accessible to the operator. Depression of an E-Stop switch shall immediately

stop the centrifuge. In addition, provide a separate, 4-pole E-Stop switch to be wall-mounted adjacent to the entrance door to the centrifuge room. Individual poles from this switch shall be wired in series with each of the three (plus 1 future) local E-Stop switches such that the depression of the common switch shall cause all centrifuges to immediately stop.

6. Clean-in-place system:

   a. Provide a Clean-In-Place (CIP) system. This system is used for optimal cleaning of the centrifuge. CIP system shall also be used during shutdown.

   b. The CIP run cycle can be started when the main drive motor is at rest as determined by the shutdown time. Before initiation of the CIP start sequence, all faults must be cleared.

Q. Motors

1. Provide in accordance with Section 16150 and as specified and indicated.

2. Horsepower rating of motors: Not less than maximum brake horsepower requirements of equipment under any condition of operation specified and indicated without operating in the motor service factor.

3. In addition to the requirements for bearings specified under Electric Motors in Section 16150, provide pump motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

4. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

5. Operate without overheating at the speeds specified and indicated.

6. Service Factor: 1.15, with 1.0 inverter duty rating for pumps equipped with variable frequency motor controllers.

7. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

8. Rating: 460V, 3-ph, 60 Hertz.

9. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

10. Site Altitude: Less than 100 feet above sea level.

R. Gauges

1. Provide gauges in accordance with Section 13437.

2. Provide gauges assemblies for washwater piping.

3. Washwater Gauges: Scale: 0 to 100 psi

S. Shop Painting

1. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with Section 09900.

2. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

3. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

T. Shop Testing

1. Comply with the requirements specified in Section 01664 and as specified herein.

2. Provide mechanical and electrical operating tests of each centrifuge and control panel at the manufacturer’s facility.

3. Test mechanical operation of the centrifuges and all components

4. Test all operating sequencing, alarm and all functions of the controls and control panel.

5. Shop Test: (centrifuge)

   a. Test the centrifuges with its drive motor, backdrive system and control panel.

   b. Run the complete system for four (4) hours at full nameplate speed and measure the vibration and noise levels.

   c. A complete inspection report and shop test report shall be furnished for each centrifuge.

   d. In the event that specified tests indicate that centrifuges, motors, or variable frequency motor controllers will not meet specifications, the Engineer has the right to require additional complete witnessed tests for all equipment, motors, and variable frequency motor controllers at no additional cost to the Owner.

   e. Repeat tests until specified results are obtained.

   f. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

U. Labeling

1. On the Control Panel of each Centrifuge, or other location as designated by the RPR, provide the following identification labels;

   a. Centrifuge Equipment Tag Number

   b. Empty Weights of the Centrifuge's major components;

      (1) Total Machine

      (2) Bowl, Scroll, Pillow Blocks & Gear Box

      (3) Scroll

   c. Equipment Tag Numbers of the system components associated with the Centrifuge;

(1) WAS Feed Pump

(2) Grinder

(3) Polymer Feed Pump

(4) Shaftless Screw Conveyor

PART 3 - EXECUTION

A. Installation

1. Install items in accordance with accepted shop drawings, manufacturer's printed instructions and as indicated.

2. Install units on a concrete pad and align thereon.

3. After alignment is correct, grout using high grade non-shrink grout.

a. Do not imbed leveling nuts in grout.

B. Field Testing

1. Comply with the requirements specified herein.

a. Polymer Selection:

(1) The centrifuge manufacturer shall provide enough polymer for start-up and testing of equipment prior to substantional completion.

2. Test piping connections to prove the equipment nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with equipment nozzles. This must be performed and the piping acceptable prior to any field performance testing.

3. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 1 for checklist.

4. After installation of equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each centrifuge in presence of the Engineer to determine its ability to operate within the specified parameters and deliver its rated capacity under specified conditions.

5. The field test shall be run for a minimum of eight hours of continuous operation at the proposed operating speeds, together with the polymer system, residuals feed system, washwater system, cake conveyance equipment, and associated instrumentation and controls. All defects or defective equipment revealed by or noted during the tests shall promptly be corrected or replaced at no additional compensation.

6. Following the initial field tests and when residuals is made available, centrifuges shall undergo the following performance tests:

   a. Centrifuge shall be operated continuously for 7 hours to demonstrate conformance with the requirements specified in paragraph 1.10.

   b. Notify Engineer 15 days written notice prior to conducting the acceptance test so that the Engineer can be present to witness the tests.

   c. Test procedures shall be submitted to the Engineer for review. A qualified representative of the manufacturer shall supervise each test and certify the performance during the tests. Provide qualified person to aid in adjustments needed during the test period.

   d. The units shall be run at essentially steady-state conditions during the tests and at the design hydraulic loading related to the residuals volume index of the residuals being supplied.

   e. Collection of test data will be temporarily suspended during periods when the feed residuals concentration is outside its specified range.

f. Samples will be collected at one hour intervals during each test for the purpose of determining the following:

(1) Feed residuals concentration.

(2) Cake solids concentration.

(3) Centrate solids concentration.

(4) Solids Capture Rate

(5) Contractor to provide laboratory analysis of the samples performed by a competent laboratory, accepted by the Engineer and in accordance with the applicable standard methods. Provide written analytical results.

g. Continuously monitor energy use and residuals feed rate during the test interval. The residuals feed rate together with the solids concentration tests shall be used to develop a complete solids balance. The calculation shall be used to verify the accuracy of the measured quantities. Test equipment used for power measurements to be calibrated before and after testing, with certified reports submitted to the Engineer.

h. The Manufacturer shall prepare a formal written test report including laboratory analysis reports, measured power usage and residuals feed flow data and the mass balance calculations. Six (6) copies of the certified report shall be submitted to the Engineer within 10 days after completion of the test.

i. The Engineer shall review the test report to determine if the acceptance tests meet the performance requirements specified herein. Acceptance shall be based on the following criteria:

(1) Power draw by the main drive motor has not exceeded the required performance limits.

(2) A minimum of 90 percent of the samples collected and analyzed comply

simultaneously with both the residuals concentration and solids capture rate performance requirements while the residuals feed rate was at the design condition.

(3) The Engineer shall notify the Owner and Contractor in writing of the non-acceptable performance of any of the installed centrifuge systems.

j. In the case of non-acceptable performance, make corrections within the 30 days and retest the system.

k. If an acceptance retest is successful and meets the requirements specified herein, the Engineer will recommend to the Owner, in writing, the acceptance of the respective centrifuges.

l. If retesting is unsuccessful remove and replace the centrifuge to meet the specified requirements at no additional cost to the owner.

m. Repeat tests until specified results are obtained.

n. Contractor to provide all labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.

(1) Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.

(2) All calibrations must be within 30 days of the field testing.

(3) The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

7. Make all adjustments necessary to place equipment in specified working order at time of above tests.

8. Test on product only.

9. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted

C. Field Touch-Up Painting

After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

D. Contract Closeout

Provide in accordance with Section 01700.

E. Warranty

1. The Manufacturer shall furnish a written warranty that the centrifuges with all their backdrives, appurtenances and control systems will be free from defects in design, materials, and workmanship for a period of five (5) years. The warranty period shall begin at the date of substantial completion of the respective process in which the equipment is installed.

2. The Manufacturer shall provide a warranty for all components of the centrifuge system furnished under this specification, whether manufactured by the centrifuge manufacturer or purchased from another manufacturer to be provided as a part of the centrifuge system.

3. The Manufacturer shall furnish, deliver, and install new parts to replace the defective parts. The manufacturer shall furnish all supervision, labor, equipment, and materials to repair or replace components which have failed as defined by the warranty at no cost to the Owner.

F. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

G. Maintenance Service Contract

Provide to the Owner, at the date of substantial completion of the process and commencement of the Manufacturer’s warranty period, a written five (5) year Manufacturer's Standard Service Contract for the centrifuge and essential support systems as provided by the Manufacturer. The Service Contract shall include all preventive maintenance services and inspections as recommended by the Manufacturer to assure the safe and dependable operation of the system. The preventive maintenance inspections shall be in addition to the site visits aforementioned. This service contract does not supersede or replace the manufacturer's five (5) year equipment warranty aforementioned.

H. 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.

END OF SECTION

DIVISION 13 – SPECIAL CONSTRUCTION

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SECTION 13121 PREFABRICATED METAL BUILDING

PART 1 - GENERAL

A. Description

This section includes materials, installation, and manufacturer's design of prefabricated metal buildings, including special structural framing and accessories.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following:

2. Submit letter of certification identifying that all building components will be designed in accordance with the 2010 FBC and design criteria specified herein.

3. Submit certification that the metal building manufacturer has been in business for at least 10 years and has designed and supplied at least five buildings similar to the specified project building. Include names of owners and locations for the referenced buildings.

4. Submit manufacturer's catalog data describing the building construction and components. Submit project-specific design and erection drawings, shop painting and finishing specifications, instruction manuals, and other data to describe the design, materials, sizes, layouts, construction details, fasteners, and erection. Include product data for the following:

   a. Structural-steel-framing system.

   b. Metal roof panels.

   c. Metal wall panels.

   d. Metal liner panels.

   e. Insulation and vapor retarder facings.

   f. Flashing and trim.

   g. Gutters and downspouts.

   h. Doors.

   i. Windows.

j. Accessories.

5. Submit engineering design calculations for structural members and covering components, bracing, equipment supports, and anchor bolts. Submit the stress values utilized in the analysis stating the design criteria and procedures used. Design calculations shall be signed by a professional engineer registered in the state of Florida.

   a. A comprehensive load report/drawing identifying the foundation loads and moments shall be furnished in the following format for both vertical and horizontal reactions:

      (1) Dead Load

      (2) Live Load

      (3) Wind (N/S)

      (4) Wind (E/W).

6. Submit approval erection drawings and diagrams for each building. Drawings shall include floor plans, roof plans, elevations of all sides of the building showing all framing, roof and wall bracing, connection details, column base anchor details, anchor bolts sizes, projection and embedment, and other necessary components for project specific metal building system.

7. Submit color charts of the colors available for wall and roof panels, however, contract to include the cost to custom color match owners' preferred color for exterior and interior wall panels & liners, as indicated on the architectural elevation sheet in the design drawings.

8. Submit all supplemental framing for pipe supports, overhead bridge crane, and miscellaneous equipment shown to be supported by the metal building system.

C. Guarantee

1. Buildings shall be guaranteed against water leaks arising out of or caused by ordinary wear and tear by the elements for a period of five years. Such guarantee is in addition to the guarantee required in the General Conditions and shall start upon final acceptance of the work by the Owner.

2. Special Warranty on Metal 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.

3. Finish Warranty Period: 20 years from date of Substantial Completion.

D. Design Criteria

1. Buildings shall be of the size and shape shown, complete with all accessories.

2. The design of the building and components shall be in accordance with Metal Building Manufacturer's Association's "Recommended Design Practices Manual," latest edition, and the FBC Building Code.

3. Design structural steel members in accordance with AISC publication, "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings." Design structural cold-formed steel framing members in accordance with AISI publication, "Specification for the Design of Cold-Formed Steel Structural Members."

4. Design building for the dead load, specified live load, and the combinations of these loads as specified in the FBC. Reduction of loads due to tributary loaded area is permitted only for the rigid frames. Include the following loads in addition to the dead load:

   a. Wind design shall conform to the 2010 Florida Building Code and ASCE/SEI 7.

   b. Roof Live load of 20 psf, non-reducible.

   c. A uniform collateral load of 15 psf or a concentrated load of 1000 lbs for primary frames and 100 lbs for secondary frames.

   d. Weights of mechanical equipment and piping supported by the structure if greater than 15 psf.

   e. Bridge crane loads as indicated on Contract Drawings.

   f. Applied loads as shown in drawings and as indicated below:

(1) Basic Wind Speed: 149 miles per hour, risk category III

(2) Exposure Category C

(3) Maximum Allowable Drift: H/100.

5. Provide additional framing to support roof loads that cannot be supported from secondary structural framing, i.e., roof purlins. Coordinate location and weights of equipment with contract drawings and equipment manufacturer.

6. Welding of steel shall be in accordance with AWS D1.1.

7. Design framed openings to replace structurally the covering and framing displaced.

8. Maximum load deflection for primary framing shall not exceed 1/240 of the span between supports.

9. Maximum load deflection for secondary framing, wall and roof covering shall not exceed 1/180 of the span between supports. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect.

10. The buildings and structures shall be designed to safely carry weight of all fans, motors, and other wall and roof mounted fixtures.

11. Prefabricated buildings also shall be designed to withstand any lifting loads incurred during delivery, unloading, hauling, storing, erection, and placement on foundations. All lifting points shall be clearly defined and located.

12. All columns shall be designed as "Pin" connected. Moment transfer to footings will not be allowed.

PART 2 - MATERIALS

A. Manufacturers

1. All Prefabricated metal buildings shall be manufactured by American Buildings, Butler, Varco-Pruden, or equal.

B. Primary Framing

1. Welded-up plate sections and roof beams complete with necessary splice plates conforming to ASTM A572.

2. End rigid frames shall be the same as interior rigid frames.

C. Secondary Framing

1. Secondary structural framing consisting of purlins, girts, shall be cold formed framing conforming to ASTM A1011, minimum yield strength 55,000 psi, minimum 16-gauge.

2. Framing shall be galvanized steel conforming to ASTM A653, G90 coating designation unless noted herein or on Contract Drawings.

D. Roof Panel System

1. Roof panel system shall be standing seam covering with rigid board insulation and an interior liner panel. Roof covering shall have interlocking ribs and secured to framing with a concealed fastening system.

2. Roof Covering shall be standing seam minimum 24-gauge galvanized steel conforming to ASTM A653, G90 coating designation, factory color finished. Panels shall have 2 major corrugations, 2 inches high not exceeding 24inches.

3. Interior roof liner panel, shall be minimum 24-gauge conforming to ASTM A653, G90 coating designation, factory color finished on exposed side. Liner shall be furnished with trim pieces.

4. Entire Roof system shall meet Factory Mutual (FM) wind uplift requirements.

E. Wall Panels

1. Wall panel system shall be rib panel covering with blanket insulation and an interior liner panel.

2. Wall Covering shall be rib panel with minimum 24-gauge galvanized steel conforming to ASTM A653, G90 coating designation, factory color finished.

3. Interior wall liner panel shall be minimum 24-gauge conforming to ASTM A653, G90 coating designation, factory color finished on exposed side. Furnish liner with base and ceiling trim

F. Bracing

1. Provide bracing where depicted on Contract Drawings. Design bracing for controlling load combinations. Brace compression flanges of structural members as required by the code.

G. Accessories

1. Flashing, trim, metal closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for covering. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or PVC premolded to match configuration of the covering.

H. Dissimilar metal Isolation

1. Coat steel in contact with aluminum or aluminum-coated steel covering per Section 09900 or provide rubber or nylon gaskets between steel and aluminum surfaces.

I. Fasteners

1. All structural framing shall utilize high-strength (H-S) bolts. H-S bolts, nuts, and washers shall conform to ASTM A325, Type 1 galvanized, ASTM A563, and ASTM F436, respectively.

2. All other bolts, nuts, and tap bolts shall conform to ASTM A307, Grade B, and shall be galvanized according to ASTM A153, Class C.

3. All sheet metal screws and/or self-tapping screws shall be of Class #410 Stainless Steel conforming to Federal Specification QQ-S-763C and shall have Type "AB" threads. Where required for weather-tightness, screws shall be equipped with metal and neoprene washers.

4. Provide gasketed washers of a material compatible with the covering and with a minimum diameter of 3/8 inch for structural connections to waterproof the fastener penetration on the exterior side. Gasketed portion of washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick.

Exposed wall fasteners shall be factory color finished or provided with plastic color caps to match the covering.

J. Louvers

1. See Division 8.

K. Eave Gutters and Downspouts

1. Eave gutter shall be roll formed minimum 26-gauge galvanized steel, 6 inches by 6 inches. Join sections with riveted and soldered or sealed joints. Provide expansion-type slip at the center. Fasten gutter with gutter straps at 3-foot spacing after roof and wall sheets are in place. Provide bronze, copper, or aluminum wire ball strainer at outlets. Contour of the gutter shall match the rake flashing and allow for easy field miter of the corner without an auxiliary box.

2. Downspouts shall be minimum 26-gauge galvanized steel, 5 inches by 5 inches. Downspouts shall have a 45-degree elbow at the bottom and shall be supported by attachment to the wall covering at 5-feet maximum spacing.

3. Paint gutter and downspout to match building covering.

L. Insulation

1. Glass-Fiber blanket insulation shall comply with ASTM C991 and of sufficient thickness to achieve a minimum R value as follows:

   a. Walls R-12

2. Rigid insulation board:

   a. Roof R-19

M. Doors, Frames, and Hardware

1. Doors, coiling doors, frames and hardware shall conform to requirements of Division 8.

N. Sealant

1. Provide sealant of the type recommended by the building manufacturer at each joint.

2. Do not use adhesives that contain urea formaldehyde.

3. VOC limits for installation adhesives, sealants and sealant primers: Use installation adhesives, sealants and sealant primers that comply with content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

A. Storage and Protection

1. Deliver, store, handle, and erect prefabricated components, sheets, panels, and other manufactured items such that they will not be damaged or deformed. Stock materials stored on the site before erection on platforms or pallets and cover with tarpaulins or other weathertight covering. Store metal sheets or panels so that water will drain off. Upon arrival on the jobsite, remove moisture on sheets and panels, restack, and protect until used.

2. Do not store the sheets or panels in contact with materials that might cause staining. Remove stained, discolored, or damaged sheets from the site.

B. Assembly and Disassembly

1. The size of the prefabricated components and the field connections required for erection shall permit easy assembly and disassembly by means of the building manufacturer's standard fasteners and construction tools. The maximum size of any shop-assembled component of the building shall permit transportation from factory to site by commercial carrier.

2. Clearly and legibly mark each and every piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and/or instruction manuals.

C. Spare Parts

1. Provide a minimum of 5% excess over the required amount of nuts, bolts, screws, washers, and other required fasteners with each building. Provide separate boxes for the parts for each building. Label each box with the name of the building to which it pertains; the building manufacturer's name; and the local representative's name, address, and telephone number. Provide individual boxes for each item (nuts, bolts, washers, etc.).

D. Erection

1. Determine anchor bolt layouts before pouring concrete footings, walls, or slabs to support the building.

2. Erect in accordance with the manufacturer's erection instructions and drawings and the requirements herein. Plug improper or mislocated drill holes with an oversize screw fastener and gasketed washers. Do not use sheets with an excess of such holes or with such holes in critical locations. Keep exposed surfaces clean and free from sealant, metal cuttings, and other foreign materials.

3. Accurately set anchor bolts by template. Provide uniform bearing under baseplates and sill members using nonshrink grout. Accurately space members to assure proper fitting of covering. As erection progresses, securely fasten the work and brace to resist vertical loads and horizontal wind loads.

4. Apply wall covering with the longitudinal configurations in the vertical position. Apply roof covering with the longitudinal configurations in the direction of the roof slope.

5. Except for self-framing buildings, make end laps over framing members with fasteners into framing members approximately 2 inches from the end of the overlapping sheet. Side lap distances, end lap distances, joint sealing, and spacing of fasteners shall be in accordance with the manufacturer's standard practice insofar as the maximum fastener spacing specified is not exceeded and provided such standard practice will result in a structure that will be free from water leaks and meet design requirements.

6. Spacing of fasteners shall present an orderly appearance and shall not exceed 8 inches on center at end laps of covering, 12 inches on center at connection of covering to intermediate supports, 12 inches on center at side laps of roof coverings, and 18 inches on center at side laps of wall covering. Install fasteners in straight lines within a tolerance of 1/2 inch in the length of a bay.

7. Seal side laps and end laps of roof and wall covering and joints at accessories. Drive fasteners normal to the surface and to a uniform depth to properly seat the

gasketed washers. Fasten accessories into framing members.

8. Insulate incompatible dissimilar materials that are in contact by means of gaskets or insulating compounds.

E. Installation of Fans, Gravity Ventilators, and Louvers

1. Provide framed openings for attaching louvers and for attaching curbs for fans and ventilators. Provide gaskets for fans and ventilator openings. Install louvers, fans, and ventilators so that rainwater cannot leak into the building.

F. Installation of Doors and Windows

1. Anchor door and window frames to the supporting structure. Install doors, windows, and frames plumb and true. Adjust doors so they operate smoothly without sticking or jamming.

G. Panting of Rigid frames, special structural framing (including spandrel beam and additional framing for roof or wall mounted equipment)

1. Rigid frames and special structural framing shall be shop coated with a primer meeting the following:

a. Solids by Volume: 61% (percent ±2)

b. Type: Zinc Rich Aromatic Urethane

c. Dry Film Thickness: 3 to 3.5 mils

d. Number of Coats: One

e. V.O.C. (Max): 2.67 (Unthinned)

2. Shop primer shall be compatible with specified field paint system

3. Field paint with a 5 mil DFT Polyamide epoxy and a finish coat of 3 mil of acrylic polyurethane. Polyamide epoxy product shall be Tnemec N69 or Sherwin-Williams Macropoxy 646. Acrylic polyurethane product shall be

Tnemec Series 73 or Sherwin-Williams B65-350. Color to be selected by Owner.

H. Panting of Exposed secondary framing, braces

All "exposed to view" secondary framing and braces shall be shop and field painted with a system as specified in Paragraph G above.

I. Painting of Walls and Roof Panels

1. Color finish wall covering and roof covering at the factory on both sides. Prepare surfaces for coating by thoroughly cleaning, pretreating, and priming (if required by the finish coat) to provide a film that is compatible with the metal surface and the color finish. Treat galvanized steel surfaces per DOD-P-15328D. Clean surfaces of oil, grease, loose scale, and other foreign substances. Prime coat shall be in accordance with the manufacturer's standard system.

2. Color finish shall consist of a Kynar 500/Hylar 500 fluoropolymer coating.

3. VOC limits for installation of interior painting and coating: Use linings and coatings that contain do not exceed VOC content as identified in Green Seal Standard GS-03.

J. Touch-up Paint

1. Touch up factory coating finish surfaces with the building manufacturer's touch-up paint for the particular finish coat used.

K. Repair of Galvanized Surfaces

1. Repair or replace metal with damaged galvanized surfaces at no additional cost to the Owner. Repair galvanized surfaces per Section 099000.

END OF SECTION

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SECTION 13300 INSTRUMENTATION AND CONTROL

PART 1 - GENERAL

A. Scope of Work.

1. Work includes engineering, furnishing, installing, testing, documenting and placing in operation a Programmable Logic Controller (PLC) based control system and associated field instruments (system) for the Centrifuge Dewatering Building Improvements at Orange County's Eastern Water Reclamation Facility (EWRF). The System shall be fully integrated with the existing plant wide control system as further detailed herein.

2. It is the responsibility of the CONTRACTOR to furnish a complete and fully operable system that reliably performs the specified functions. A single entity (henceforth referred to as the SYSTEM SUPPLIER) be retained by the CONTRACTOR to have overall responsibility for designing, furnishing, interfacing, adjusting, testing, documenting, and starting-up the control equipment described in the Contract Documents.

3. The SYSTEM SUPPLIER shall be subcontracted by and paid by the CONTRACTOR. The SYSTEM SUPPLIER shall be:

   a. Commerce Controls, Largo, FL

   b. Revere, Birmingham, AL.

   c. Curry Controls, Lakeland, FL.

   d. Control Instruments Inc (C2i), Smyrna, GA.

4. The SYSTEM SUPPLIER shall co-ordinate closely with the supplier of the PLC based Centrifuge Control Panels defined in Specification Section 11371, Centrifuges and Appurtenances and the Shaftless Screw Conveyor defined in Specification Section 14549, to ensure the

panels are correctly integrated with this system.

5. The CONTRACTOR shall be responsible for:

   a. Equipment storage and protection until installed following the storage and handling instructions recommended by the SYSTEM SUPPLIER. Anti-static and winterization requirements shall be per the SYSTEM SUPPLIER's instructions and the SYSTEM SUPPLIER shall periodically verify that these instructions are followed.

   b. Including within the electrical subcontractor's scope the provision, installation and termination of field and power wiring to the system. Termination shall be made in accordance with final accepted interconnection diagrams developed by the SYSTEM SUPPLIER. The electrical subcontractor shall mark on the interconnect diagram the field wire numbers used for each termination point. The SYSTEM SUPPLIER shall finalize the interconnect diagrams by including these field wire numbers in the final as built version.

   c. Physical installation of the system. The CONTRACTOR shall require the SYSTEM SUPPLIER to observe and advise on the installation of the system to the extent required to certify, with the operational check-out tests, that the equipment will perform as required.

6. All engineering development required by the SYSTEM SUPPLIER will be in accordance with the Conditions of this Contract.

7. Equipment found to be defective prior to system acceptance shall be replaced and installed at no additional cost to the OWNER.

8. In the bid price, the SYSTEM SUPPLIER shall provide for obtaining the services of

authorized field personnel from the manufacturers of components or systems provided under this section but not manufactured by the SYSTEM SUPPLIER. Should these personnel be required during installation, start-up and checkout of the system, such services shall be provided at no additional cost to the OWNER.

B. Related Work.

1. All conduits, power and field wiring and cables are provided and installed under Division 16, Electrical.

2. The PLC based Centrifuge Control and Local Operator Panels are defined in Specification Section 11371, Centrifuges and Appurtenances.

3. The conveyor system components are defined in Specification Section 14549, Screwless Shaft Conveyor System.

4. Overall system operation and programming requirements are defined in Specification Section 13301, Control System Operation.

5. Variable Frequency Drives are defined in Specification Section 16370, Variable Frequency Drives.

6. Other Motor Control Center components are defined in Specification Section 16482, Motor Control Centers.

7. The surveillance system, to be incorporated into the control system, is defined in Specification Section 16800 Surveillance System.

C. System Description.

1. The SCADA Control Panel (SCP) shall be NEMA 1 construction and the SCADA Remote I/O Panel shall be NEMA 4X 316 Stainless Steel.

2. The control system shall comprise the following major elements:

a. A SCADA Control Panel located within the North Electrical Building. The panel shall contain a CPU based PLC chassis, the surveillance system DVR furnished by others under Specification Section 16800 and networking/media conversion equipment.

b. An air-conditioned SCADA Remote I/O Panel located within the centrifuge room. The panel shall contain a PLC Remote I/O chassis, pull-out drawer with lap-top computer (equipped as a client workstation on the Plant Control System) and networking/media conversion equipment.

c. A Centrifuge Control Panel for each centrifuge located within the North Electrical Building and furnished by others under Specification Section 11371.

d. A Centrifuge Starter Panel for each centrifuge located within the North Electrical Building and containing the Variable Frequency Drives furnished by others under Specification Section 11371.

e. A Centrifuge Local Operator Panel for each centrifuge located within the centrifuge room and containing an Operator Interface Unit furnished by others under Specification Section 11371.

f. Three (3) plus one future Truck Filling Station Local Control panels, one for each conveyor, located on the walkway on the centrifuge building's lower level and furnished by others under Specification Section 14549.

g. Surveillance system equipment furnished by others under Specification Section 16800 but installed within control panels furnished hereunder and integrated into the Plant Control System network.

3. The above system elements shall be interconnected via Profibus and/or Ethernet as shown on the Contract Drawings.

4. The Waste Activated Sludge (WAS) Booster Pumps, Sludge Grinders and related instruments shall be monitored and controlled by the control system using signals connected to the existing PLC/Remote Input/Output (I/O) drops in the North Control Building and Biosolids Handling Building.

5. The following additional programming, as specified elsewhere herein, shall be provided by the SYSTEM SUPPLIER:

    a. Control strategy for the WAS booster pumps.

    b. Modification of the existing sludge feed pumps' control strategy to utilize commands from the new Centrifuge PLC instead of the existing Belt Press PLC when in automatic.

    c. Control strategy for the sludge grinders.

    d. Modification of the existing polymer feed pumps' control strategy to utilize commands from the new Centrifuge PLC instead of the existing Belt Press PLC when in automatic.

    e. Control strategy for the conveyor systems.

    f. Control strategy for coordinating operation of the centrifuges, conveyor systems, sludge feed pumps and polymer feed pumps.

    g. Modification of the existing Human Machine Interface (HMI) graphic screens to incorporate the new equipment.

    h. Provision of new HMI graphic screens for Centrifuge system operation.

i. Provision of a new report documenting sludge operations using the new Centrifuges.

D. Submittals.

1. Furnish, as prescribed under the General Requirements, all required submittals covering the items included under this section and its associated sections of the work.

2. Submit complete, neat, orderly, and indexed submittal packages. Handwritten diagrams are not acceptable.

3. Partial submittals or submittals that do not contain sufficient information for complete review or are unclear will not be reviewed and will be returned by the ENGINEER as not approved.

4. Provide all shop drawing submittals on disk in PDF format.

5. Submit the following Field Instrumentation Shop Drawings in a single package:

a. Catalog information, descriptive literature, wiring diagrams, and shop drawings on all components of the field instruments, including all miscellaneous electrical and mechanical devices furnished under this section.

b. Complete part numbers for all instruments, including any options, shall be identified. Provide manufacturer's data that correlates to the complete part number.

c. Individual data sheets for all components of the field instruments to supplement the above information by citing all specific features for each specific component (e.g. scale range, materials of construction, special options included, etc.). Each component data sheet shall bear the

component name and instrument tag number designation shown in the Drawings and Specifications.

d. Installation details for all field mounted devices to show conformance with the Contract Documents.

e. Configuration documentation for all programmable devices to indicate actual settings used to set the device scale, range, trip points, and other control parameters.

6. Provide a single control system shop drawing submittal containing the following:

a. Loop diagrams, consisting of complete wiring and/or plumbing diagrams for each control loop showing all terminal numbers, the location of the dc power supply, the location of any booster relays or common dropping resistors, surge arrestors, etc. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus divide each loop diagram into four areas for identification of element locations: PLC I/O point(s), panel face, back-of-panel, and field, respectively.

b. System interconnect diagram that shows all connections required between component parts of the items covered in this section and between the various other systems specified in this Contract. Number all electrical terminal blocks and field wiring. Identify each line at each termination point with the same number. Do not use this number again for any other purpose in the complete control scheme.

c. Bill of Materials: A list of all components, including all 3rd party software. Group components by type and include component model number and part number, component description, quantity

supplied, and reference to component catalog information.

d. Descriptive Information: Catalog information, descriptive literature, performance specifications, internal wiring diagrams, power and grounding requirements, power consumption, and heat dissipation of all elements. Clearly mark all options and features proposed for this project.

e. Installation Details. Equipment installation drawings showing external dimensions, enclosure material and spacing, mounting connections, and installation requirements.

f. A list of, and descriptive literature for, spares, expendables, and test equipment.

7. Application Programming. Submit an application programming design package that contains a written description of each control strategy. These descriptions shall lead the user through the major subsections of the programs. They shall generally describe the programming methods and techniques that will be used to implement the functional requirements of this Specification.

8. Test Procedures: Submit the procedures proposed to be followed during all system testing. Procedures shall include test descriptions, forms, and check lists to be used to control and document the required tests.

9. Test Reports: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures to the ENGINEER.

E. Final Documentation

1. After the demonstration tests have been completed and as a part of the final acceptance requirements, submit the system record drawings. Record drawings shall include,

corrected for any changes that may have been made up through Substantial Completion:

a. instrument loop wiring diagrams

b. panel wiring diagrams

c. panel elevations

d. interconnection diagrams showing terminal numbers at each wiring termination

2. Record drawings shall be developed or converted to AutoCAD latest version. Provide two copies of all AutoCAD files on separate Compact Disks.

3. Operating and Maintenance (O&M) Manuals: Provide the specified number of complete sets of three-ring bound O&M manuals in accordance with Division 1. Include descriptive material, drawings, and figures bound in appropriate places. Include:

a. Operating and maintenance instructions in sufficient detail to facilitate the operation, removal, installation, adjustment, calibration and maintenance of each component provided with the system.

b. All the submittal data for each component from the approved shop drawing submittals with corrections made on approved as noted items.

c. A Compact Disk containing the shop drawing data in PDF format in the binder sleeve.

4. Provide a system operational manual that provides a single source describing overall centrifuge operations detailing operator interaction methods and locations (i.e. plant control system HMI, Centrifuge Local Operator Panel Operator Interface Terminal or local, manual hardware switches).

5. Provide the following additional final documentation:

a. licenses in the OWNER's name for all software supplied

b. final copies of all programming files on Compact Disk

F. Quality Control.

1. The SYSTEM SUPPLIER shall meet all of the requirements of these specifications, and, unless specifically stated otherwise, no prior acceptance of any subsystem, equipment, or materials has been made.

2. The SYSTEM SUPPLIER shall be subcontracted by and paid by the CONTRACTOR. Base bids for the SYSTEM SUPPLIER shall be as listed in the Contract Proposal. Acceptance of alternates shall be made based on price, location of the fabrication shop, accessibility of personnel, PLC programming knowledge, and OWNER confidence. SYSTEM SUPPLIER seeking ENGINEER approval shall meet the following minimum requirements:

a. Have extensive experience in systems of similar size and complexity. Provide references for a minimum of five completed water and/or wastewater projects furnished within the last four years. For each identify the following:

(1) Project name

(2) Control Panel dollar value

(3) General Contractor

(4) Engineer, with contact name and phone number

(5) Owner, with contact name and phone number

b. Panel fabrication shop shall be a UL listed panel shop. Submit evidence thereof.

c. Have specific experience with the controller hardware and software to be supplied hereunder. Submit resumes of personnel available to work on the project demonstrating said experience.

d. Have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than six (6) hours travel time from the jobsite. Identify the location of said facility.

3. All equipment furnished by the SYSTEM SUPPLIER shall be of the latest and most recent design and shall have overall accuracy as guaranteed by the manufacturer.

4. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.

5. Component equipment shall be as supplied by one of the manufacturers named or approved equal. The design of the system is based on the first-named manufacturer's equipment if there is a difference.

6. To facilitate the OWNER's operation and maintenance, products shall be of the same major MANUFACTURER, with panel mounted devices of the same type and model as far as possible.

7. In order to insure the interchangeability of parts and the maintenance of quality, strict compliance with the above requirements shall be maintained.

8. The SYSTEM SUPPLIER shall designate a single point of contact for interface with the ENGINEER on this project. The ENGINEER reserves the sole right to approve or reject this point of contact.

9. The SYSTEM SUPPLIER shall provide experienced personnel on-site to coordinate and/or perform

installation, termination, and adjustment; on-site testing; OWNER training; and startup assistance for the system.

G. Standards.

1. The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment and accessories proposed under this Contract shall conform to the National Electrical Code and to applicable state and local requirements. UL listing and labeling shall be adhered to under this Contract.

2. Instrument Society of America (ISA) and National Electrical Manufacturers Association (NEMA) standards shall be used where applicable in the design of the system.

3. Any equipment that does not have a UL, FM CSA, or other approved testing laboratory label shall be furnished with a notarized letter signed by the supplier stating that the equipment famished has been manufactured in accordance with the National Electric Code and OSHA requirements.

4. Any additional work needed resulting from any deviation from codes or local requirements shall be at no additional cost to the OWNER.

H. Warranty and Guarantees.

1. In accordance with Division 1, the SYSTEM SUPPLIER shall furnish to the OWNER a written two year guarantee commencing with substantial completion, that all equipment and parts thereof, material and/or workmanship are of top quality and free from defects.

2. The SYSTEM SUPPLIER shall guarantee all equipment whether or not of his own manufacture.

PART 2 - PRODUCTS

A. General Requirements.

1. Equipment to be installed in a hazardous area shall meet Class, Group, and Division classification as shown on the Contract Electrical Drawings, or comply with the local or National Electrical Code, whichever is the most stringent requirement.

2. All instruments requiring plumbing shall utilize stainless steel components as follows:

   a. Test Tap: Shall consist of Crawford Fitting Co. Swagelock quick connects Series QC4-DE, or equal.

   b. Tubing, Stainless Steel: Shall be ASTM A 312, TP 316, seamless, soft annealed with 0.065 inch wall. Fittings shall be ASTM A 276, TP 316 compression or socket weld type.

   c. Valve, Ball: Shall be stainless steel ball valves, Whitey Series 40, Hoke Flamite Series 7100, or equal.

3. All instrumentation supplied shall be of the MANUFACTURER's latest design and shall produce or be activated by signals, which are established standards for the water and wastewater industries.

4. All electronic instrumentation shall be of the solid-state type and shall utilize linear transmission signals of 4 to 20 mA DC (milliampere direct current); however, signals between instruments within the same panel or cabinet may be 1-5 volts DC (direct current). Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.

5. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks.

6. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent. Indicator readouts shall be linear in process units. All transmitters located outdoors shall be equipped with a sun shield.

7. Electronic equipment shall utilize printed circuitry suitably coated to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for their purpose, to assure optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

8. All equipment shall be designed to operate on a 60-Hertz alternating current power source at a normal 120 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

9. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single MANUFACTURER, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion through the installation of plug-in circuit cards or additional cabinets.

10. The equipment furnished for air conditioned areas shall be designed to operate

satisfactorily between 0 degrees C and 40 degrees C at up to 95 percent Relative Humidity (non condensing). Equipment to be furnished for other areas shall be designed to operate satisfactorily between 0 degrees C and 50 degrees C at up to 95 percent Relative Humidity (non condensing).

11. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 volts-amperes (VA), unless specifically noted otherwise.

12. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

B. Lightning/Surge Suppression

1. Surge suppressors and arrestors meeting the requirements of ANSI Standard C-62.41 (latest revision) shall be provided as further detailed below.

2. DC signals. Lightning and surge protection shall be provided on all 4-20 mA signal wires entering or leaving the panel. The protectors shall meet the following criteria:

   a. 35 mm DIN rail mounted.

   b. Response time of less than five nanoseconds.

   c. Automatic reset.

   d. Operating signal voltage: up to 30 Volts DC

   e. Operating signal current: up to 150 mA

   f. Capable of withstanding 1,200 Amps at IEEE/ANSI C-62.41 8 x 20 microseconds combination wave.

g. Capable of withstanding 100 Amps at IEEE/ANSI C-62.41 10 x 1 milliseconds long wave.

h. Nominal series resistance of 5 ohms each leg

i. Manufacturer/model:

(1) EDCO DRS-036

(2) PSI D Dual 2W

(3) Approved equal.

3. Single phase AC Power (to 15Amps). Lightning and surge protectors for AC power supply lines up to 15 Amps service shall meet the following criteria:

a. Serial protection with replaceable fuse.

b. Failure indicator

c. Response time of less than five nanoseconds.

d. Capable of withstanding up to 10,000 Amps at IEEE/ANSI C-62.41 8 x 20 microseconds combination wave.

e. Manufacturer/model:

(1) EDCO HSP121BT

(2) Approved equal.

4. Single phase AC Power (over 15Amps). Lightning and surge protectors for AC power supply lines over 15 Amps service shall meet the following criteria:

a. Parallel protection using MOVs and thermal fusing technology.

b. Failure indicator

c. Response time of less than five nanoseconds.

d. Capable of withstanding up to 6,500 Amps at IEEE/ANSI C-62.41 8 x 20 microseconds combination wave.

e. Manufacturer/model:

(1) EDCO FAS-120AC

(2) Approved equal.

5. AC Powered Instruments. Lightning and surge protection shall be provided on both the AC power supply and signal lines. The protectors and the instrument/transmitter shall be mounted in a NEMA 3R Stainless Steel vented enclosure with three point latch. The protectors shall meet the following criteria:

a. NEMA 4X small case, conduit mounted enclosure.

b. Response time of less than five nanoseconds.

c. AC Power protection: IEEE/ANSI Std. C-62.41 rated C3 at 330 Volts clamping level.

d. Signal line protection: 10,000 Amp 8 x 20 microsecond surge, clamped at 36 Volts clamping level.

e. Test jacks for low level signal monitoring.

f. Manufacturer/model: EDCO SLAC series or approved equal.

6. Loop Powered Instruments. Lightning and surge protection shall be provided on the 4-20 mA DC signal line. The protectors shall meet the following criteria:

a. Encapsulated in Stainless Steel Pipe nipples for in-line conduit mounting.

b. Response time of less than one nanosecond.

c. Capable of withstanding up to 400 occurrences of 500 Amps at 10 x 1 millisecond.

d. Series resistance of 5 ohms per line.

e. Protection of both lines plus shield.

f. Manufacturer/model: EDCO SS65 or approved equal.

7. All discrete output signals, regardless of their destination, shall be equipped with interposing relays to electrically isolate them from the control system I/O. The interposing relays shall each be equipped with a snubber circuit across the coil.

C. Programmable Logic Equipment.

1. Control and data acquisition associated with the site equipment shall be performed by Programmable Logic Controllers (PLC). The design is based on the use of Siemens S7 300 series PLC and components.

2. All control system equipment, including the Operator Interface Units shall be rated for operating between 0 and 55 degrees Celsius.

3. I/O count: I/O count shall be as required to implement the functional requirements of the system and as shown in the Contract Drawings. In addition, provide the following:

a. A minimum of fifteen percent (15%) spare direct I/O of each type shall be provided in each panel.

b. Size the I/O chassis for the required I/O cards plus the greater of 1 or 20%

additional unpopulated slots equipped with slot fillers.

c. If necessary, use expansion chassis' to accommodate these requirements.

4. CPU and communications modules:

a. Power Supply: 115/230VAC, 24VDC, 5A. P/N 6ES7 307-1EA00-0AA0.

b. CPU: 512 KB RAM processor 85k statements 1000 channels of DIO, 1000 channels of AIO. P/N 6ES7 317-2AJ10-0AB0.

c. EtherNet Module: 10/100 Mbit/s, CP343-1. P/N 6GK7 343-1EX20-0XE0.

d. Remote I/O Profibus Interface Module: ET 200M, IM 153. P/N 6ES7 153-2AA02-0XB0.

5. I/O Modules:

a. Discrete Input Module: 120VAC inputs 16 channels. P/N 140 6ES7 321-1FH00-0AA0.

b. Discrete Output Module: Relay Outputs: 5A @ 24VDC, 120VAC, 230VAC, 8 outputs, isolated in groups of 4. P/N 6ES7 322-1HF10-0AA0.

c. Analog Input Module: 8 channels, 16-bit resolution, optically isolated, P/N 6ES7 331-7NF00-0AB0.

d. Analog Output Module: 4 channels, 16-bit resolution, isolated. P/N 6ES7 332-7ND00-0AB0.

6. Operator Interface Panel. Provide a 15-inch full color touch screen panel where required for local operator interface. Siemens model MP 377.

7. PLC Software. The latest revision of the programming software shall be installed as of substantial completion. This shall include

software for programming the PLCs as well as Windows based software for configuring the local operator interface applications. Provide a full copy of both packages on the programming laptop specified elsewhere herein. Provide:

a. PLC programming software: Siemens "Portal".

b. Local Operator Interface programming software: Siemens "Comfort".

D. Other Control System Equipment

1. Furnish all other miscellaneous equipment required to implement the control system network specified herein and as shown on the Contract Drawings.

2. Control System Ethernet Switch. Provide a 24-port 10/100 Base TX switch for the control system interconnections within the SCP and within the SCADA Remote I/O Panel. Provide N-Tron 7026TX or approved equal.

3. Network Interconnect Ethernet Switch. Provide a minimum 6 port Gigabyte switch interconnecting the surveillance system and control system with the plant fiber optic network. N-Tron 7010TX or approved equal.

4. Profibus fiber optic to copper converter.

5. Ethernet fiber optic to copper converter.

6. Fiber Patch Panel. Within the SCADA panels, provide fiber patch panels for terminating the incoming fiber. Corning or approved equal.

7. Optical Coupler Module. Provide an optical coupler module to interface with the existing plant control system Base FX Ethernet network.

E. Field Instrumentation

1. Electro-magnetic Flow Metering System. The magnetic flow metering system shall comprise a

flow through spool piece with sensing electrodes (Flow Element, FE) and an electronics unit (Flow Indicating Transmitter, FIT). The spool piece shall contain a coil energized by d.c. pulses from the electronics unit. The voltage induced in the process fluid shall be sensed by the electrodes and converted, by the electronics unit, into a derived flow signal.

a. System Performance:

(1) Overall system accuracy shall be plus or minus 0.5 percent of rate between 1 and 30 feet per second.

(2) Systems shall be wet calibrated at the factory using NIST traceable equipment.

b. Materials:

(1) Tube – 304 Stainless Steel.

(2) Liner – Teflon.

(3) Flange –304 Stainless Steel ANSI 150#

(4) Electrodes – 316 Stainless Steel.

(5) Grounding rings – 316 Stainless Steel.

c. Ratings:

(1) Spool piece – Rated for continual submergence to 10 feet. This shall include potting of the cable between the spool piece and electronics unit.

(2) Electronics Unit – NEMA 4X.

d. Electrical:

(1) Power Requirement - 120 VAC plus or minimum 10 percent, 60 Hertz.

(2) Maximum Power Consumption – 20 Watts.

e. Functional:

(1) Programmable low flow cut-out.

(2) Empty pipe detection.

(3) Electronic unit display: minimum of 2 x 16 character, backlit LCD.

f. Options:

(1) Provide grounding rings to establish potential matching.

(2) Provide special tools and software necessary to effect field calibration.

(3) Provide certificate of factory calibration.

g. Manufacturer, Model series:

(1) Rosemount model 8705 flow tube with 8712C transmitter.

(2) Approved equal.

2. Submerged Pressure Level Measurement System. The level measurement system shall comprise a submerged pressure transducer (Pressure Transmitter, PT), factory attached and sealed interconnecting cable, and junction/termination box. Within the pressure transmitter, process pressure variations shall be sensed by a barrier diaphragm and transferred via a non-compressible fill liquid to a Wheatstones Bridge strain gage diffused onto a silicon diaphragm. The electronics within the element shall produce an analog signal proportional to the process pressure. The level indicating transmitter shall convert this signal and retransmit an analog signal proportional to the depth of process fluid in the vessel being monitored.

a. Performance:

(1) Static accuracy of the pressure transmitter shall be less than or equal to 0.25% full scale including the combined effects of nonlinearity, hysteresis and non repeatability, based on a Best Fit Straight Line at 25 degrees C.

(2) The pressure transmitter shall be temperature compensated between 0 and 50 degrees C.

(3) The shielded and vented interconnecting cable shall be of sufficient length to allow the pressure transmitter to be properly located within the tank, basin, wetwell, etc. being monitored. The cable shall be able to withstand 200 pounds of tensile strength, allowing the transducer to be suspended directly by the cable.

(4) The cable shall be equipped with a dessicant filter at the surface end of the vent tube.

(5) Transducer shall include 304 stainless steel spacers, nuts, and bolts to protect and keep the diaphragm off the tank floor.

(6) Transducer shall be provided with a sealed air bag for compensating for atmospheric changes and to insure that no external moisture reaches the internal electronics.

(7) The level indicating transmitter shall be the process indicator/retransmitter specified elsewhere within this specification section.

b. Materials:

(1) Exterior pressure transmitter parts – 316 Stainless Steel and Viton.

(2) Fill liquid - NSF approved for use in drinking water applications.

(3) Interconnecting cable jacket – Polyurethane.

(4) Terminal junction box – 316 Stainless Steel.

c. Ratings:

(1) Terminal junction box – NEMA 4X.

d. Electrical:

(1) Transmitter excitation: Loop powered.

e. Manufacturer, Model series:

(1) Blue Ribbon Birdcage GP50 Model 311Z.

(2) Drexelbrook, Ametek 750 series.

(3) Approved equal.

3. Suspended Solids Analyzer.

a. Type: In-line sensor.

b. Functional/Performance

(1) Operation: Phased-array light source and photo detector combination measures suspended solids content of process water, which is indicated and transmitted by the analyzer.

(2) Accuracy: ± 5% of reading or ± 100 mg/L, whichever is greater.

(3) Repeatability: ± 1% of reading or ± 20 mg/L, whichever is greater.

(4) Output: Profibus DP serial connection transmitting measured suspended solids concentration, and all available diagnostic data.

(5) Display: Backlit LCD display for local operation. The reading shall be displayed in engineering units.

(6) Calibration: User-selectable linearization curves and auto-ranging.

(7) Diagnostics: Built-in diagnostics will detect at least the following faults: sensor light detector failure, abnormal calibration, internal program failure.

(8) Power: 120VAC, 60 Hz.

c. Physical:

(1) Sensor Pressure/Temperature: 0-50 psig / 0-50 deg. C.

(2) Sensor Mounting: Furnish hot-tap ball valve assembly and strapping for inline mounting, as required.

(3) Analyzer Enclosure: NEMA 4X / IP65 rated.

(4) Analyzer Mounting: Provide brackets as needed for wall or pipe mounting.

(5) Cable: Furnish connector cable between sensor and analyzer, length as needed.

d. Manufacturer:

(1) Cerlic ITXIL / BB2

(2) Or approved equal.

4. Pressure Switch. The pressure switch shall sense pressure variations by means of a diaphragm and operate a snap action switch when the pressure reaches an adjustable level. Pressure switches shall be equipped with diaphragm seals where shown on the drawings.

a. Performance:

(1) Adjustable deadband between 5% and 50% of maximum range.

(2) Automatic reset.

(3) Dual SPDT contacts.

(4) Setpoint and deadband adjustments visible from outside the enclosure.

b. Materials:

(1) Pressure Chamber Wetted parts – 316 Stainless Steel.

(2) Diaphragm and O-ring – Buna-N.

(3) Housing – Low copper aluminum with polyurethane paint.

c. Ratings:

(1) NEMA 4X.

d. Electrical:

(1) Contacts rated 15 Amps at 120 V AC.

e. Manufacturer, Model series:

(1) Mercoid, SA 1100 series.

(2) Approved equal.

F. Control Panels

1. Provide control panels housing the PLC equipment and related appurtenances as shown on the Contract Drawings and as specified herein as well as any other panels or enclosures required to implement the system.

2. General:

a. All conduit entry shall be from the bottom only.

b. The panels shall be provided with an isolated copper grounding bus to ground all signal shield connections.

c. All Process Control Panels shall be equipped with an internal, hand-switch controlled, 40-watt fluorescent light and 120V, 15 amp, duplex utility receptacle.

d. The panels shall be protected from internal corrosion by the use of corrosion – inhibiting vapor capsules. Provide:

(1) Northern Instruments Model Zerust VC

(2) Hoffman, model A-HCI

(3) Approved equal.

3. Finish:

a. All front panel openings for panel-mounted equipment shall be cut with counter-boring and provided with trim strips as required to give a neat finished appearance.

b. All steel panel surfaces shall be treated with phosphatized treatment inside and out, and then finished on the exterior with two coats of baked enamel of the approved color. Interiors of panels shall be white, ANSI No. 51.

4. Doors:

a. All control panels shall have a continuous piano hinge door for ease of access. A minimum of 80% of the panel interior shall be exposed by doors.

b. The inside of each door shall be equipped with a print pocket.

c. Two-door enclosures shall have a removable center post.

5. Nameplates:

a. All front-face panel mounted controls shall be equipped with screw mounted laminated plastic nameplates to completely define their use. The use of adhesive to mount front panel nameplates will not be acceptable.

b. All internal components shall be equipped with identification tags

6. Power Supplies.

a. An Uninterruptible Power Supply (UPS) shall be provided as follows:

(1) Size the UPS for all internal equipment plus an additional 20% spare capacity.

(2) Provide 15 minutes battery back-up capability at full load.

(3) Provide Invensys Powerware Ferrups or approved equal.

b. Provide isolated 24 Volt DC power supplies as follows:

(1) Redundant supplies with separately fused connections to power each PLC I/O rack and the Operator Interface Unit.

(2) A wetting supply for interposing relay contacts that provide discrete inputs to the PLC, separately fused for each input group. An additional, separately fused connection from this supply shall also power the discrete output isolation relay coils.

(3) A loop power supply for analog inputs, with each input separately fused.

7. Electrical:

a. Main circuit breaker and branch circuit breaker for each branch circuit as required to distribute power from the main power feed.

b. All breakers accessible when the panel door is open.

c. No more than 20 devices on any single circuit.

d. No more than 12 amps for any branch circuit.

e. Panel (or site) lighting, receptacles, heaters, controls, telemetry and fans on separate branch circuits.

8. Wiring:

a. Power wiring shall be 300 volt, type THWN stranded copper, No. 14 AWG size, for 120V service.

b. Discrete wiring shall be 300-volt type THWN stranded copper, sized for the current carried, but not smaller than No. 16 AWG.

c. Analog signal wiring shall be 300 volt, stranded copper in twisted shield pairs, no smaller than No. 16 AWG.

d. Panel wiring shall be routed within wire troughs or panduits.

e. Hinge wiring shall be secured at each end with the bend portion protected by a plastic sleeve.

f. Analog or dc wiring shall be separated from any ac power or control wiring by at least six inches.

g. Each wire shall be uniquely identified using plastic, snap-on numbered tags.

h. Terminal blocks shall be provided for all field wiring entering the panel. The greater of 4 or 15% spare terminal blocks shall be provided.

i. No more than one wire per field termination point.

9. Construction:

a. Minimum metal thickness: 14-gauge.

b. Stiffeners as required to prevent deflection under instrument loading and permit lifting without racking or distortion.

c. When required, removable lifting rings and fill plugs to replace rings after installation.

d. All components and terminals shall be accessible without removing other components except for covers.

10. The panel shall be a manufactured item, Hoffman Engineering, or equal.

G. Internal Panel Devices

1. Control/Interposing Relays: All relays shall meet the following:

a. Compact, general-purpose, plug-in type.

b. Socket mounted.

c. Contacts rated for not less than 10 amperes at 120V.

d. Equipped with neon status lights and test buttons.

e. Permanent, legible identification.

f. Potter & Brumfield series KRPA or approved equal.

2. Terminal Blocks. Terminal blocks shall meet the following requirements:

   a. Screw terminals capable of accepting 10-26 AWG wire.

   b. Fused disconnect style.

   c. DIN-rail mounting.

   d. Connectors shall be either copper or steel. Use of aluminum connectors shall not be permitted without prior approval of the Engineer.

   e. Phoenix Contact UT4 HES1 or approved equal.

3. Current Switch, Isolator: Units shall receive an isolated 4 to 20 mA dc input signal and shall provide an adjustable contact closure on the selected setpoint. Units shall meet the following:

   a. The set point shall be continuously adjustable over the full input span and shall be repeatable within plus or minus 0.1 percent of span.

   b. Activation on rising or falling setpoint shall be internally adjustable.

   c. Dead band shall be continuously adjustable from 1 to 100 percent of full scale.

   d. The contact output shall be an isolated DPDT contact rated for 5 amps at 120V ac.

   e. Housed in a NEMA 1 rated enclosure.

   f. Operate on an isolated 120 volt, 60 Hz power supply.

   g. Moore Industries DCA, AGM Electronics PTA 4034 or 4035, or equal.

4. Converter, Current-to-Current, Isolator: Units shall receive a 4 to 20 mA dc input signal and

shall produce a repeated, isolated, proportional 4 to 20 MA dc output signal into loads in the range of 0 to 1,200 ohms without load adjustments for a 24V dc supply. Units shall meet the following:

a. Input impedance less than or equal to 50 ohms.

b. Accuracy plus or minus 0.25 percent of span.

c. Multi-turn span and zero adjustment.

d. Operate on an isolated 120 volt, 60 Hz power supply.

e. Moore Industries SCT, AGM Electronics PTA 4000, or equal.

H. Control Strategies

1. The following control strategies apply to processes not associated with centrifuge operations.

2. General. Provide control strategies that meet the following general conditions:

a. Wherever in the descriptions the control strategy refers to the operator, it is intended to mean via the HMI graphic screens.

b. Wherever in the descriptions the control strategy refers to software switches, it is intended to mean operator controllable via the HMI graphic screens.

c. All control strategies shall run within the PLC. Data manipulation (calculated analog values, elapsed time functions, event determination) shall be performed by the PLC for the associated equipment it is monitoring. Any resulting values from these manipulations shall be reported as individual registers. The intent is to

avoid using the HMI software for this purpose.

d. The control functions described herein are not intended to be complete comprehensive programming logic descriptions. They describe only the general intended control operation required. Provide complete program logic to completely fulfill the functional requirements indicated.

e. Provide all programming necessary to support the functional requirements of the process graphic screens.

3. WAS Booster Pump Control. Establish a LEAD/LAG sequence for the pumps. If either pump is OFF, make the other LEAD. If either pump is in HAND and running, make it the LEAD. Provide an operator controllable software HAND/OFF/AUTO select switch for each pump. Control the pumps as follows:

a. Provide the following operator controllable functions associated with WAS pumping:

(1) KS – A time of day setting for the start of wasting.

(2) FQ – A total flow target for wasting.

(3) LSH – Maximum level for the sludge holding tanks.

(4) Software START and STOP pushbuttons for wasting

b. While the H/O/A switch is in HAND, run the pump.

c. While the H/O/A switch is in OFF prevent any control signals being sent to the pump.

d. While the H/O/A switch is in AUTO:

(1) Start the LEAD pump at the time of day established by KS or when the START pushbutton is pressed. If the START button is pressed, reset the timer for the following day.

(2) Run the pump until the total WAS flow reaches FQ or either sludge holding tank level reaches LSH or the STOP pushbutton is pressed.

(3) If the LEAD pump fails to start within a preset time after being called to do so or fails while running, automatically call for the LAG.

e. Prevent a pump starting within a preset time of it being turned off.

I. HMI Modifications

1. Modify the SCADA HMI system to accommodate the new process equipment while maintaining the same graphic standards etc., as those currently in use.

2. Revise the system database as necessary for the added points,

3. Modify the existing Sludge Storage Tanks process graphic to indicate the new WAS booster pumps' status and operator interface functions.

4. Modify the existing Sludge Feed Pumps graphic to indicate the new grinders, feed points, and flow rate indication.

5. Provide new process graphics depicting the Centrifuge operations. These graphics shall be similar in level of detail to those available locally on the CCP OIT units except reflecting the HMI graphic standards.

6. Provide a new sludge operations report containing information similar to that of the existing belt press operations report.

7. The OWNER and/or the ENGINEER reserve the right to direct changes in the HMI modifications during on site testing at no additional Contract Price.

J. Spares and Expendables

1. Provide the following spare parts:

a. One spare d.c. power supply of each type provided.

b. Five percent (rounded up) spare relays of each type provided.

c. Five percent (rounded up) spare surge suppressors of each type provided

d. One of each type of PLC module used.

e. One spare Operator Interface Unit.

2. Provide the following expendables:

a. Two year supply of corrosion inhibitor capsules

b. Ten percent (rounded up) spare fuses (minimum of 10) of each type and rating supplied.

c. Ten percent (rounded up) spare indicator light bulbs (minimum of 20) of each type and color supplied.

PART 3 - EXECUTION

A. General

1. Prerequisite Activities and Lead Times: Do not start the following key project activities until the listed prerequisite activities have been completed and lead times have been satisfied:

a. Hardware Purchasing, Fabrication, and Assembly: Associated design related

submittals completed (no exceptions, or approved as noted).

b. Shipment: Completion and approval of all design related submittals.

c. Startup: Operational Checkout Tests.

d. Demonstration Tests: Operational Check-out Tests, Startup, and Demonstration Test Procedures must be complete. Give 4 weeks' notice prior to the planned test start date.

2. Control Panels and enclosures shall be assembled as far as possible at the supplier’s shop. No work, other than correction of minor defects or minor transit damage, shall be done on the panels at the jobsite.

3. Substantial Completion: Substantial Completion for the project is as defined in the General Conditions. However, the following requirements must be fulfilled before consideration will be given for Substantial Completion of the instrumentation and control system:

a. All submittals have been completed.

b. The system has successfully completed the Demonstration Tests.

c. All spares, expendables, and test equipment have been received by OWNER.

4. Final Acceptance: Final acceptance is defined as the date when the ENGINEER issues a written notice of final acceptance. For this Section, the following must have been completed before consideration will be given to the issuance of notice of final acceptance:

a. All punch-list items have been checked off.

b. Revisions to the O&M Manuals have been made (that may have resulted from the Demonstration Tests).

B. Product Handling

1. Adequately pack manufactured material to prevent damage during shipping, handling, storage and erection. Pack all material shipped to the project site in a container properly marked for identification. Use blocks and padding to prevent movement.

2. Ship materials that must be handled with the aid of mechanical tools in wood-framed crates.

3. Ship all materials to the project site with at least one layer of plastic wrapping or other approved means to make it weatherproof. Anti-stat protection shall be provided for all sensitive equipment.

4. Inspect the material prior to removing it from the carrier. Do not unwrap equipment until it is ready to be installed. If any damage is observed, immediately notify the carrier so that a claim can be made. If no such notice is given, the material shall be assumed to be in undamaged condition, and any subsequent damage that is discovered shall be repaired and replaced at no additional expense to the OWNER.

5. Store and protect equipment until installation following the storage and handling instructions recommended by the equipment manufacturers. Place special emphasis on proper anti-static protection of sensitive equipment.

6. ESD Protection: Provide for the proper handling, storage, and environmental conditions required for the system components deemed static sensitive by the equipment manufacturer. Utilize anti-stat wrist straps and matting during installation of these items to prevent component degradation.

7. Protection During Construction: Throughout this Contract, provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Provide covers for panels and other elements that may be exposed to dusty construction environments. Specific storage requirements shall be in accordance with the SYSTEM SUPPLIER's recommendations.

8. Corrosion Protection: Protect all consoles, panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules. Prior to shipment, include capsules in the shipping containers, and equipment as recommended by the capsule manufacturer. During the construction period, periodically replace the capsules in accordance with the capsule manufacturer's recommendations. Replace all capsules just prior to Final Acceptance.

9. The CONTRACTOR shall be responsible for any damage charges resulting from the handling of the materials.

C. Installation

1. Install the system in the locations indicated on the Drawings and follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instruction, and these Contract Documents, follow ENGINEER's decision, at no additional cost. Keep copy of manufacturers' instructions on the jobsite available for review at all times

2. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance. Coordinate I&C

work with the OWNER and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the existing plant during construction.

3. Provide finish on instruments and accessories that protects against corrosion by the elements in the environment in which they are to be installed. Finish both the interior and exterior of enclosures. Provide extra paint of each color used in the material from the manufacturer for touch-up purposes.

4. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. Clean and polish the exterior of all panels and enclosures upon the completion of the demonstration tests.

5. Ground each analog signal shield on one end at the receiver end only. Properly ground all surge and transient protection devices. Coordinate grounding system with Division 16, Electrical.

6. For the purposes of uniformity and conformance to industry standard, provide analog signal transmission modes of electronic 4-20 ma DC. No other signal characteristics are acceptable.

7. Fully isolate outputs for transmitted electronic signals between transmitters and receivers, equipment of different manufacturers and between control panels to conform to ISA Standard S 50. 1.

D. Testing – General

1. All elements of the system, both hardware and software, shall be tested to demonstrate that

the total system satisfies all of the requirements of the Contract Documents

2. As a minimum, the testing shall include shop tests, operational check-out tests, and Field Acceptance Test.

3. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system producing the correct result (effect), the specific test requirements will have been satisfied.

4. All tests shall be conducted in accordance with, and documented on, prior approved procedures, forms, and checklists. Each specific test to be performed shall be described and a space provided after it for signoff by the appropriate party after its satisfactory completion. Copies of these signoff test procedures, forms, and checklists will constitute the required test documentation.

5. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation. Define these simulation techniques in the test procedures.

6. The SYSTEM SUPPLIER shall coordinate all of their testing with the CONTRACTOR, the ENGINEER, all affected suppliers, and the OWNER.

7. The ENGINEER reserves the right to test or retest any and all specified functions whether or not explicitly stated in the approved test procedures. The ENGINEER's decision shall be final regarding the acceptability and completeness of all testing.

E. Operational Readiness Test

1. Prior to startup and demonstration testing, certify that the system (inspected, tested and documented) is ready for operation. These inspections and tests shall include Loop/Component inspections and tests. The SYSTEM SUPPLIER shall fully debug problems in the system as a whole. Final approval of control software will not be based on written descriptions of software functions alone, but on actual performance in the field.

2. Check the entire system for proper installation, calibration and adjustment on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and the Contract Documents.

3. The Loop/Component Inspections and Tests shall be implemented using approved forms and checklists. These shall be developed by the SYSTEM SUPPLIER and submitted for approval.

4. Loop Status Report: Each control loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and check-off items with spaces for sign-off by the SYSTEM SUPPLIER:

    a. Project Name

    b. Control Loop Number or description

    c. Tag Number or description for each component of the control loop

    d. Check-offs/sign-offs for each component for proper installation, termination, and calibration/adjustment

    e. Check-offs/sign-offs for the control loop for proper panel interface terminations, 1/0 interface terminations, I/0 signal operation relative to the computer network, and total loop operation ready

    f. Space for comments

5. Component Calibration Sheet: Each field instrument element and each PLC I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for signoff by the SYSTEM SUPPLIER:

   a. Project Name

   b. Component Identification or I/O Module Number

   c. Manufacturer, Model Number/Serial Number of field element

   d. Summary of Functional Requirements (scale, range, computing equation, control action, etc.)

   e. Calibrations of span, setpoints, and preset adjustable parameters

   f. Space for comments

6. Maintain the Loop Status Reports and Component Calibration Sheets at the jobsite and make them available to the ENGINEER at any time.

7. Witnessing: Resident Project Inspector shall witness the Loop Test. Contractor to notify Owner seven (7) days prior to tests. The ENGINEER will review the Loop Status Sheets and Component Calibration Sheets and spot-check their entries periodically and upon completion of the Operational Check-out Tests. Contractor to correct any deficiencies found.

F. Field Acceptance Test (FAT)

1. Once the system has passed the ORT, the SYSTEM SUPPLIER shall perform a witnessed Field Acceptance Test (FAT) on the complete system. The FAT shall demonstrate that the system is operating and in compliance with the Contract requirements. Each specified function shall be demonstrated on a paragraph-by-paragraph basis.

2. Prior to the FAT, the entire installed system shall be certified in writing by the CONTRACTOR that it is ready for operation.

3. The system shall operate for a continuous 100 hours without failure before this test will be considered successful.

4. The FAT shall cover the entire system, including control functions, alarms, and status monitoring. Test procedures used for shop tests may be adopted for these tests if modified as required.

END OF SECTION

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SECTION 13301 CONTROL SYSTEM OPERATION

PART 1 - GENERAL

A. Scope of Work.

1. This section defines requirements for the overall operation and control requirements for sludge handling at Orange County's Eastern Water Reclamation Facility (EWRF) Centrifuge Dewatering Improvements.

2. Portions of the Work specified will be performed by different suppliers as further identified herein.

3. It is the responsibility of the CONTRACTOR to ensure that the affected suppliers properly coordinate in order to ensure a complete and fully operable system that reliably performs the specified functions.

4. All engineering development shall be in accordance with the Conditions of this Contract.

5. Work or equipment found to be defective prior to system acceptance shall be replaced and installed at no additional cost to the OWNER.

B. Related Work.

1. The PLC based Centrifuge Control and Local Operator Panels are defined in Specification Section 11371, Centrifuges and Appurtenances.

2. The PLC based SCADA Control and Remote I/O Panels are defined in Specification Section 13300, Instrumentation and Control.

3. The conveyor system components are defined in Specification Section 14549, Screwless Shaft Conveyor System.

4. Variable Frequency Drives are defined in Specification Section 16370, Variable Frequency Drives.

5. Other Motor Control Center components are defined in Specification Section 16482, Motor Control Centers.

C. System Description.

1. Overall system operation shall be achieved by the coordinated functioning of the following major sub-systems:

   a. Four (initially three) individual centrifuges.

   b. Conveyors, one per centrifuge with centrifuges 1 and 2 conveyors feeding Truck Loading Bay 1 and centrifuges 3 and future 4 conveyors feeding Truck Loading Bay 2.

   c. Sludge feed, one per centrifuge.

   d. Polymer feed, one per centrifuge.

2. Overall system operation shall be controlled by the following major elements as shown on the Contract Drawings:

   a. A CPU based PLC (PLC-14A) within the SCADA Control Panel located in the electrical building. Signals associated with equipment and instruments not directly associated with the individual centrifuges shall be connected to the SCADA Remote I/O Panel (RIO-14A) in the Centrifuge Building.

   b. CPU based PLC within each of the three (plus one future) Centrifuge Control Panels (PLC-14B through PLC-14E respectively for centrifuge's 1 through 4) are located in the North Electrical Building. Signals associated with the individual centrifuges' equipment and instruments shall be connected to remote I/O (RIO-14B through RIO-14E respectively for centrifuge's 1 through 4) within the

Centrifuge Local Operator Panels (CLOP) in the Centrifuge Building.

3. The control system as supplied shall allow (with suitable password protection) the complete control of all centrifuge operations including associated sub-systems to be performed by operators using the plant control system HMI. The individual centrifuge OIT in the CLOP will control Centrifuge functionality specifically. The plant control system requirement includes the lap-top computer in the SCADA Remote I/O Panel within the Centrifuge Building and the following:

   a. Ability to change any operator adjustable parameters.

   b. Ability to change any software select switch.

   c. Ability to manually control any equipment set to AUTO or REMOTE at the local, manual select switch.

4. All programming for the SCADA Control Panel PLC, control system HMI and overall operation shall be provided by the SYSTEM SUPPLIER under Specification Section 13300.

5. All PLC and OIT programming for the Centrifuges' CCP and CLOP shall be provided under Specification Section 11371.

PART 2 – PRODUCTS

THIS PART NOT USED

PART 3 - EXECUTION

A. General

1. In the descriptions herein, certain phrases are used which have specific meanings. These are as follows:

a. “operator adjustable” or “operator controllable” shall mean via the SCADA HMI and Centrifuge OIT graphic screens.

b. “controllable” shall mean controllable by the system; i.e. all associated local hardware switches are set to remote or automatic and the equipment is available for use.

2. When the operating sequence descriptions call for a piece of equipment to be started, refer to the individual control strategy descriptions for additional details.

3. For each centrifuge provide the following operator controllable software functions associated with overall centrifuge operations:

   a. AUTO/OFF/MANUAL select switch.

   b. STOP pushbutton.

   c. START pushbutton.

   d. E-STOP maintained switch.

4. When a centrifuge is set to AUTO, the START pushbutton shall initiate a fully automatic start up sequence and the STOP pushbutton shall initiate a fully automatic shutdown sequence.

5. When a centrifuge is set to OFF, all control commands from the system shall be disabled.

6. When a centrifuge is set to MANUAL, the START pushbutton shall cause the next step in the start-up sequence to occur. Upon completion of each step, the system shall hold until the START pushbutton is once more depressed before proceeding. The STOP pushbutton shall similarly initiate the steps for a shut-down sequence.

7. Regardless of the position of the AUTO/OFF/MANUAL select switch, depression of the E-STOP switch shall initiate an emergency shutdown of the centrifuge. This shall cause all systems to be immediately stopped. To avoid accidental

initiation, the system shall require the operator to confirm this operation before proceeding.

B. Start-up Sequence.

1. The start-up sequence shall be coordinated by a strategy running in the SCADA Control Panel PLC (PLC-14A).

2. Upon initiation of start-up, the system shall confirm all associated equipment (Sludge feed, polymer feed, centrifuge and conveyor) are controllable. If any are not, issue the operator an advisory alarm and do not proceed until the alarm has been acknowledged and the START pushbutton pressed again.

3. Call for the centrifuge main and back drives to start.

4. After an operator adjustable time and when the drives are up to speed, call for the sludge and polymer feeds to start.

5. After a further operator adjustable time, sound the conveyor alarm for a preset time. After the preset alarm duration, call for the conveyor to start and open the diverter gate.

6. If any equipment fails at any stage of the start-up, issue an advisory alarm and proceed as follows:

   a. Centrifuge fault – Stop the centrifuge drives and the sludge and polymer feeds, if running. After a preset duration, close the diverter valve then stop the conveyor.

   b. Sludge Feed fault – temporarily stop the polymer feed and pause the start-up sequence. If the operator next presses the STOP pushbutton, proceed to the shut down sequence. If the fault condition is cleared and the operator presses the START pushbutton, restart the polymer feed and resume the start-up sequence.

c. Polymer Feed fault –Pause the start-up sequence for a preset time. If the time expires or the operator presses the STOP pushbutton, proceed to the shut down sequence. If the fault condition is cleared and the operator presses the START pushbutton, resume the start-up sequence.

d. Conveyor fault - Pause the start-up sequence for a preset time. If the time expires or the operator presses the STOP pushbutton, proceed to the shut down sequence. If the operator presses the START pushbutton, resume the start-up sequence.

C. Shut-down Sequence.

1. The shut-down sequence shall be coordinated by a strategy running in the SCADA Control Panel PLC (PLC-14A).

2. Stop the Sludge and Polymer Feeds.

3. After an operator adjustable time, stop the centrifuge main drive.

4. Once the main drive has stopped, stop the back drive after an operator adjustable time and close the diverter gate.

5. Once the diverter gate is closed, open the flush valve for an operator adjustable time and, after a second operator adjustable time, stop the conveyor.

D. Centrifuge Main Drive

1. The centrifuge main drive control strategy shall run within the associated Centrifuge Control Panel PLC (PLC-14B through PLC-14E).

2. Provide an operator controllable software HAND/OFF/AUTO select switch and operator controllable SPEED potentiometer.

3. When the select switch is placed in HAND, run the drive at the speed set by the software SPEED potentiometer.

4. When the select switch is placed in OFF, prevent any commands to the drive.

5. When the select switch is placed in AUTO, start and stop the drive when called from the overall centrifuge system control strategy and run it at the speed set by the software SPEED potentiometer.

E. Centrifuge Back Drive

1. The centrifuge back drive control strategy shall run within the associated Centrifuge Control Panel PLC.

2. Provide operator controllable software HAND/OFF/AUTO and DIFFERENTIAL/TORQUE select switches and an operator controllable SPEED potentiometer.

3. When the select switch is placed in HAND, run the drive at the speed set by the software SPEED potentiometer.

4. When the select switch is placed in OFF, prevent any commands to the drive.

5. When the select switch is placed in AUTO, start and stop the drive when called from the overall centrifuge system control strategy and run it at a speed set as follows:

   a. If the select switch is in DIFFERENTIAL, set the speed to an operator adjustable ratio of the main drive speed.

   b. If the select switch is in TORQUE, set the speed to maintain an operator adjustable constant torque.

   c. When the main drive is called to stop, set the speed to an operator adjustable value and run it until called to stop by the overall centrifuge system control strategy.

F. Sludge Feed

1. The sludge feed shall be coordinated by a strategy running in the SCADA Control System PLC (PLC-14A).

2. Provide an operator controllable software FLOW/SPEED select switch.

3. Start and stop the sludge feed pump and associated grinder when called from the overall centrifuge system control strategy.

4. If the software select switch is in FLOW, run the sludge pump at a speed to maintain an operator adjustable ratio of the centrifuge main drive speed.

5. If the software select switch is in SPEED, run the sludge pump at an operator adjustable speed.

G. Polymer Feed

1. The polymer feed shall be coordinated by a strategy running in the SCADA Control System PLC (PLC-14A).

2. Provide an operator controllable software FLOW/SPEED select switch.

3. Start and stop the polymer feed pump when called from the overall centrifuge system control strategy.

4. If the software select switch is in FLOW, run the feed pump at a speed to maintain an operator adjustable feed flow at an operator adjustable ratio of the sludge feed flow.

5. If the software select switch is in SPEED, run the feed pump at an operator adjustable speed.

H. Conveyor System

1. The conveyor system operation shall be coordinated by a strategy running in the SCADA Control Panel PLC (PLC-14A).

2. Whenever a truck pulls into the truck loading station, as indicated by the truck scale, record the weight.

3. If the conveyor Local Control Panel select switch is in LOCAL or OFF, disable any PLC control commands, otherwise proceed as follows.

4. When called to run by the centrifuge system control strategy, close both gate valves and start the conveyor running forward.

5. After an operator adjustable time delay, open the gate valve farthest from the conveyor drive motor.

6. After the same operator adjustable time delay, open the gate valve nearest to the conveyor drive motor.

7. After the same operator adjustable time delay, run the conveyor in reverse and close both gate valves.

8. An operator adjustable time delay following the diverter gate becoming closed, stop the conveyor.

9. If, during conveyor operation, the truck scale goes to zero weight (evidencing a truck leaving the loading station), halt the conveyor until a preset time after the truck scale indicates another truck is in place.

10. Record the weight whenever a truck leaves and calculate and store the total weight of solide delivered to the truck.

END OF SECTION

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SECTION 13437 PRESSURE GAUGES

PART 1 - GENERAL

A. Description

This section includes materials and installation of pressure gauges, vacuum gauges, compound pressure/vacuum gauges, gauge protectors, diaphragm seals, pulsation dampeners, and accessories.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog data and descriptive literature. Call out materials of construction by ASTM reference and grade. Submit manufacturer's certificate of compliance with the referenced ANSI standards. Identify each gauge by tag number to which the catalog data and descriptive literature pertain.

PART 2 - MATERIALS

A. Pressure Gauges

1. Pressure range shall be as designated by the following type numbers shown in the drawings:

Type Number	Description	Pressure Range
3	Pressure	0 to 30 psi
4	Pressure	0 to 60 psi
5	Pressure	0 to 100 psi
6	Pressure	0 to 150 psi
7	Pressure	0 to 300 psi

2. If no type number is shown in the drawings, use Type 4 gauges.

3. Gauges 4-1/2 inches and larger shall comply with ASME B40.1, Grade 2A. Gauges shall incorporate the following features:

a. Solid or open front with side or rear blowout relief.

b. Pressure tight.

c. 270-degree arc with adjustable pointer.

d. Stem mounted.

e. Hermetically sealed unless specified to be liquid filled.

Size of gauge shall be 4-1/2 inches, unless otherwise indicated in the drawings. Stem or connection size shall be 1/2 inch, except that gauges connected to gauge protector spools or rings may have 1/4-inch connections.

1. Gauges smaller than 4-1/2 inches shall conform to ASME B40.1, Grade A. Otherwise, construction shall be as described above.

2. Materials of construction for gauges shall be as shown in the following table:

Item	Material	Specification
Case	Stainless steel, aluminum, polypropylene, or phenolic plastic	AISI 316, 6061-T6
Bourdon tube	Stainless steel	AISI 316
Windows	Acrylic plastic	---
Ring	Stainless steel	AISI 316
Stem	Stainless steel	AISI 316
Dial face	Aluminum with clear baked-on acrylic coating	ASTM B209, 6061-T6

4. Gauges, diaphragm seals, snubbers, and tools shall be as manufactured by Ashcroft, Crosby, Marshalltown, Marsh, or equal.

B. Pressure Switches

See Section 13300.

C. Gauge Protectors

1. Gauge protectors shall consist of three parts: a flexible, impermeable, elastomer cylinder; a captive sensing liquid; and a steel or stainless steel housing. The process liquid pressure shall be transmitted through the elastomer-lined cylinder wall and the sensing liquid

to the pressure gauge. An attached 4-1/2-inch pressure gauge shall indicate the pressure. Gauge outlet in the spool or ring shall be threaded, 1/4- or 1/2-inch, per ASME B1.20.1. Spools shall be of either the isolation-spool type with flanged ends or of the isolation-ring type, fitting between two adjacent flanges. Determine the flange rating based on the test pressure shown in the Piping Schedule in the drawings. For test pressures 200 psi and less, use Class 150 flanges, ASME B16.5. For test pressures greater than 200 psi, use Class 300 flanges, ASME B16.5.

2. Materials of construction shall be as follows:

Item	Material	
	Type 1	**Type 2**
Housing, flanges	Type 316 stainless steel	Carbon steel
Flexible cylinder	Teflon	Buna N or neoprene
Sensing liquid	Silicone oil	Silicone oil

3. Use Type 1 gauge protectors if no type number is shown in the drawings.

4. Protectors shall be manufactured by Ronningen-Petter; Red Valve Company, Inc.; Onyx; or equal.

D. Diaphragm Seals (Stainless Steel)

1. Provide diaphragm seals with gauge assemblies and/or switch where shown in the drawings. Material of construction shall be Type 316 stainless steel. Mount the pressure gauge directly on the socket of the diaphragm seal top housing. Instrument (gauge) connection socket shall be 1/2 inch. Diaphragm seal connection socket shall be 1/2-inch NPT threaded female with flush connection. Pressure rating shall be at least that of the pressure gauge to which it is attached. Liquid filling shall be silicone or glycerin.

2. Gauge and diaphragm seal shall be assembled together at the factory, with the liquid fill included. Provide a Type 316 stainless steel plug or cock in the flush connection.

E. Pressure Snubbers

Provide pressure snubbers with gauge assemblies where shown in the drawings. Material of construction shall be Type 316 stainless steel. Snubber design shall incorporate a porous metal disc for use with the process fluid in the pipeline. Inlet and outlet connections shall be NPT female and shall match the connection size of the attached pressure gauge.

B. Pulsation Dampeners

Provide pulsation dampeners with gauge assemblies where shown in the drawings. Material of construction shall be Type 316 stainless steel. Dampening shall be achieved by use of a pin in selected holes. Pin shall move up and down in normal operation. Connections shall be NPT female and shall match the connection size of the attached pressure gauge.

C. Pipe Nipples and Fittings

Nipples for connecting gauges and pressure switches to piping shall be Schedule 80S, Grade TP 316 seamless stainless steel, conforming to ASTM A312. Fittings shall conform to ASTM A403, Class WP316. Threads shall conform to ASME B1.20.1. Size of pipe nipple shall match the gauge or pressure switch connection size.

F. Tools for Gauges

Provide two gauge tool kits, each containing a hand jack set, screwdriver, five reamers (minimum), two pin vise holders, wiggler, tweezer, and carrying case.

PART 3 - EXECUTION

A. Installation

Install gauges and pressure switches before conducting pressure tests. Do not disassemble gauges from the factory-assembled diaphragm seals or isolation sleeves or rings.

END OF SECTION

DIVISION 14 – Conveying Equipment

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SECTION 14549 SHAFTLESS SCREW CONVEYORS AND APPURTENANCES

PART 1 - GENERAL

A. Description:

Provide and test shaftless screw conveyors, gear reducers, motors, discharge knife gates, controls and appurtenances as indicated and specified.

B. References:

1. American Society for Testing and Materials (ASTM):

a. A48: Specification for Gray Iron Castings.

2. American National Standards Institute (ANSI):

a. S1.11: Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets.

3. National Electrical Manufacturers Association (NEMA):

a. MG1: Motors and Generators.

C. Submittals:

1. Submit the following shop drawings in accordance with Section 01300:

a. Data regarding equipment performance and motor characteristics and performance.

b. Drawings showing materials of construction, thicknesses, operating and maintenance envelope and assembly and component weights.

c. General arrangement drawings, plan and section showing conveyors, gate, chutes, supports and all process equipment interfaces

d. Shop drawing data for accessory items.

e. Certified setting plans, with tolerances, for anchor bolts.

f. Manufacturer's literature as needed to supplement certified data.

g. Operating and maintenance instructions and parts lists.

h. Listing of reference installations as specified with contact names and telephone numbers. Conveyor torque requirement calculations.

i. Torque calculations for the gear reducer and reducer motor.

j. Horsepower calculations for the drive motor(s).

k. Spiral strength calculations using Mark’s Handbook calculation for spring (spiral) compression and elongation showing the supplied spiral meets or exceeds spring effect intent specified herein for conveyors 40 feet or longer.

l. Bearing temperature operating range for the service conditions specified.

m. List of recommended spare parts other than those specified.

n. Shop and field inspection reports.

o. Bearing Life: Certified by the equipment manufacturer. Include design data.

p. Equipment shop test results.

q. Motor shop test results.

r. Qualifications of field service engineer.

s. Recommendations for short and long-term storage.

t. Shop and field testing procedures, set up and equipment to be used.

u. Special tools.

v. Gear reducer data including service factor, efficiency, torque rating and materials

w. Local Control Panel (Typical of 3):

(1) Front elevations, with and without door.

(2) Elementary wiring connection diagram.

(3) Catalog sheets for devices in the control panel.

(4) Use NEMA device designations and symbols for electric circuit diagrams. Make contents of elementary connection diagrams in accordance with NEMA ICS 1.

(5) Manufacturer's standardized elementary diagrams will not be acceptable unless applicable portions of the diagram have been clearly identified and non-applicable portions deleted or crossed out.

x. Number of service person-days provided and per diem field service rate.

y. Manufacturer's product data, specifications and color charts for shop painting.

z. Provide listing of reference installations with contact names and telephone numbers.

aa. Manufacturer's product data, specifications and color charts for shop painting.

bb. List of recommended spare parts other than those specified.

cc. Equipment weight and lifting points for installation and removal purposes.

dd. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

ee. The latest ISO 9001 and 14001 series certification.

ff. Provide a scaled drawing showing the equipment, motors, hoists and bridge cranes including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.

gg. Number, size and weight of pieces shipped.

hh. Material Certification:

(1) Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions. Provide proposed materials at no additional cost to the Owner.

(2) Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

2. In order to demonstrate satisfactory experience and qualifications, provide an installation list for a minimum of twenty-five (25) operating installations with equipment of the equivalent size and similar service conditions as specified herein operating for not less than five (5) consecutive years from final completion of the respective project of the installation. The installations must be within the contiguous lower forty-eight (48) States of the United States of America. At a minimum the reference information shall include the following;

a. Current Owner Reference Contact Information

b. Installation Service Conditions

c. Equipment Model Numbers

d. Date of Final Completion of the Project

3. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes

are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

a. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

4. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

D. Spare Parts:

1. Comply with the requirements specified in herein.

2. Provide spare parts that are identical to and interchangeable with similar parts installed.

a. Furnish following spare parts:

(1) Two set of all special tools required for normal operation and maintenance. A minimum of two liner replacement tools shall be provided.

(2) Sufficient liner stripping to completely replace the liner for one screw conveyor.

(3) One complete set of all gaskets and seals for each sized chute provided. (Furnish within air-tight plasticene packaging).

(4) Sufficient oil for reducer gearmotors to provide two oil changes or a 24 month supply, whichever is greater.

E. Quality Assurance:

1. Comply with the requirements specified herein.

2. Equipment specified shall be the product of one manufacturer.

3. The Contractor shall obtain the shaftless screws, troughs, covers, supports, chutes, gates controls, gear reducers, motors and appurtenances from the shaftless screw conveyor manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

4. Equipment specified shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

5. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

6. Shop tests as specified.

7. Services of Manufacturer's Representative as specified herein.

8. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

   a. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

   b. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

   c. Preliminary Matter, per Section 01664: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of electrical and miscellaneous utility connection:

(1) 1 person-day.

d. System Start-Up Testing, per Section 01664: Calibrate, check alignment and perform a functional test. Tests to include all items specified.

(1) 2 person-days.

e. System Testing, per Section 01664: Field performance test equipment specified.

(1) 2 person-days.

f. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

(1) 1 person-day.

g. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

h. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

9. As of the date in which Bids are submitted, the manufacturer shall have a minimum of twenty-five (25) operating installations with equipment of the equivalent size and similar service conditions as specified herein operating for not less than five (5) consecutive years from final completion of the respective project of the installation. The installations must be within the contiguous lower forty-eight (48) States of the United States of America.

10. If equipment proposed is heavier or taller, different width, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

a. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

11. Electrical Equipment Labeling Requirements:

a. Provide equipment labeled by a nationally recognized testing company where standards have been established. Where equipment is not available with label, provide service of a nationally testing company to examine the equipment and certify in writing that it complies with its safety standards. Tests and inspections of equipment shall be at no additional cost to Owner.

12. Provide fabrication in compliance with all applicable ASTM standards or equivalent international standards.

13. Factory welding to use shielded arc, inert gas, MIG or TIG method.

a. Filler wire: Add to all welds to provide for a cross section equal to or greater than the parent metal.

b. Butt welds: Fully penetrate to the interior surface and gas shielding to interior and exterior of the joint.

F. Delivery, Storage and Handling:

Comply with the requirements specified herein and Section 01600.

G. Structural Support System:

Provide a structural support system for the conveyor assembly; including but not limited to the shaftless screw conveyor, knife gates, electric motor actuators (EMA), drop chutes and all other ancillary required components per the following requirements:

1. The 2010 Florida Building Code (FBC) requirements and design criteria noted within the Drawings.

2. Structural connections to the Elevated Equipment Platform shall be in locations as designated within the Drawings.

3. Provide with the Certificate of Unit Responsibility, certification for all equipment signed by a structural engineer, registered in the State of Florida, stating that computations were performed and that all components have been sized for criteria as specified herein.

PART 2 - PRODUCTS

A. System Description:

1. Conveyor system capacities and operating data are indicated in the Conveyor Schedule.

2. Conveyor system to include motor, drive, u-trough, shaftless reversible screw conveyors, covers, chutes, gates, drain, controls, control panel, structural steel supports, and appurtenances, as specified and indicated, to provide a complete and ready to operate system. The equipment's design shall be compatible with the thixotropic nature of polymer conditioned sludge cake. The equipment's design shall take into account the sludge cake's varying properties over the conveyed distance, balling and plugging tendencies and the inherent stickiness of the sludge cake.

3. Interface:

a. Coordinate collection points with the discharge of the process equipment so that the conveyor properly receives material to be conveyed.

b. Coordinate conveyor collection points with process equipment discharge chutes.

c. Coordinate conveyor discharge chutes and gates with the container.

d. Coordinate support locations with the process equipment to avoid conflicts.

e. Coordinate wash water connections and provide Type 320 316 SST ball valves at 48" above finished floor for manually flushing the conveyor.

4. Performance:

a. Conveying equipment to transport dewatered sludge from the process equipment as indicated and specified.

b. Conveying equipment shall be capable of handling:

(1) Capacity range as specified and indicated.

(2) Range of moisture content of sludge as specified in Section 11371.

B. Manufacturers:

1. JDV

2. Keystone

3. KWS

4. Custom Conveyor Corporation

C. Shaftless Screw Conveyor Construction:

1. General:

a. Provide shaftless screw conveying system as specified and indicated. Provide conveyors designed specifically for transport of dewatered sludge. Conveyor designs developed for free flowing bulk material are not acceptable. Provide conveyors complete with appurtenances and accessories as specified and as necessary to continuously convey materials automatically.

(1) Conveyors with shafted spirals are not acceptable.

b. Provide screw conveyors able to operate continuously at the specified operating conditions and also able to start and operate with a full trough.

c. Provide each screw conveyor with the following:

(1) A minimum of 1-1/2-inch freeboard between the top of the screw flight and the underside of the trough cover.

(2) Stub shafts: Flanged and bolted to mating flanges of the conveyors spiral rotor or coupling disc and shall incorporate register fits.

(3) Provide the rotating speed of the screw selected to match the pitch, diameter, trough fill, and screenings transport characteristics.

(4) Provide each conveyor equipped with torque overload and motor overload protection.

2. Screw Conveyor Troughs and Casings:

a. U-shaped and similar to the dimensional standards of CEMA 300 and enclosure classification IIIE.

b. Provide a flanged drain outlet with each conveyor to facilitate cleaning.

(1) Provide the drains piped as indicated and specified.

(2) Provide drain flushing connections as indicated and specified.

c. Provide each trough equipped with inlet and/or discharge openings as indicated.

(1) Where the inlet and discharge openings connect to another device provide flanged connections.

(2) Provide all interconnecting devices such as chutes and hoppers fabricated from the same grade of material as the troughs.

d. Covers: Provide bolted or hinged covers with either a spring-clamp or toggle-clamp quick release fabricated of minimum 7/64-inch (12 gauge) Type 316L stainless steel for any portion of each trough that is not covered by the filling chute. Covers shall conform to Conveyor Equipment Manufacturers Association (CEMA) Standard No. 300-24.

(1) Provide covers manufactured in maximum 5.0 foot lengths to allow for easy access and ease of liner replacement.

(2) Provide two handles on each cover section for lifting.

(3) The cover shall prevent odors from escaping. Neoprene gaskets shall be installed along each trough cover flange and each stiffener to ensure a drip proof connection trough covers shall have turned down edges perpendicular to the trough cover flange.

(4) To prevent unsafe access to the conveyors, covers are also to be bolted with wing-nut for safety to prevent access during operation.

(5) All hardware to be Type 316 Stainless steel.

(6) Provide each conveyor with the appropriate warning labels to call for lock out – tag out of the electrical system before the covers are removed. If inspection of the system during operation is required, provide an inspection hatch with finger guards as indicated.

e. Sample ports: provide as indicated and specified.

f. Hold Down Provisions.

(1) In order to avoid excessive wear and increased maintenance provide the conveyors designed without the use of steel hold down bars. Proprietary hold-down guide liners mounted under the lids are acceptable if they do not interfere with the flow of conveyed product.

g. Provide shaftless spiral screw conveyor trough fabricated of minimum 9/64-inch (10 Ga.) thick Type 316L stainless steel. Provide troughs with an integral (welded or bolted connection), minimum 3/8-inch thick Type 316L stainless steel end plate and drive support base of all welded construction onto which the conveyor drive assembly is mounted. The end plate of the last segment of each screw conveyor trough shall consist of a welded minimum 10 mm thick Type 316L stainless steel plate of the full cross-section of the trough, and its segment mating flanges.

h. Provide each conveyor trough with two (2), 1-1/2-inch wash water (W3) connections located at the centerline of each conveyor discharge chute, centered, on the spirals axis. Provide each connection with an isolation ball valve and manifolded to a single 1-1/2 inch connection. Provide ball valves in accordance with Section 15100. Provide connections shall allow for manually washing down the screw and trough. Provide a 3-inch flanged drain connection on conveyor troughs as indicated.

i. Provide trough segments consisting of rolled sections butt welded together to give a maximum single segment of not more than 20 feet in length. Provide trough end flanges roll formed Type 316L stainless steel bar welded to the ends of the trough segments. Locate bolt holes for connecting trough sections together on the centerline of the roll formed flanged within a tolerance of plus or minus 0.02 inches of the theoretical radius centerline and at a distance of not greater than 0.02 inches. Provide bolt holes uniformly located on either side of the trough's vertical section centerline. Apply compressible "flow type string" gasket material to flanged faces to give a sealed joint when trough segments are bolted together.

j. Provide the trough body roll formed to a uniform radius (or diameter) within a tolerance of plus-or-minus 1/8-inch. Provide the trough with double U-shape or L-shape flanges formed by a break press as an integral part of the rolled trough body. Separate welded flanges are not acceptable.

k. Provide troughs with discharge chutes and electric actuated discharge knife gates for conveyance of dewatered sludge to the containers. Provide at the locations indicated on drawings. Provide chutes with flanged ends. Provide a transition to match the size of the centrifuge discharge chutes. Provide transition with a rubber expansion joint.

l. Discharge knife gates shall be actuated by electric motor actuators as specified in section 15119. The slide blade shall be guided and supported by pins or guide rails to prevent binding. The gate frame body shall be constructed of type 316 stainless steel

formed shapes and plates. The gate blade shall be 3/16" minimum thickness type 316 stainless steel, stiffened as required.

m. The maximum length of any preassembled section of trough: 20-feet and no more than two separate segments bolted together in any preassembly shipped to site. Site welding is not acceptable.

n. Provide separate support extending to a distance of approximately 4-inch below the bottom of the trough at a quantity of not less than one for every 10 feet of length of trough segment plus one additional support. Provide supports of Type 316L stainless steel with its flat face rolled to match the trough shape and extending around the entire trough circumference up to within 2-inch of the top face of the trough U-flange.

o. Coordinate conveyor support with the centrifuge chute discharge locations so as to avoid interferences with installation of the equipment.

p. Support spacing across the trough: Not to exceed 2.5 feet from center of support leg to center of support leg.

q. Provide a trough stiffener channel bolted across the width of the trough made of Type 316L stainless steel. Set stiffener channel spacing to match cover edges to give a sealed face upon which the covers are bolted.

r. Provide troughs fitted with a liner manufactured from ultra high molecular weight polyethylene, not less than 1/2-inch thick formed and bonded with two layers each a different color.

(1) The liner shall meet the following requirements:

(a) Density: 61.2 lbs/ft^3

(b) Shore Hardness, D: 64

(c) Ball Indent Hardness: 5946 lb/in^2

(d) Crystalline Melting Range: 278 degree F

(e) Dynamic Coefficient of Friction: 0.1-0.12 ratio of tension/load

(f) Molecular Weight: 9.2+10a g/mol

(2) Liner Length:

(a) 4 foot maximum Sections.

(3) Provide liner held in place with Type 316 stainless steel clips.

3. Screw Conveyor Flights:

a. Provide spiral flighting for the shaftless screw conveyors designed to convey material without a center shaft or hanger bearings.

b. Spiral flights:

(1) Cold-formed high strength chrome alloy steel with a minimum hardness of 225 Brinnell.

(2) Provide the spiral flights designed to prevent distortion and jumping in the trough.

(3) Provide a second, inner spiral, concentric with the outside spiral.

(4) Provide the flights design so that the torsional rating of the auger flighting exceeds the torque rating of the drive motor at 150 percent of its nameplate horsepower.

(5) Spring effect of the spiral: Not to exceed 0.12 inches per foot of length at maximum load conditions.

(6) Maximum outer spiral thickness: 0.75 inches for spiral diameters up to 9 inches and 1 inch for spirals diameters greater than 9 inches.

(7) Provide the spiral flighting formed in sections from one continuous flat bar and concentric to within +5/64 inch.

(8) Sectional flighting formed from plate is not acceptable.

(9) Provide spiral flighting with full penetration welds at all splice connections.

(10) Align the flights to assure true alignment when assembled in the field.

(11) Couple the spiral flights to the end shaft by a flanged, bolted connection.

(12) Field welds at the jobsite by the Contractor for installation may be necessary when any overall conveyor length presents shipping or handling constraints. If this is the case the manufacturer will provide supervision and inspection of the welds.

(13) Provide a gland packing ring consisting of two aramid fiber packing rings to seal the drive shaft where its penetrations through the end plate, along with a greased labyrinth sealing system.

(14) Provide the connection of the spiral to the drive system through a flanged connection plate that is welded to the spiral forming a smooth and continuous transformation from the flange plate to the spiral.

(15) Provide the drive shaft with a mating flange bolted to the spiral connection plate. Provide a grease lubricated labyrinth seal shaft mounted internally in the conveyor between the back plate and spiral coupling connection.

4. Hoppers, Discharge Chutes, & Discharge Knife Gates:

a. Provide inlet and discharge hoppers of the same gauge and construction material as the conveyor troughs, at locations as indicated.

(1) Flanges: Minimum 3/16-inch thick.

b. Provide flanged discharge chutes at locations as indicated.

(1) Materials shall be a minimum of ¼" thickness Type 316L stainless steel.

c. Discharge Knife Gates:

(1) Provide discharge knife gates where indicated

(2) Provide discharge knife gates designed with the following performance:

(a) Electrically actuated discharge knife gates shall be attached via flange to flange bolted connection with a neoprene sealing gasket. The discharge knife gates shall be specifically designed to operate as an integral part of the shaftless spiral conveyor system and shall be supplied by the conveyor system supplier.

(b) With the gate in the full, open position at least one pitch rotation of the spiral is exposed to the opening in the direction of transport and where layout permits 1.5 x spiral pitch opening.

(c) The gate blade shall be guided and supported by pins or guide rails to prevent binding.

(d) Gate Opening: At least the full width of the conveyor trough.

(3) Materials: Type 316/316L stainless steel with UHMW PE components, all minimum 3/16-inch thick. Provide UHMW PE with a machined groove to accept the gate blade and give a positive seal.

(4) Electric motor actuators shall be furnished in accordance with Section 15119.

5. All necessary supports for the conveyors, discharge knife gates, operators and the drive motors shall be provided by the manufacturer with the conveyor. Support system shall be stamped by a Structural Professional Engineer in the State of Florida.

D. Safety Devices:

1. Comply with ANSI B20.1 Standard, and include the following:

   a. Audible alarm, to sound for 30 seconds before conveyor starts and whenever emergency stopped.

2. Provide a zero speed sensing device as an input to the plant SCADA to alarm when motor is running but conveyor is not.

   a. Enclosures NEMA 4X Type 316L stainless steel

E. Conveyor and Control Panel:

1. Provide a Control Panel for the conveyors located at the operating level as indicated. Provide the panel factory wired with all appurtenances for a complete operating system as specified and indicated.

   a. Provide NEMA 4X Type 316L stainless steel panels

   b. Provide combination reversing starters in accordance with Division 16.

   c. Provide panel supports or mount to conveyor supports.

2. Controls:

   a. Contractor to provide conveyor control panel from the conveyor manufacturer, PLC based controls.

   b. Provide shutdown of conveyors on actuation of any conveying system safety device, sound alarm horn and light the safety stop alarm light.

      (1) System to be resettable only after the safety devices are restored to the normal condition.

   c. Provide the safety shutdown to interlock with the conveyor motor starter, energize the alarm light and sound alarm horn.

   d. Provide interlock with the respective motor starter, energize the alarm light, and sound the alarm horn.

F. Conveyor Drive Systems:

1. Motor:

a. Provide in accordance with Section 16150 and as specified and indicated.

b. Horsepower rating of motors: Not less than maximum brake horsepower requirements of equipment under any condition of operation specified and indicated without operating in the motor service factor.

c. Motor enclosure and motor speed: As indicated in the conveyor Equipment Schedule.

d. In addition to the requirements for bearings specified under Electric Motors in Section 16150, provide motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

e. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

f. Operate without overheating at the speeds specified and indicated.

g. Service Factor: 1.15.

h. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

i. Rating: 460V, 3-ph, 60 Hertz.

j. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

k. Site Altitude: 100 feet above sea level.

l. Provide capacity sufficient to start and operate conveyor 50 percent full without exceeding nameplate ratings for current and power and without operating in the service factor.

m. Provide drive units, including the reduction gearbox, shaft-mounted and positioned to facilitate maintenance work.

2. Gear Reducer:

a. Provide parallel shaft arrangement classified for continuous, AGMA Class II, 24-hour duty.

b. Provide ASTM A48 Class 30 cast iron housing.

c. Gears: Case hardened alloy steel forgings with precision ground gear teeth minimum AGMA quality 12.

d. Provide horizontal parallel or bevel right angle shafting, arrangement or as indicated in the Conveyor Schedule.

e. Design reducer to match output speed requirements of screens.

f. Match torque-rating of driven equipment.

g. Minimum gear reducer service factor 1.50 minimum, based on motor horse power rating.

G. Conveyor Schedule:

Dewatered Sludge Truck Loading Conveyors	650-SC-1 through 650-SC-3
Number of Conveyors	3
Number Operating	2
Number of Standby	1
Number of Future	1
Material Conveyed	Dewatered Sludge
Degree Inclined	0
Conveyor Capacity – Maximum Sludge Feed Rate, (lbs/hr dry weight)	2700
Minimum Percent Cake Solids (percent dry solids by weight)	18%
Normal Screw Diameter, in	12
Conveyor Length, ft (minimum)	25
Screw Speed (maximum), rpm	20
Motor Hp (minimum)	7.5
Motor Speed. rpm	1750
Motor Enclosure	TEFC

H. Shop Painting:

1. Primer and Fini14549sh Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with Section 09900 System 10.

2. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

3. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

I. Shop Testing:

1. Comply with the requirements specified herein.

2. Provide motor shop testing in accordance with Section 16150.

3. Conveyor Testing:

   a. Control Panel Tests:

      (1) Test all functions and alarms of each control panel.

4. Conveyor Tests:

   a. Operate conveyor for 30 minutes and record results.

   b. Fully factory assembly conveyor and operate in the installed position.

5. Repeat tests until specified results are obtained.

6. In event that specified tests indicate that equipment will not meet the specifications; AECOM has the right to require complete witnessed tests for all equipment at no additional cost.

7. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to Owner.

8. Provide a 30 day minimum notice prior to testing.

PART 3 - EXECUTION

A. Installation:

1. Install items in accordance with shop drawings with no exceptions noted, manufacturer's printed instructions and as indicated.

2. After alignment is correct, grout using high grade non-shrink grout.

   a. Do not imbed leveling nuts in grout.

B. Field Testing:

1. Comply with the requirements specified in Division 1 and as specified herein.

2. Field testing will not be conducted without a procedure with no exceptions noted, calibration certificates for all testing equipment for checklist.

3. After installation of equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer’s field service technician, conduct a dry running test and a performance test for each unit in presence of the Engineer to determine its ability to deliver its rated capacity under specified conditions.

   a. Repeat tests until specified results are obtained.

4. Make all adjustments necessary to place equipment in specified working order at time of above tests.

5. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted.

C. Field Touch-Up Painting:

1. After installation and acceptance testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces in accordance with Section 09900. Coating type and color shall match shop painting.

D. Contract Closeout:

Provide in accordance with Section 01700.

E. Warranty

1. The Manufacturer shall furnish a written warranty covering materials and workmanship for the equipment provided for a period of three (3) years. The warranty period shall begin at the date of substantial completion of the respective process in which the equipment is installed.

2. The manufacturer shall furnish, deliver, and install new parts to replace the defective parts. The manufacturer shall furnish all supervision, labor, equipment, and materials to repair or replace components which have failed as defined by the warranty at no cost to the Owner.

J. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

F. 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.

END OF SECTION

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SECTION 14600 CRANES, HOISTS, AND TROLLEYS--GENERAL

PART 1 - GENERAL

A. Description

This section describes the general standards, materials, installation, and testing of motorized cranes, hoists, and trolleys.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions Section 01300 and the following.

2. Submit manufacturer's catalog data and dimensioned drawings for bridge cranes, trolleys, hoists, rails, and controls.

3. Show areas to be coated and type of coating.

4. Submit electrical drawings showing wiring, disconnect switch, terminals, limit switches, and fuses. Label each terminal showing which control or electric power wire connects to each terminal. Submit motor data showing motor horsepower, enclosure, and NEMA design classification.

5. Submit manufacturer's field assembly and installation instructions.

6. Submit calculations showing that runway and trolley stops resist the forces applied.

7. Submit test report describing procedures and results of both shop and field tests.

C. Manufacturer's Services

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. Two (2) labor days to check the installation and advise during start-up, testing, and adjustment of the bridge crane.

2. Two (2) labor days to instruct the Owner's personnel in the operation and maintenance of the bridge crane.

PART 2 - MATERIALS

A. Standards, Specifications, And Codes--Single Girder Electric Bridge Cranes (Section 14633)

Design and construction of single girder traveling bridge cranes shall conform to CMAA 74 and ASME B30.17.

B. Standards, Specifications, and Codes--Motorized Hoists and Trolleys (Section 14633)

Design and construction of motorized hoists shall conform to ANSI HST-4-1999 (reaffirmed 2010).

C. Motorized Hoists (Section 14633)

1. Hoists shall be electric, wire-rope type. Hoisting machinery shall consist of a rope drum driven through gear reductions by an electric motor with hoisting rope, sheaves, and hoist brake. Hoist and trolley shall be a standard package of a single trolley/hoist manufacturer. Provide true vertical lift. Design and construct hoists in accordance with ANSI HST-4-1999 (reaffirmed 2010) and and CMAA 74.

2. Provide drums grooved to 50% (minimum) of the rope diameter to protect against rope pileup. Hoisting rope shall be of plow steel or improved plow steel, flexible, designed and manufactured for crane and hoist service, and complying with ANSI HST-4-1999 (reaffirmed 2010).

3. Provide two brakes for hoist, each brake capable of independently holding the hoist's rated load capacity. One brake shall be a fail-safe electric type, connected to the motor shaft or to a shaft in the hoist gear train. The second brake shall be a mechanical load brake mounted in the gearbox and operating in a continuous oil bath. Both brakes shall operate when power to the motor is shut off or there is a power failure. Hoist brakes shall comply with ANSI HST-4-1999 (reaffirmed 2010).

4. Provide upper and lower adjustable geared limit switch.

5. Design load hook so that it opens slowly before hook failure when the hoist is overloaded. Provide hook

latch. Provide gauge marks to show if hook has opened up.

6. Provide hoist block with steel-enclosed housing.

7. Provide mechanical or electrical overload protection to prevent lifting of loads exceeding the rated capacity of the crane.

D. Motorized Trolleys (Section 14633)

1. Trolley frame shall be welded steel, cast steel, or ductile iron.

2. Design wheel and axle system to prevent a drop of more than 1 inch in case of axle failure.

3. Trolley drive shall consist of a drive shaft driven by an electric motor through a gear reduction unit. The trolley drive shall drive the trolley wheels either directly or through another gear reduction at the wheels.

4. Gears shall be of the helical, spur, worm, or herringbone type, made from rolled or cast steel, with machine-cut teeth having a 20-degree pressure angle. Horsepower ratings shall be in accordance with AGMA standards for the service factor associated with the ANSI HST trolley service classification. Gears shall be AGMA Class II service. Gearing shall be oil splash lubricated.

5. Provide trolley brakes designed in accordance with ANSI HST-4-1999 (reaffirmed 2010).

6. Provide mechanical stops and limit switches at both ends of trolley travel.

7. Wheels shall be drop forged or rolled steel with heat-treated treads and flanges or cast iron with chilled tread. Wheels and wheel bearings shall comply with ANSI HST-4-1999 (reaffirmed 2010).

E. Motors (Section 14633)

1. Motors shall be NEMA Design D with high starting torque, low starting current, and high slip at full load.

2. Provide separate motors for bridge, hoist, and trolley drives when motorized units are specified. Provide one motor for hoist. Provide one or two motors for trolley.

3. Motors shall be totally enclosed nonventilated (TENV), with Class B or F insulation, 65°C ambient temperature, and with a temperature rise that does not exceed the insulation class at the duty rating listed in the subsection on "Service Conditions." Provide thermal overload protection either of the thermostatic type in the motor starter or of the relay type in the motor windings. Provide integral motor starters for the bridge, hoist, and trolley motors.

4. Motors shall be single or two speed and have voltage and frequency ratings as specified in the subsection on "Service Conditions." Motor speed shall not exceed 1,800 rpm. Determine the required motor horsepower for the trolley and bridge per ANSI MH27.1 and ANSI HST-4-1999 (reaffirmed 2010).

F. Single Girder Bridges (Section 14633)

1. The crane shall be a single girder bridge crane. The main crane girder shall be a wide-flange girder or standard I-beam. Material of construction shall conform to ASTM A36. The bridge shall be braced or reinforced with an outrigger or auxiliary girders made from structural steel shapes to provide squareness to the end trucks. The outrigger or auxiliary girder shall also support the bridge drive shaft and drive.

2. Motorized bridges shall be center motor drive or dual drive.

3. Design bridge end trucks in accordance with CMAA 74. Provide end trucks with rail sweeps and impact absorbing bumpers. Attach runway stops to resist the force applied when contacted. Locate runway stops at the limits of travel of the bridge. Runway stops shall not engage the wheels.

4. Provide limit switches at both ends of the bridge travel for motorized bridges.

5. Gears shall be of the helical, spur, worm, or herringbone type, made from rolled or cast steel, with machine-cut teeth having a 20-degree pressure angle.

Horsepower ratings shall be in accordance with AGMA standards for the bridge service rating, per CMAA 74. Gears shall comply with AGMA Class II service. Gearing shall be oil-splash lubricated.

6. Provide alloy steel wheel axles, machined and ground to receive inner bearing races. When rotating axles are used, mount the wheels on axles with a press fit and keys or with keys alone.

7. Gear reduction at the wheels may be used for fixed axle cranes. Gear reduction at wheels shall be either oil or grease lubricated.

8. Bearings shall be combination radial and thrust type, consisting of either double-row angular contact ball bearings or single-row tapered roller bearings. Bearings shall be lifetime lubricated and sealed or fitted with ZERK fittings for pressure lubrication.

G. Runways For Overhead And Toprunning Bridge Cranes (Section 14633)

Provide runways including rails, beams, brackets, and framework on which the crane operates. Railways shall be 40-pound ASCE rails, minimum.

H. Controls

1. Bridge, trolley, and hoist controls shall be by a floor-operated push-button pendant station.

2. Push-Button Pendant Station: Provide momentary contact push buttons. Mount controls in a NEMA 4 enclosure. For direct-hung pendants, provide an offset swing arm. Provide cable lengths such that floating pendants hang 36 inches off the floor and direct-hung pendants hang 12 inches off the floor.

I. Electrical Equipment for Bridge Cranes (Section 14633)

1. Bridge conductors shall be of the flat cable festoon type.

2. Hoist and trolley conductors shall be of the flat cable festoon type.

3. Festooned tag line conductors shall consist of a flexible conductor cable, supported by a cable of

monorail system that will dispense and retrieve the flexible conductor cable during bridge or trolley travel without twisting or tangling. Festooned tag line conductors for control shall be No. 16 maximum. Festooned conductors shall be encased in a molded plastic casing.

4. Provide control transformers to supply 120-volt a-c for control power.

5. Provide an alarm gong for motorized bridges and trolleys that shall operate whenever either the bridge or the trolley is in motion.

J. Factory Testing of Motorized Bridge Cranes (Section 14633)

Test cranes having motorized bridges at the factory. Assemble the crane at the factory. Provide no-load manufacturer-certified, nonwitnessed running tests of the bridge and trolley. Perform running tests with the pendant control that will operate the crane in service.

PART 3 - EXECUTION

A. Labeling and Marking

1. Provide labels and marking per Section 15075. Provide capacity plates on each side of the trolley/hoist and on bridge. Plates shall be legible from the floor.

2. Provide tags on each piece of equipment requiring lubrication. Tag shall state the following information:

   a. Manufacturer's recommended lubricant, by brand name and number or code.

   b. Frequency of lubrication.

   c. Provide removable paper date calendar on which maintenance personnel can fill in dates of lubrication. Enclose calendar in a plastic shield. Attach calendar to equipment by means of a stainless steel or brass chain.

3. At each Centrifuge, provide a label for the maximum capacity of the Crane directly adjacent to the labeling of the Centrifuge components, as specified per Section 11371, Part 2.U.

B. Lubrication

Provide the manufacturer's recommended lubricants for motors, gears, and other equipment.

C. Installing Single and Multiple Girder Bridge Cranes (Section 14633)

1. For electrical cranes, install runway conductors before the runway rails. The alignment of the conductors shall be horizontal and vertical within a tolerance of ±1/4 inch. Install the runway rail adjacent to the conductors next.

2. For manually actuated cranes, install one rail, with horizontal and vertical alignments within a tolerance of ±1/4 inch.

3. Install the opposite runway rail and align to correct span and straightness with the first rail. The runway rails shall be horizontal and parallel. The distance center-to-center and the elevation of the rails shall be as shown in the drawings within a tolerance of ±1/8 inch.

4. Bolt the rail sections together. The rail joints shall be tight and provide a smooth running surface.

5. After assuring that rail alignment is correct, securely fasten the rails to their supports.

6. Install crane runway end stops before placing crane on the runway. Faces of the two end stops at each end of the runway shall form a line perpendicular to the runway rails. Install bridge and trolley per the manufacturer's instructions. After crane is placed on runway, assure that both bridge bumpers contact the end stops at the same instant. If this does not occur, check the bridge for squareness. If bridge is square, either adjust the stops or place shims behind the bumpers.

D. Painting and Coating

Coat track, bridge, trolley, hoist, gear reducer enclosures, and motors per Section 09900, System No. 10. Apply prime coat at factory. Color of finish coat shall be OSHA Safety Yellow.

E. Field Performance Testing for Electrically Powered Cranes, Hoists, and Trolleys (Section 14633)

Perform a no-load test and a load test on each crane or monorail system in the presence of the Owner's Representative as follows:

1. No-Load Test:

   a. Raise empty block to within about 2 feet of its upper position and stop.

   b. Raise empty block until the upper limit trips and stops the hoisting motion. Assure that limit switch trips at the specified setting.

   c. Adjust upper limit switch if necessary. Repeat Steps a and b.

   d. Lower the block to about 2 feet above its lower position and stop.

   e. Lower empty block until the lower limit switch trips and stops the lowering motion. Assure that limit switch trips at the specified setting.

   f. Adjust lower limit switch if necessary. Repeat Steps d and e.

   g. Do not lower the block beyond the point at which two wraps remain at each end of the drum.

   h. Move the trolley.

2. Trolley Test:

   a. Move the trolley to within about 2 feet of its farthest left limit switch position and stop.

   b. Move the trolley to the left until the limit switch trips and stops the trolley motion. Assure that limit switch trips at the specified setting.

   c. Adjust limit switch if necessary. Repeat Steps a and b.

   d. Repeat Steps a, b, and c for the right limit switch.

3. Load Test: After the no-load test and trolley test have been successfully completed, test the system with loads in the following manner:

   a. Raise a load equal to 50% of the rated load no higher than required to clear its supports and stop. Adjust brakes if necessary. Raise load about 3 feet above its supports and stop. Lower load about 12 inches and stop. Check drift of load during stopping. If load drifts, brakes are not in proper adjustment and shall be corrected. Repeat this operation until proper adjustment of the brakes is obtained. Lower load carefully back to its supports.

   b. Follow the same procedure as indicated in Step a above except with a 125% test load; then hoist the load high enough to clear all obstructions. Move trolley across the entire span of bridge or length of track. Transport the test load by means of the bridge for full length of the runway in one direction with the trolley at one extreme end of the crane and in the other direction with the trolley at the extreme opposite end of the crane. Lower load carefully onto its supports.

4. Crane system shall run smoothly, with no binding, stopping, or sticking. Adjust and realign equipment and retest if binding, stopping, or sticking occurs. Motors shall not be overloaded.

F. Warranty

1. The Manufacturer shall furnish a written warranty covering materials and workmanship for the equipment provided for a period of three (3) years. The warranty period shall begin at the date of substantial completion of the respective process in which the equipment is installed.

2. The manufacturer shall furnish, deliver, and install new parts to replace the defective parts. The manufacturer shall furnish all supervision, labor, equipment, and materials to repair or replace components which have failed as defined by the warranty at no cost to the Owner.

G. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

H. 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.

END OF SECTION

SECTION 14633 TOP RUNNING SINGLE GIRDER BRIDGE CRANES

PART 1 - GENERAL

A. Description

This section includes materials, fabrication, installation, and testing of single girder traveling bridge cranes with electric controls, motors, trolleys, and hoists.

B. Related Work Specified Elsewhere

Cranes, Hoists, and Trolleys--General: 14600.

C. Submittals

See Section 14600.

D. Manufacturer's Services

See Section 14600.

PART 2 - MATERIALS

A. Manufacturers

Top running single girder bridge cranes with motorized hoists and trolleys shall be manufactured by Advanced Overhead Systems, R&M Materials Handling, TC/American Monorail, or Whiting.

B. Standards, Specifications, and Codes

See Section 14600.

C. Motorized Hoist

See Section 14600.

D. Motorized Trolley

1. Design and construct trolleys in accordance with the CMAA specifications and Section 14600 and as follows.

2. Trolley drive shall consist of a drive shaft driven by an electric motor through a gear reduction unit.

3. Provide limit switches at both ends of trolley travel.

E. Motors

See Section 14600 & Section 16150.

F. Bridge

See Section 14600. Per section 14600, the crane supplier will be also required for supply of the runway girders and connection members thereof.

G. Trolley Track

Provide a single girder track to carry the trolley. Track shall meet or exceed the requirements of Sections 3 and 4 of ANSI MH27.1. Provide stop plates at the ends of the track.

H. Bridge and Trolley Wheels

See Section 14600. Wheel sizes and maximum loading shall comply with Section 4.7 in CMAA 74.

I. Runways

See Section 14600.

J. Electrical Equipment

1. Provide electrification per Section 14600 and CMAA 74, Section 5. Provide electrical equipment for the crane, including motors, controls, wire, and conduit.

2. Bridge, trolley, and hoist control shall be by a floor-operated push-button pendant station per CMAA 74, Section 5.

K. Factory Testing

See Section 14600.

PART 3 - EXECUTION

A. Labeling and Marking

See Section 14600.

B. Lubrication

See Section 14600.

C. Installation

See Section 14600.

D. Painting and Coating

1. See Section 14600.

2. The Contractor shall provide signage on the crane and within the room regarding the crane capacity with respect to the total weight of the centrifuge dewatering equipment. The signage shall state the following "CAUTION: TOTAL WEIGHT OF CENTRIFUGE EQUIPMENT EXCEEDS CAPACITY OF THE BRIDGE CRANE. BOWL & SCROLL MUST BE LIFTED INDEPENDTLY FROM REMAINING MACHINE ASSEMBLY."

E. Service Conditions

1. Traveling bridge crane performance conditions and design data shall be as shown below.

2. Equipment Tag Number: 650-BC-1

General	
Equipment Capacity:	10 tons
Equipment Location: Indoor installation within the Process 650 Centrifuge Dewatering Building to service mezzanine mounted centrifuges	
Service:	Indoors
Altitude:	100 feet above mean sea level
Relative Humidity:	Up to 100%
Main Power Supply:	460 volts, 60 hertz, 3 phase
Motorized Bridge	
Bridge Speed:	Variable Speed, 100 fpm maximum
Motor Duty Rating:	30 minutes per ANSI MH27.1
CMAA Service Class:	C per ANSI MH27.1

Motorized Trolley	
Trolley Speed:	Variable Speed, 65 fpm maximum
Motor Duty Rating:	30 minutes per ANSI MH27.1
Left Trolley Limit Switch:	2 feet from left end of bridge
Right Trolley Limit Switch:	2 feet from right end of bridge
Left Trolley Stop:	1.5′ from end of runway girder
Right Trolley Stop:	1.5′ from end of runway girder
Span:	39′
Runway Girder Length:	92′
Motorized Hoist	
Type:	Standard headroom, two speed: 3.3 and 19 fpm
Maximum Distance From Bottom Flange of Track to Centerline of Hook, with Hook in Maximum Raised Position:	12 inches
Service Class:	H4 per ANSI HST-4-1999
Motor Duty Rating:	30 minutes per ANSI MH27.1
Control:	Push-button pendant
Lift speed:	Two speed: 4 and 20 fpm
Lift:	31.5 feet
Lower Limit Switch Setting:	12 inches above floor (elevation 85.50)
Upper Limit Switch Setting (Floor to High Hook):	32.5 feet above floor (elevation 117.00)

F. Field Performance Testing

See Section 14600.

G. Warranty

See Section 14600.

H. Certification

See Section 14600.

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DIVISION 15 – MECHANICAL

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SECTION 15050 PIPING SCHEDULE AND GENERAL PIPING REQUIREMENTS

PART 1 - GENERAL

A. Description

This section describes the application of the Piping Schedule shown in the drawings and the general requirements for selecting piping materials; selecting the associated bolts, nuts, and gaskets for flanges for the various piping services in the project; and miscellaneous piping items.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit affidavit of compliance with referenced standards (e.g., AWWA, ANSI, ASTM, etc.).

3. Submit certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.

4. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.

C. Definitions of Buried and Exposed Piping

1. Buried piping is piping buried in the soil, commencing at the wall or beneath the slab of a structure. Where a coating is specified, provide the coating up to the structure wall. Piping encased in concrete is considered to be buried. Do not coat encased pipe.

2. Exposed piping is piping in any of the following conditions or locations:

   a. Above ground.

   b. Inside buildings, vaults, or other structures.

   c. In underground concrete trenches or galleries.

D. Piping Service

Piping service is determined by the fluid conveyed, regardless of the pipe designation. For example, pipes designated "Air Low Pressure," "Air High Pressure," and "Air" is all considered to be in air service.

E. Default Piping Materials

If no material is shown in the drawings or in the Piping Schedule, use the following piping materials:

Service	Size Range (inches)	Material	Specification Section
Buried	3 and smaller	PVC	15290
	4 and larger	DIP	15240
Exposed	3 and smaller (RW service)	SST	15278
	3 and smaller (other than RW service)	PVC	15290
	4 and larger	DIP	15240

PART 2 - MATERIALS

A. Materials Selection and Alternative Materials

1. The Piping Schedule in the drawings lists the material and specification for each piping service in the project. In locations where the piping material referenced on the Piping Schedule is not appropriate, the piping material is indicated in the drawings. Materials called out in the drawings shall govern over materials stated in the Piping Schedule.

2. The Piping Schedule in the drawings may show alternative piping materials for certain services. In such cases, the same pipe material shall be used for all pipe sizes in all locations for the given piping service. Do not intermix piping materials.

B. Thread Forming for Stainless Steel Bolts

Form threads by means of rolling, not cutting or grinding.

C. Bolts and Nuts for Flanges for Ductile-Iron Piping (Specification Sections 15240)

1. Bolts and nuts for Class 150 flanges (including AWWA C207, Class D) located indoors, outdoors and above ground, shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

2. Bolts and nuts for buried or submerged Class 150 flanges and Class 150 flanges located outdoors above ground or in vaults and structures shall be Type 304 stainless steel conforming to ASTM A193 (Grade B8) for bolts and ASTM A194 (Grade 8) for nuts.

3. Hex head machine bolts for use with lugged valves shall comply with ASTM A 193, Grade B7.

4. Fit shall be Classes 2A and 2B per ASME B1.1 when connecting to cast-iron valves having body bolt holes.

5. Bolts used in flange insulation kits shall conform to ASTM A193 (Grade B7). Nuts shall conform to ASTM A194 (Grade 2H).

6. Provide washers for each nut. Washers shall be of the same material as the nuts.

D. Bolts and Nuts for Flanges for PVC, CPVC, and FRP Pipes (Specification Sections 15290, 15294, and 15850)

1. Bolts and nuts for flanges located indoors shall be carbon steel, ASTM A307, Grade B.

2. Bolts and nuts for buried and submerged flanges and flanges located outdoors above ground or in vaults and structures shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M for bolts and ASTM A194, Grade 8M for nuts.

3. Bolts for piping in sodium hypochlorite service shall be made of titanium, per ASTM F467, Grade Ti1 or Ti7. Nuts shall conform to ASTM F467, same material as the bolts.

4. Provide a washer under each nut and under each bolt head. Washers shall be of the same material as the nuts.

E. Lubricant for Stainless Steel Bolts and Nuts

Lubricant shall be chloride free and shall be TRX-Synlube by Ramco, Anti-Seize by Ramco, Husk-It Husky Lube O'Seal, or equal.

F. Gaskets for Flanges for Ductile-Iron Piping and Fittings in Water Service (Specification Sections 15240)

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 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Style 19 or equal.

G. Gaskets for Flanges for Ductile-Iron Piping and Fittings in Raw Sewage, Sludge, and Scum Service (Specification Sections 15240)

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 psi at a temperature of 250°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Provide Garlock Style 9122 or equal.

H. Gaskets for Flanges for FRP Piping (Specification Section 15850)

1. Gaskets for pipe and fittings 12 inches and smaller shall be full faced, 3/16-inch thick EPR having a hardness of 50 to 70 durometer A.

2. Gaskets for pipe and fittings larger than 12 inches shall be full faced, 1/4-inch-thick EPR, having a hardness of 50 to 70 durometer A.

I. Gaskets for Flanges for PVC and CPVC Pipes (Specification Sections 15290 and 15294)

Gaskets for flanged joints shall be full faced, 1/8-inch thick, having a hardness of 50 to 70 durometer A. Gasket material shall be EPR. Gasket material for sodium hypochlorite service shall be Viton ETP.

J. Threaded Caps for Protection of Nuts and Bolt Threads

Caps shall be high-density polyethylene, color orange. The caps shall be filled with an anticorrosive lubricant to

prevent nuts and bolts from rusting and corroding. Lubricant shall be suitable for use in potable water. Caps shall withstand temperatures from -40°F to 200°F. Caps shall be suitable to use in exposed, buried, and submerged service conditions. Products: Sap-Seal Products, Inc.; Advance Products and Systems, Inc., "Radolid"; or equal.

K. Insulating Unions

Insulating unions shall consist of a molded nylon sealing sleeve mounted in a three-piece malleable-iron (ASTM A 47 or A 197) body. Ends shall be threaded (ANSI B1.20.1) when connecting to steel piping, and copper solder joint when connecting to copper piping. Minimum working pressure shall be 150 psi. Unions shall be as manufactured by Central Plastics Company, Capital Insulation, or equal.

L. Dielectric Sealant

Unbacked elastomeric tape 0.125-inch thick, "Moldable Sealant" by Tapecoat Co., "Tac-Tape" by Royston Laboratories, with manufacturer's primer.

M. Joint Bonding Wires

Joint bonding wires shall be No. 2 AWG single-conductor, stranded copper, with 600-volt TW insulation.

N. Flexible Pipe Coupling Bonds

Flexible pipe coupling bonds shall be copper straps 1/16 inch thick by 1-1/4 inches wide and shall have an electrical resistance equivalent to a 1/0 stranded copper wire. Each strap shall have five holes punched in it at the locations for thermite welding the strap to the pipe, coupling follower rings, and coupling middle ring or sleeve. The bonding strap shall allow a total of 1-inch expansion or contraction of the pipe joint. Connect the bonding strap to the pipe and coupling by thermite welds (five places) using a 15-gram cartridge as manufactured by Cadweld, Thermoweld, or equal.

O. Flange Insulation Kits and Polyurethane Sealant

1. Flange insulation kits shall consist of insulating gasket, an insulating stud sleeve for each bolt, insulating washers for each bolt, and a steel washer between each insulating washer and the nut. The sleeves shall be one piece, integral with the insulating washer. Gaskets shall be full face. Provide double sleeve and washer sets for each bolt.

2. Gasket material shall be phenolic, 1/8 inch thick. The flange insulating gasket shall be full diameter of the flange with a nitrile O-ring on each side of the gasket. Dielectric strength shall be not less than 500 volts per mil and a compressive strength of not less than 24,000 psi.

3. Insulating flange bolt sleeves shall be high-density polyethylene or spiral-wrapped mylar. Dielectric strength shall be not less than 1,200 volts per mil.

4. Insulating flange bolt washers shall be high-strength phenolic a minimum thickness of 1/8- inch. Dielectric strength shall be not less than 500 volts per mil and a compressive strength of not less than 25,000 psi.

5. Steel flange bolt washers for placement over the insulating washers shall be a minimum thickness of 1/8 inch and be cadmium plated.

6. Flange insulation kits shall be as manufactured by Central Plastics Company, Advance Product Systems, or equal.

7. Polyurethane sealant shall be PRC 270 or equal.

PART 3 - EXECUTION

A. Installing Pipe Spools in Concrete

Install pipes in walls and slabs before placing concrete.

B. Raised Face and Flat Face Flanges

Where a raised face flange connects to a flat-faced flange, remove the raised face of the flange.

C. Installing Aboveground or Exposed Piping

1. Provide pipe hangers and supports as detailed in the drawings and as specified in Section 15064.

2. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

D. Installing Flanged Piping

1. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within 1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.

2. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.

3. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.

4. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably engaged if the lack of complete engagement is not more than one thread.

5. Do not use more than one gasket between contact faces in assembling a flanged joint.

6. Tighten the bolts to the manufacturer’s specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.

7. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

8. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation. Install on exposed and buried piping.

9. Prior to paint, trim back gasket and caulk joints.

E. Installing Blind Flanges

1. At outlets not indicated to be connected to valves or to other pipes and to complete the installed pipeline hydrostatic test, provide blind flanges with bolts, nuts, and gaskets.

2. Coat the inside face of blind flanges per Section 09900, System No. 7.

F. Installation of Stainless Steel Bolts and Nuts

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

G. Installing Insulating Flange Kits

Install insulating flange kits per NACE RP0286. Prevent moisture, soil, or other foreign matter from contacting any portion of the insulating joint prior to its being sealed. If moisture, soil, or other foreign matter contacts any portion of the insulating joint, disassemble the entire joint, clean with a solvent, and dry prior to reassembly. Follow the manufacturer’s recommendations regarding the torquing pattern of the bolts and the amount of torque to be used when installing the flange insulating kit.

H. Coating Flexible Pipe Coupling Bonds

Prime coat with vinyl butyral acid wash. Then coat the copper straps used to bond the flexible pipe couplings in accordance with Section 09900, System No. 21.

I. Lining and Coating Insulating Flanges

1. After testing, wrap buried insulating flanges, including bolts, nuts, and washers, and adjacent surfaces of the pipe or valve with polyethylene wrap per Section 09954.

2. Line the interior of the piping per Section 09900, System No. 7 for a distance of two pipe diameters in each direction away from the insulating flange. At an insulated valve flange, line interior of the piping for a distance of two pipe diameters away from the valve.

END OF SECTION

SECTION 15055 - MECHANICAL PIPING MATERIALS AND METHODS

PART 1 - GENERAL

A. SUMMARY

1. This Section includes the following:

a. Piping materials and installation instructions common to most non-process piping systems.

b. Dielectric fittings

c. Mechanical sleeve seals

d. Sleeves

B. DEFINITIONS

1. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

2. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

3. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

4. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

5. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. SUBMITTALS

Welding certificates

A. QUALITY ASSURANCE

1. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code-Steel."

2. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

   a. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   b. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

3. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

A. PIPE, TUBE, AND FITTINGS

1. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

2. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

B. JOINING MATERIALS

1. Refer to individual Division 15 piping Sections for special joining materials not listed below.

2. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

3. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

5. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

6. Welding Filler Metals: Comply with AWS D10.12.

7. Solvent Cements for Joining Plastic Piping:
   a. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

C. DIELECTRIC FITTINGS

1. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

2. Insulating Material: Suitable for system fluid, pressure, and temperature.

3. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

4. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

5. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

6. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

D. MECHANICAL SLEEVE SEALS

1. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Carbon steel Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

E. SLEEVES

1. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

1. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

1. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

   a. Underdeck Clamp: Clamping ring with set screws.

1. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

2. PVC Pipe: ASTM D 1785, Schedule 40.

3. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

PART 3 - EXECUTION

A. PIPING SYSTEMS - COMMON REQUIREMENTS

1. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

2. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

3. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

4. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

6. Install piping to permit valve servicing.

7. Install piping at indicated slopes.

8. Install piping free of sags and bends.

9. Install fittings for changes in direction and branch connections.

10. Install piping to allow application of insulation.

11. Select system components with pressure rating equal to or greater than system operating pressure.

12. Install escutcheons for penetrations of walls, ceilings, and floors.

13. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

14. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

    a. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.

    b. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

    c. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

15. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

    a. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

16. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

17. Verify final equipment locations for roughing-in.

18. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

B. PIPING JOINT CONSTRUCTION

1. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

2. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

3. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

4. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

5. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

6. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

   a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

   b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

7. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

8. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

9. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

    a. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.

    b. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.

    c. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

    d. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

    e. PVC Nonpressure Piping: Join according to ASTM D 2855.

    f. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

10. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

11. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

12. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

    a. Plain-End Pipe and Fittings: Use butt fusion.

    b. Plain-End Pipe and Socket Fittings: Use socket fusion.

13. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

C. PIPING CONNECTIONS

1. Make connections according to the following, unless otherwise indicated:

   a. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

   b. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

   a. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

   b. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

D. EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

1. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

3. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

4. Install equipment to allow right of way for piping installed at required slope.

E. CONCRETE BASES

1. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

   a. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.

   b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.

   c. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

   d. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

   e. Install anchor bolts to elevations required for proper attachment to supported equipment.

   f. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

   g. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement

E. ERECTION OF METAL SUPPORTS AND ANCHORAGES

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

2. Field Welding: Comply with AWS D1.1.

F. ERECTION OF WOOD SUPPORTS AND ANCHORAGES

1. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

2. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

3. Attach to substrates as required to support applied loads.

END OF SECTION

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SECTION 15062 WALL PIPES, SEEP RINGS, AND PENETRATIONS

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of steel, cast-iron, and ductile-iron wall pipes and sleeves (including wall collars and seepage rings) and penetrations.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit detail drawings for fabricated steel or cast-iron wall and floor pipes and sleeves, wall flanges, seep rings, and sealing materials. Show dimensions and wall thicknesses.

3. Show flange sizes and the appropriate ANSI or AWWA flange dimensional standard where flanged end wall pipes or penetrations are used.

4. Show grooved-end dimensions and AWWA grooved-end dimensional standard where grooved-end wall pipes or penetrations are used.

5. List coating systems to be applied, manufacturer, and dry thickness of coatings. Call out coatings where coatings are to be applied.

6. List materials of construction, with ASTM material reference and grade.

7. Submit manufacturer's instructions for installing rubber annular hydrostatic sealing devices.

8. Submit six copies of the results of the leakage test for cast-iron sleeves having shrink-fit steel collars or collar halves bottomed in a groove and steel sleeves having welded steel collars.

PART 2 - MATERIALS

A. General

1. Use cast-iron, ductile-iron, or fabricated steel wall sleeves when containing rubber annular hydrostatic sealing devices through which piping passes.

2. Use only cast-iron or ductile-iron wall pipes when connecting to cast-iron and ductile-iron pipe. Use only fabricated steel or stainless steel wall pipes when connecting to steel or stainless steel pipe, respectively.

3. Cast-iron flanges shall conform to ASME B16.1, Class 125 or 250, to match the flange on the connecting pipe.

4. Class 150 steel flanges shall conform to AWWA C207, Class D. Flanges shall be flat face. Flanges shall match the flange on the connecting pipe.

5. See Section 15050 for flange bolts and gaskets.

B. Cast-Iron or Ductile-Iron Wall Pipes and Sleeves

1. Provide cast- or ductile-iron wall pipes with ends as shown in the drawings for connection to adjacent cast-iron and ductile-iron pipe or for containing pipes where they pass through concrete walls, ceilings, and floor slabs. Provide seepage ring on wall pipes and sleeves passing through concrete walls and slabs that are to be watertight. Locate collars such that the collar is at the center of the wall or floor slab, unless otherwise shown in the drawings.

2. Wall pipes and sleeves shall be of the following types:

   a. Pipe or sleeve with integrally cast seep ring.

   b. Pipe or sleeve with shrink-fit steel collar attached.

   c. Pipe or sleeve with steel collar halves bottomed in a groove provided in the pipe or sleeve.

3. Minimum wall thickness for pipes and sleeves having integrally cast seep rings shall be as shown in the following table:

Pipe or Sleeve Size (inches)	Minimum Wall Thickness (inches)
3	0.48
4	0.52
6	0.55
8	0.60
10	0.68
12	0.75
14	0.66
16	0.70
18	0.75
20	0.80
24	0.89
30	1.03
36	1.15
42	1.28
48	1.42

4. Minimum wall thickness of pipes or sleeves having shrink-fit collars shall be special Class 52. Cut shrink-fit collars from a 1/4-inch-thick steel ring. Attach the collar to a cast-iron or ductile-iron pipe or sleeve by heating the steel collar and allowing it to shrink over the pipe at the necessary location. Provide an epoxy bond (Keysite 740 or 742 or Scotchkote 302) between the pipe and collar. Sandblast the area of the pipe to be epoxy coated per SSPC SP-10.

5. Wall pipes or sleeves having steel collar halves bottomed in a groove shall be ductile iron Special Class 54 minimum unless otherwise shown. Wall flanges shall consist of 1/4-inch-thick steel seep ring halves for pipes through 24-inch and 3/8-inch-thick halves for pipe 30-inches and larger, bottomed in a groove provided on the pipe. The pipe groove shall be machine cut to a depth of 1/16-inch to 5/64-inch to provide a press fit for the seep ring. Seep ring halves shall be welded together after fit into groove but shall not be welded to pipe. Seep rings shall be sealed completely around the pipe with silicon sealant manufactured by Dow-Corning No. 790, General Electric Silpruf, or equal.

6. The material used in cast- or ductile-iron wall flanges, wall sleeves, and wall penetrations shall conform to ASTM A395, A436, A536, A48 (Class 35), or A126 (Class B).

7. Pressure test at least one of each size of cast-iron pipes or sleeves having shrink-fit steel collars or collar halves installed in a groove in the pipe at the place of fabrication to demonstrate watertightness of the seal between the collar and the sleeve. The test shall be at a pressure of 20 psig for four hours duration and shall show zero leakage.

C. Fabricated Steel Wall Pipes and Sleeves

1. Provide fabricated steel wall pipes and sleeves with ends as shown in the drawings for connection to adjacent steel pipes, or for containing pipes, where they pass through concrete walls. Provide seepage ring or wall flange on wall pipes and sleeves passing through concrete walls and slabs that are to be watertight. Wall thickness shall be the same as the pipe wall thickness when connecting to steel pipe. Minimum wall thickness for sleeves containing pipes shall be standard weight per ASME B36.10.

2. Wall flanges shall be in the form of a steel wall collar welded to the steel sleeve or penetration. Cut welded wall collars from a 1/4-inch steel ring. Attach the collar to a steel wall pipe or sleeve with full circle, 3/16-inch fillet welds. Welding procedures shall be in accordance with ASME B31.3, Chapter V.

3. Steel pipe used in fabricating wall sleeves containing pipes shall comply with ASTM 53 (Type E or S), Grade B; ASTM A135, Grade B; ASTM A139, Grade B; or API 5L or 5LX. Wall pipes connecting to steel pipe shall be of the same material as the connecting pipe. Wall collar material shall comply with ASTM A36, A105, A181, or A182.

4. Stainless steel pipe used in fabricating wall pipes shall be of the same material as the connecting pipe. Wall collar material shall comply with ASTM A240.

5. Pressure test at least one of each size of fabricated steel wall sleeve or penetration and collar assemblies at the place of fabrication to demonstrate watertightness of the seal between the collar and the

sleeve. The test shall be at a pressure of 20 psig for four hours duration and shall show zero leakage.

D. Rubber Annular Hydrostatic Sealing Devices

1. Rubber annular hydrostatic sealing devices shall be of the modular mechanical type, utilizing interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe sleeve and the passing pipe. Assemble links to form a continuous rubber belt around the pipe, with a pressure plate under each bolthead and nut.

2. Materials of construction shall be as follows:

Compound	Material
Pressure plate	Type 316 stainless steel
Bolts and nuts for links	Type 316 stainless steel
Sealing element	Nitrile rubber

3. The size of the wall sleeve needed to accommodate the passing pipe shall be as recommended by the rubber annular seal manufacturer.

4. Provide centering blocks in 25% of the sealing elements on pipelines larger than 12-inches in diameter.

5. The rubber annular hydrostatic sealing devices shall be Link Seal as manufactured by Thunderline Corporation; Innerlynx as manufactured by Advance Products & Systems, Inc.; or equal.

E. Bolts, Nuts, and Gaskets for Flanged-End Wall Pipes

See Section 15050.

F. Polyethylene Foam Filler for Pipe Penetrations

Packing foam shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware; Ethafoam, as manufactured by Dow Chemical Company, Midland, Michigan; or equal. The rod shall be 1/2-inch larger in diameter than the annular space.

G. Polyurethane Sealant for Pipe Penetrations

Sealant shall be multipart, polyurethane sealant, to cure at ambient temperature, for continuous immersion in water. Install as recommended by the manufacturer. Products: SIKA Sikaflex 2C or equal.

H. Painting and Coating

1. Coat penetrations and sleeves exposed, above ground, or in vaults and structures in accordance with Section 09900, System No. 10 unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.

2. Coat submerged sleeves and penetrations per Section 09900, System No. 7 unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.

3. Coat buried sleeves and penetrations per Section 09900, System No. 21.

4. Do not coat stainless steel sleeves and penetrations.

PART 3 - EXECUTION

A. Location of Pipes and Sleeves

1. Provide a wall or floor pipe where shown in the drawings and wherever piping passes through walls or floors of tanks or channels in which the water surface is above the pipe penetration.

2. Provide a floor sleeve where shown in the drawings and wherever plastic pipe, steel, or stainless steel pipe 3-inches and smaller or stainless steel or copper tubing passes through a floor or slab. Provide a rubber annular sealing device in the annular space between the sleeve and the passing pipe or tubing.

3. Provide wall sleeves where shown in the drawings and wherever plastic, steel or stainless steel pipe 3-inches and smaller, or stainless steel or copper tubing passes through a wall. Provide a single rubber annular seal when the wall is 8-inches thick or less. Provide two rubber annular seals (one at each end of the sleeve) when the wall is more than 8-inches thick. Pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2-inches of elastomeric sealant on both sides of the structure.

4. Where wall sleeves are installed in which water or soil is on one or both sides of the channel or wall, provide two rubber annular seals (one at each end of the sleeve).

5. Where pipes pass through walls or slabs and no sleeves or wall or floor pipe with seep ring is provided, pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2-inches of elastomeric sealant on both sides of the structure.

B. Installation in Existing Concrete Walls and Slabs

Core drill holes 1 to 2 inches larger in diameter than the outside diameter of the wall flange or collar. Install wall pipe and collar assembly axially aligned with the piping to which it will be connected or will contain. Pack the void space between the sleeve and concrete with grout. See Section 03600 for grouting specification.

C. Installation in New Concrete Walls and Slabs

Install wall pipes and sleeves in walls before placing concrete. Do not allow any portion of the pipe or sleeve to touch any of the reinforcing steel. Install wall pipe or sleeve and collar assembly axially aligned with the piping to which it will be attached or will contain. Provide supports to prevent the pipe or sleeve from displacing or deforming while the concrete is being poured and is curing.

D. Installation in Dry Floors and Slabs

Install pipe sleeves and spools in concrete floors and slabs which do not have water over them such that the sleeve or pipe extends from the bottom of the floor or slab to 2-inches above the floor or slab unless shown otherwise in the drawings.

E. Installation of Wall Pipes Having Flanged End Connections

1. Check alignment before grouting in place or pouring concrete. Realign if the sleeve is not properly aligned.

2. Install flanged end wall sleeves or penetrations with bolt holes of the end flanges straddling the horizontal and vertical centerlines of the sleeve.

3. Lubricate flange bolts with oil and graphite prior to installation.

F. Qualifications of Welders

Welder qualifications shall be in accordance with AWS D1.1.

G. Installation of Rubber Annular Hydrostatic Sealing Devices

Install in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 15064 PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

A. Description

This section includes materials and installation of pipe hangers and supports including accessory items, such as anchor bolts and screws, and neoprene isolation pads.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Provide line drawings of each piping system to the scale shown in the drawings, locating each support or hanger. Identify each type of hanger or support by the manufacturer's catalog number or figure.

3. Provide installation drawings and manufacturer's catalog information on each type of hanger and support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the hangers and supports.

PART 2 - MATERIALS

A. Design Criteria

1. Not all pipe supports or hangers required are shown in the drawings. Provide pipe supports for every piping system installed. Support piping by pipe support where it connects to pumps or other mechanical equipment.

2. Pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water), plus valve actuators and any insulation, and shall have a minimum safety factor of five based on material ultimate strength.

B. Hanger and Support Systems

1. Pipe hangers and supports shall be as manufactured by Anvil, Unistrut, B-Line, Superstrut, or equal.

2. Pipe hangers and supports shall comply with MSS SP-58 for the standard types referenced in the drawings.

Construct special hangers and supports if detailed in the drawings. Type numbers for standard hangers and supports shall be in accordance with MSS SP-58 as listed below:

Type Number	Description	Manufacturer and Model (or Equal)
1	Adjustable steel clevis	Anvil Fig. 590 or 260, B-Line B3100 or B3102
3	Steel double-bolt pipe clamp	Anvil Fig. 295A or 295H, B-Line B3144 or B3144A
4	Steel pipe clamp (pipes smaller than 3 inches)	Anvil Fig. 212, B-Line B3140
4	Steel pipe clamp (pipes 3 inches and larger)	Anvil Fig. 216, B-Line 3142
5	Pipe hanger	B-Line B6690
6	Adjustable swivel pipe ring	Anvil Superstrut 714, Anvil Fig. 104
7	Adjustable steel band hanger	B-Line B3172
8	Extension pipe or riser clamp	Anvil Fig. 261, B-Line B5573
9	Adjustable band hanger	Anvil Fig. 97
10	Adjustable swivel ring band hanger	Anvil Fig. 70, B-Line B3170 NF
11	Split pipe ring with adjustable turnbuckle	Anvil Fig. 108, B-Line B3173
13	Steel turnbuckle	Anvil Fig. 230, B-Line B3202
14	Steel clevis	Anvil Fig. 299, B-Line B3201
15	Swivel turnbuckle	Anvil Fig. 114, B-Line B3224
16	Malleable iron socket	Anvil Fig. 110R, B-Line B3222
17	Steel weldless eye nut	B-Line B3200
18	Steel or malleable iron concrete insert	Anvil Fig. 281, Superstrut 452
19	Top beam C-clamp	Anvil Fig. 92, B-Line B3033

Type Number	Description	Manufacturer and Model (or Equal)
20	Side I-beam or channel clamp	Anvil Fig. 14 or 217
21	Center I-beam clamp	Anvil Figure 134
22	Welded attachment type	Anvil Fig. 66 B-Line B3083
23	C-clamp	Anvil Fig. 86, B-Line B3036L
24	U-bolt	Anvil Fig. 137, B-Line B3188
26	Clip	Anvil Fig. 262, B-Line B3180
28	Steel I-beam clamp with eye nut	Anvil Fig. 228
29	Steel wide flange	Anvil Fig. 228 clamp with eye nut
30	Malleable iron beam clamp with extension piece	Superstrut CM-754, B-Line B3054
31	Light welded steel bracket	Anvil Fig. 194, B-Line B3063
32	Medium welded steel bracket	Anvil Fig. 195, B-Line B3066
33	Heavy welded steel bracket	Anvil Fig. 199, B-Line B3067
34	Side beam bracket	Anvil Fig. 202, B-Line B3062
36	Pipe saddle support	Anvil Fig. 258, B-Line B3095
37	Pipe stanchion saddle	Anvil Fig. 259, B-Line B3090
38	Adjustable pipe saddle support	Anvil Fig. 264, B-Line B3093/B3089
39	Steel pipe covering	Anvil Fig. 160, 161, 162, 163, 164, or 165; Superstrut A 789; B-Line B3160/B3165
40	Insulation protection shield	Anvil Fig. 167, B-Line B3151
41	Single pipe roll	Anvil Fig. 171, B-Line B3114

Type Number	Description	Manufacturer and Model (or Equal)
43	Adjustable roller hanger with swivel	Anvil Fig. 181, B-Line B3110
44	Pipe roll, complete	Anvil Fig. 271, B-Line B3117SL

3. Pipe hangers and supports shall be hot-dipped galvanized per ASTM A 153 carbon steel (ASTM A36, A575, or A576). Bases, rollers, and anchors shall be steel as described above or may be cast iron (ASTM A48). Pipe clamps shall be steel as described above or may be malleable iron (ASTM A47).

4. Pipe hangers and supports in submerged service shall be Type 316 stainless steel.

C. Miscellaneous Pipe Supports and Hangers

1. Pipe Anchor Chair: Anvil Figure 198 or equal.

2. One Hole Clamp: Anvil Figure 126 or equal.

3. Roller Chair: Anvil Figure 175 or equal.

D. Pipe Spiders

Superstrut S-794 or equal.

E. Waffle Isolation Pads

Mason Type "W"; Machinery Installation Systems "Unisorb" Type S, SB, F, or FB; or equal. Provide minimum 1/4-inch thickness.

F. Neoprene Isolating Sleeves for Metal Pipe

Unistrut P2600, B-Line "Vibrocushion," or equal.

G. Anchor Bolts and Screws

Anchor bolts and screws for attaching pipe supports and hangers to walls, floors, ceilings, and roof beams shall be Type 316 stainless steel, ASTM A276 or F593. Nuts shall be Type 316 stainless steel, ASTM A194, Grade 8M or ASTM F594, Type 316 stainless steel.

PART 3 - EXECUTION

A. Pipe Hanger and Wall Support Spacing

Install pipe hangers and wall supports on horizontal and vertical runs at the spacing shown or detailed in the drawings. Provide hanger rods (for horizontal runs) and wall supports of the sizes shown or detailed in the drawings. If no spacing or rod sizes are given in the drawings or in the specifications for a particular piping system, use the following:

1. Pipe Hanger and Wall Support Spacing Ductile-Iron Pipe (Sections 15240):

Pipe Size (inches)	**Maximum Support or Hanger Spacing (feet)**	**Minimum Rod Size (inches)**
3/8 and smaller	4	3/8
1/2 through 1	6	3/8
1-1/4 through 2	8	3/8
2-1/2 and 3	10	1/2
3-1/2 and 4	10	5/8
6	12	3/4
8	12	7/8
10 and 12	14	7/8
14 and 16	16	1
18	15	1
20 through 24	9	1
30	6	1

2. Pipe Hanger or Wall Support Spacing for PVC Pipe (Sections 15290):

Pipe Size (inches)	**Maximum Support or Hanger Spacing (feet)**	**Minimum Rod Size (inches)**
3/4	4	3/8
1	4	3/8
1-1/2	5	3/8
2	5	3/8
2-1/2	5	1/2
3	6	1/2

3. Pipe Hanger or Wall Support Spacing for FRP Pipe (Section 15850):

Pipe Size (inches)	Maximum Hanger or Support Spacing (feet)	Minimum Rod Size (inches)
1	3	3/8
1 1/2	4	3/8
2	5	3/8
3	6	1/2
4	6	5/8
6	7	3/4
8	8	7/8
10	9	7/8
12	10	7/8
14 to 16	10	1
18	10	1
20 to 24	9	1
30 to 36	6	1

4. Pipe Hanger or Wall Support Spacing for Stainless Steel Tubing (Section 15278):

Tube Outside Diameter (inches)	Maximum Hanger or Support Spacing (feet)	Minimum Rod Size (inches)
1/8 to 1/4	2	3/8
5/16 to 1/2	3	3/8
5/8 to 7/8	4	3/8
1 to 2	6	3/8

B. Pipe Support Spacing for Supports on Top of Slabs or Grade

Install pipe supports on horizontal runs at the spacing shown or detailed in the drawings. Provide supports of the type shown or detailed in the drawings. If no spacings are given in the drawings or in the specifications for a particular piping system, use the following:

1. Pipe Support Spacing for Ductile-Iron Pipe (Sections 15240):

Pipe Size (inches)	Maximum Support Spacing (feet)
3/8 and smaller	4
1/2 through 1	6
1-1/4 through 2	8
2-1/2 and 3	10
3-1/2 and 4	10
6	12
8	12
10 and 12	14
14 and 16	16
18	16
20 through 24	18
30 through 36	18

2. Pipe support spacing for other pipe materials shall be the same as described above in paragraph entitled “Pipe Hanger and Wall Support Spacing.”

C. Installing Pipe Hangers and Supports

1. Provide separate hangers or supports at each valve. Provide one hanger or support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional hangers or supports to relieve eccentric loadings imposed by offset valve actuators.

2. Provide separate hangers or supports at each pipe elbow, tee, or fitting. Provide separate hangers or supports on both sides of each nonrigid joint or flexible pipe coupling.

3. Adjust pipe hangers per MSS SP-89, paragraph 10.6.

4. Install leveling bolts beneath support baseplates. Provide 1-inch thick grout pad beneath each base.

5. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.

D. Installing Stainless Steel Channel Frames

Use 1-5/8-inch high channel frames unless 3-1/4-inch is needed to provide clearance from walls. Use multiple back-to-back channels if additional clearance is needed.

E. Installing Neoprene Isolating Sleeves

Install a sleeve around each metal pipe 6-inches and smaller at the point of bearing or contact with the pipe hanger or support.

F. Painting and Coating

1. Grind welds of fabricated steel pipe supports smooth, prepare surface by sandblasting, and apply coating system.

2. Paint exposed pipe hangers and supports to match the color of the adjacent wall using System No. 10 per Section 09900. If the adjacent wall is not painted, paint the hangers and supports to match color code of the largest pipe on the support.

3. Do not coat stainless steel pipe supports.

4. Remove heat tint completely from the heat affected zones HAZ of the finished weld on stainless steel pipe supports by grinding or blasting. The maximum depth of grinding or abrasive blasting to remove defects shall not exceed 10% of the support thickness. Do not perform abrasive blasting with steel shot, grit, or sand. Perform a final cleaning then pickle, and passivate the heat affected zones (HAZ) on stainless steel pipe supports.

END OF SECTION

SECTION 15075 EQUIPMENT, PIPING, DUCT, AND VALVE IDENTIFICATION

PART 1 - GENERAL

A. Description

This section includes materials and installation of markers, labels, and signs for pipes, ducts, and valves; for mechanical equipment; for hazardous materials warnings; and for miscellaneous plant services.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit manufacturer's catalog data and descriptive literature describing materials, colors, letter size, and size of labels.

PART 2 - MATERIALS

A. Labels for Exposed Piping

1. Labels for piping shall bear the full piping system name as shown in the Piping Schedule in the drawings. Provide separate flow directional arrows next to each label. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Labels for piping inside buildings shall be vinyl cloth: W. H. Brady Co. B-500 vinyl cloth, Seton Name Plate Corporation Pipe Markers, or equal. Labels for piping located outdoors shall be weather and UV-resistant acrylic plastic and shall be W. H. Brady Co. B-946, Seton Name Plate Corporation Pipe Markers, or equal.

2. Alternatively, provide preprinted, semirigid, snap-on, color coded pipe markers. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Label shall cover 360 degrees (minimum). Labels shall be fabricated of weather and UV-resistant acrylic plastic. Labels shall be Seton Nameplate Corporation SetMark pipe marks or equal.

3. Provide 1-inch thick molded fiberglass insulation with jacket for each plastic pipe label or marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F or greater. Cut length to extend 2 inches beyond each end of plastic pipe marker.

B. Labels for Valves

Provide each valve of size 3 inches and larger with an identification tag. Tag shall be 2-inch square or circular aluminum or 1/16-inch thick fiberglass: W. H. Brady B-60, Seton Name Plate Corp. Series SVT, or equal. Aluminum tags shall have black-filled letters. Tag shall show the valve tag number and/or name or designation as given in the drawings.

C. Hose Bibb Signs--Unsafe Water

Provide a rigid sign labeled "DANGER--UNSAFE WATER—NO BEBER" for each hose bibb as denoted for a reclaimed water source. The size and lettering shall conform to OSHA requirements. Signs shall be Seton Nameplate Company 20-gauge baked enamel, minimum size 7 inches by 3 inches; Brady B-120 Fiber-Shield fiberglass, minimum size 7 inches by 3 inches, 1/8-inch thick; or equal.

D. Labels for Mechanical Equipment

Provide a label for each pump, blower, compressor, tank, feeder, flocculator, flash mixer, clarifier mechanism, or other piece of mechanical equipment. Label shall show the equipment name. Labels shall be 1-1/2 inches (minimum) by 4 inches (minimum) brass, aluminum, or 1/8-inch thick fiberglass tags: Brady B-120 Fiber-Shield, Seton Style 2065, or equal.

E. Labels for Tanks

Signs shall be weather- and UV-resistant. Labels shall be Brady B-946, Seton Name Plate Corporation PSPL, or equal. Minimum size shall be 7 inches by 10 inches. Provide a sign on each tank bearing the tank tag number and the name of the liquid stored.

F. Wall Signs

Wall signs shall be 1-1/2 inches by 4 inches (minimum dimensions), 1/16-inch thick satin-surfaced material conforming to ASTM D709 (Grades ES-1, ES-2, or ES-3).

Lettering shall be 1/2-inch high white letters on black background. Do not provide mounting holes.

G. Labels for Automatic Start/Stop Equipment

Provide a sign reading "CAUTION--EQUIPMENT STARTS AND STOPS AUTOMATICALLY" on each piece of equipment listed below. Signs shall be pressure-sensitive vinyl with adhesive for application to equipment. Signs mounted on adjacent walls are also acceptable. Table does not include all equipment within the Project to receive signage. Reference the Drawings and provide signage for all equipment within the Project that stops and starts automatically. Size shall be 10 inches by 7 inches minimum. Products: Seton, Brady, or equal.

Equipment Type	Location	Tag Number
WAS Booster Pumps	WAS Booster Pump Station (Process 610)	610-P-1 and 610-P-2
Sludge Thickening Mechanisms	WAS Holding Tanks (Process 620)	620-TM-1 and 620-TM-2
Polymer Feed Pumps	Biosolids Handling Building (Process 630)	630-P-6, 630-P-7 and 630-P-8
Grinders	Biosolids Handling Building (Process 630)	630-GD-1, 630-GD-2 and 630-GD-3
Centrifuges	Centrifuge Dewatering Building (Process 650)	650-CF-1, 650-CF-2 and 650-CF-3
Screw Conveyor	Centrifuge Dewatering Building (Process 650)	650-SC-1, 650-SC-2 and 650-SC-3
Miscellaneous Knife Gates	Centrifuge Dewatering Building (Process 650)	Refer to Drawings

Diverter Gates	Centrifuge Dewatering Building (Process 650)	650-DG-1, 650-DG-2 and 650-DG-3

H. Labels for Ventilation Ducts

Identify air supply, return exhaust, intake, and relief ductwork with duct markers, showing ductwork service and direction of flow. Signs shall be pressure-sensitive vinyl with adhesive for application to ducts and duct insulation. Size shall be 10 inches by 7 inches minimum. Products: Seton, Brady, or equal.

I. Underground Plastic Warning Tape for Metallic Pipe

Provide permanent, bright-colored, continuous-printed plastic tape, intended for direct burial service, not less than 6 inches wide by 3.5 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe. Provide the following colored tape for the various piping services:

Service	**Color**
Cable TV	Orange
Chemical	Yellow
Electric	Red
Fuel Oil, Gasoline	Yellow
Gas	Yellow
Reclaimed Water	Violet
Sewer	Green
Telephone	Orange
Water	Blue

J. Underground Detectable Metallic Pipe Warning Tape for Nonmetallic Pipe

Provide permanent, bright-colored, continuous-printed tape consisting of an aluminum or steel foil sheathed in a plastic laminate, not less than 2 inches wide by 3 mils thick. Provide tape with printing which most accurately indicates type of buried service. Provide the following colored tape for the various piping services:

Service	Color
Cable TV	Orange
Chemical	Yellow
Electric	Red
Fuel Oil, Gasoline	Yellow
Gas	Yellow
Reclaimed Water	Violet
Sewer	Green
Telephone	Orange
Water	Blue

K. No Smoking Signs

Provide a sign reading "NO SMOKING" at each location listed below. Signs shall be weather and UV resistant, minimum size 10 inches by 7 inches, 1/8-inch thick fiberglass. Products: Brady, Seton, or equal.

Room & Process Number	Location
Biosolids Dewatering Area (Process 650)	Biosolids Dewatering Building

PART 3 - EXECUTION

A. Installing Pipe Labels

1. Provide label and flow arrow at each connection to pumps or other mechanical equipment, at wall boundaries, at tees and crosses, and at 20-foot centers on straight runs of piping.

2. On piping having external diameters less than 6 inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location.

3. On piping having external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers but not narrower than three times letter height (and of required length), fastened by one of the following methods:

   a. Laminated or bonded application of pipe marker to pipe or insulation.

b. Strapped-to-pipe or insulation application of semirigid type with Type 304 or 305 stainless steel bands.

4. Label destination on pipes entering and leaving buildings.

B. Installing Valve and Equipment Labels

1. Attach labels to the valve or piece of equipment with Type 304 or 316 stainless steel chains or wires.

2. Attach valve labels to the valve handwheels. If the valve has no handwheel, attach the label to the valve by tying the tag wire or chain around the operating shaft or nut.

C. Installing Miscellaneous Signs

Attach per sign manufacturer's recommendations and per OSHA requirements.

D. Installing Wall and Door Signs

Attach to walls and doors using epoxy adhesive.

E. Installing Labels for Automatic Start/Stop Equipment and Hazardous Materials Warning Signs for Equipment

1. Attach signs for exposed equipment directly to the equipment.

2. Attach signs for sump pumps on the adjacent wall.

F. Installing Ventilation Ductwork Labels

1. In each space where ductwork is exposed or concealed only by a removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground, or similar concealment) and at 20-foot spacings along exposed runs.

2. Provide markers on each access door in ductwork and housings, indicating purpose of access.

3. Assure that all identification labels are clearly visible.

G. Installing Underground Plastic Warning Tape for Metal Pipe

During backfilling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6 to 8 inches above the top of the pipe. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker.

H. Installing Underground Detectable Metallic Pipe Warning Tape

Install tape 12 to 18 inches below finished ground surface, located directly over buried pipelines. Where multiple small pipelines are buried in a common trench and do not exceed an overall width of 16 inches, install a single marker tape.

END OF SECTION

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SECTION 15076 - HVAC IDENTIFICATION

PART 1 - GENERAL

A. SUMMARY

This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.

2. Equipment markers.

3. Access panel and door markers.

B. SUBMITTALS

Product Data: For each type of product indicated.

C. QUALITY ASSURANCE

ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

PART 2 - PRODUCTS

A. EQUIPMENT IDENTIFICATION DEVICES

1. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

    a. Data:

        1) Manufacturer, product name, model number, and serial number.

        2) Capacity, operating and power characteristics, and essential data.

        3) Labels of tested compliances.

    b. Location: Accessible and visible.

    c. Fasteners: As required to mount on equipment.

2. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

   a. Terminology: Match schedules as closely as possible.

   b. Data:

      1) Name.

   c. Size: 2-1/2 by 4 inches for equipment.

PART 3 - EXECUTION

A. APPLICATIONS, GENERAL

Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

A. EQUIPMENT IDENTIFICATION

Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fan coil and Condensing Units.

B. ADJUSTING AND CLEANING

1. Relocate mechanical identification materials and devices that have become visually blocked by other work.

2. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

SECTION 15080 - HVAC INSULATION

PART 1 - GENERAL

A. Summary

1. This Section includes mechanical insulation for duct, equipment, and pipe, including the following:

a. Insulation Materials:

1) Flexible elastomeric.

2) Mineral fiber.

b. Insulating cements.

c. Adhesives.

d. Mastics.

e. Sealants.

f. Factory-applied jackets.

g. Field-applied fabric-reinforcing mesh.

h. Field-applied jackets.

i. Tapes.

j. Securements.

k. Corner angles.

B. Submittals

1. Product Data: For each type of product indicated.

2. Shop Drawings: Show details for the following:

a. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

b. Attachment and covering of heat tracing inside insulation.

c. Insulation application at pipe expansion joints for each type of insulation.

d. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

e. Removable insulation at piping specialties, equipment connections, and access panels.

f. Application of field-applied jackets.

g. Application at linkages of control devices.

h. Field application for each equipment type.

3. Field quality-control inspection reports.

C. Quality Assurance

1. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

A. Manufacturers

1. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

   a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

   b. Products: Subject to compliance with requirements, provide one of the products specified.

   c. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

   d. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Insulation Materials

1. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.

2. Products shall not contain asbestos, lead, mercury, or mercury compounds.

3. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

6. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

a. Products:

1) Aeroflex USA Inc.; Aerocel.

2) Armacell LLC; AP Armaflex.

3) RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

7. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

a. Products:

1) CertainTeed Corp.; Duct Wrap.

2) Johns Manville; Microlite.

3) Knauf Insulation; Duct Wrap.

4) Manson Insulation Inc.; Alley Wrap.

5) Owens Corning; All-Service Duct Wrap.

8. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

a. Products:

1) CertainTeed Corp.; Commercial Board.

2) Fibrex Insulations Inc.; FBX.

3) Johns Manville; 800 Series Spin-Glas.

4) Knauf Insulation; Insulation Board.

5) Manson Insulation Inc.; AK Board.

6) Owens Corning; Fiberglas 700 Series.

C. Adhesives

1. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

2. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

a. Products:

1) Aeroflex USA Inc.; Aeroseal.

2) Armacell LCC; 520 Adhesive.

3) Foster Products Corporation, H. B. Fuller Company; 85-75.

4) RBX Corporation; Rubatex Contact Adhesive.

3. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

a. Products:

1) Childers Products, Division of ITW; CP-82.

2) Foster Products Corporation, H. B. Fuller Company; 85-20.

3) ITW TACC, Division of Illinois Tool Works; S-90/80.

4) Marathon Industries, Inc.; 225.

5) Mon-Eco Industries, Inc.; 22-25.

4. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

a. Products:

1) Childers Products, Division of ITW; CP-82.

2) Foster Products Corporation, H. B. Fuller Company; 85-20.

3) ITW TACC, Division of Illinois Tool Works; S-90/80.

4) Marathon Industries, Inc.; 225.

5) Mon-Eco Industries, Inc.; 22-25.

D. Mastics

1. Materials shall be compatible with insulation materials, jackets, and substrates: Comply with MIL-C-19565C, Type II.

2. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

a. Products:

1) Childers Products, Division of ITW; CP-35.

2) Foster Products Corporation, H. B. Fuller Company; 30-90.

3) ITW TACC, Division of Illinois Tool Works; CB-50.

4) Marathon Industries, Inc.; 590.

5) Mon-Eco Industries, Inc.; 55-40.

6) Vimasco Corporation; 749.

b. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.

c. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

d. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.

e. Color: White.

E. Sealants

1. Joint Sealants:

2. FSK and Metal Jacket Flashing Sealants:

a. Products:

1) Childers Products, Division of ITW; CP-76-8.

2) Foster Products Corporation, H. B. Fuller Company; 95-44.

3) Marathon Industries, Inc.; 405.

4) Mon-Eco Industries, Inc.; 44-05.

5) Vimasco Corporation; 750.

b. Materials shall be compatible with insulation materials, jackets, and substrates.

c. Fire- and water-resistant, flexible, elastomeric sealant.

d. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

e. Color: Aluminum.

F. Factory-Applied Jackets

1. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

a. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

G. Field-Applied Jackets

1. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

2. For exterior ducts, provide a field applied jacket to ensure a weather tight, liquid tight seal for all ductwork insulation in addition to aluminum jackets.

3. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

   a. Products:

      1) Childers Products, Division of ITW; Metal Jacketing Systems.

      2) PABCO Metals Corporation; Surefit.

      3) RPR Products, Inc.; Insul-Mate.

   b. Sheet and roll stock ready for shop or field sizing.

   c. Finish and thickness are indicated in field-applied jacket schedules.

   d. Moisture Barrier for Indoor Applications: 1-mil-(0.025-mm-) thick, heat-bonded polyethylene and kraft paper.

   e. Moisture Barrier for Outdoor Applications: 3-mil-(0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

   f. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.

      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.

      3) Tee covers.

      4) Flange and union covers.

      5) End caps.

6) Beveled collars.

7) Valve covers.

8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

H. Tapes

1. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.

   a. Width: 3 inches (75 mm).

   b. Thickness: 6.5 mils (0.16 mm).

   c. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

   d. Elongation: 2 percent.

   e. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

   f. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

   a. Width: 2 inches (50 mm).

   b. Thickness: 3.7 mils (0.093 mm).

   c. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

   d. Elongation: 5 percent.

   e. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

I. Securements

1. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal.

2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

   b. Spindle: Aluminum, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

5. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

6. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

J. Corner Angles

Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

A. Preparation

1. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

2. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

B. Common Installation Requirements

1. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

2. Install insulation with tightly butted joints free of voids and gaps. Vapor barriers shall be continuous. Before installing jacket material, install vapor-barrier system.

3. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

4. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

5. Install insulation with longitudinal seams at top and bottom of horizontal runs.

6. Install multiple layers of insulation with longitudinal and end seams staggered.

7. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

8. Keep insulation materials dry during application and finishing.

9. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

10. Install insulation with least number of joints practical.

11. Hangers and Anchors: Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

    a. Install insulation continuously through hangers and around anchor attachments.

    b. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

    c. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

    d. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

12. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

13. Install insulation with factory-applied jackets as follows:

a. Draw jacket tight and smooth.

b. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

c. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.

1) For below ambient services, apply vapor-barrier mastic over staples.

d. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

e. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

14. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

15. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

16. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

17. For above ambient services, do not install insulation to the following:

a. Vibration-control devices.

b. Testing agency labels and stamps.

c. Nameplates and data plates.

d. Handholes.

e. Cleanouts.

C. Penetrations

1. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

   a. Seal penetrations with flashing sealant.

   b. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

   c. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.

   d. Seal jacket to roof flashing with flashing sealant.

2. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

3. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

   a. Seal penetrations with flashing sealant.

   b. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

   c. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).

   d. Seal jacket to wall flashing with flashing sealant.

4. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

5. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

6. Insulation Installation at Floor Penetrations:

   a. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).

   b. Pipe: Install insulation continuously through floor penetrations.

D. Duct And Plenum Insulation Installation

1. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

   a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

   b. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

   c. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

      1) On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3

inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

2) On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

3) Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

4) Do not overcompress insulation during installation.

5) Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

d. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

1) Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

2) Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

e. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows.

f. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

E. Pipe Insulation Installation

1. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

2. Secure single-layer insulation with bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.

3. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with bands at 12-inch (300-mm) intervals.

4. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

5. Cover segmented insulated surfaces with a layer of insulating cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

6. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

7. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

8. Insulation Installation on Straight Pipes and Tubes:

   a. Secure each layer of preformed insulation to pipe with wire or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
   b. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

   c. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

   d. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.

   e. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

9. Insulation Installation on Pipe Flanges:

   a. Install preformed pipe insulation to outer diameter of pipe flange.

   b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

   c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of same insulation material and thickness as pipe insulation.

d. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

e. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

10. Insulation Installation on Pipe Fittings and Elbows:

a. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

b. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

11. Insulation Installation on Valves and Pipe Specialties:

a. Install preformed sections of same material as straight segments of pipe insulation when available.

b. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

d. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

e. Install insulation to flanges as specified for flange insulation application.

12. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

13. Install removable insulation covers at locations indicated. Installation shall conform to the following:

a. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

b. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

c. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

d. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

14. Special Installation Requirements for Flexible Elastomeric Insulation:

a. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

b. Insulation Installation on Pipe Flanges:

1) Install pipe insulation to outer diameter of pipe flange.

2) Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3) Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4) Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

c. Insulation Installation on Pipe Fittings and Elbows:

1) Install mitered sections of pipe insulation.
2) Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

F. Field-Applied Jacket Installation

Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

G. Finishes

1. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating for interior concealed insulation.

2. Color: white.

3. Do not field paint aluminum jackets.

H. Field Quality Control

1. Perform the following field tests and inspections and prepare test reports:

a. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

b. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three location(s) for each type of equipment defined in the "Equipment Insulation

Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

c. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe.

2. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Remove defective Work.

3. Install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures after new materials are installed.

I. Duct Insulation Schedule, General

1. Plenums and Ducts Requiring Insulation:

a. Indoor, concealed supply and outdoor air.

b. Indoor, exposed supply and outdoor air.

c. Indoor, concealed return located in nonconditioned space.

d. Indoor, exposed return located in nonconditioned space.

e. Outdoor, concealed supply and return.

f. Outdoor, exposed supply and return.

2. Items Not Insulated:

a. Fibrous-glass ducts.

b. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.

c. Factory-insulated flexible ducts.

d. Factory-insulated plenums and casings.

e. Flexible connectors.

f. Vibration-control devices.

g. Factory-insulated access panels and doors.

J. Indoor Duct And Plenum Insulation Schedule

1. Exposed Supply-Air and Outside Air Duct and Plenum Insulation: Mineral-fiber board, 1 inches (75 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density to achieve a min R value installed of R=4.3.

2. Concealed Supply-Air and Outside Air Duct and Plenum Insulation: Mineral-fiber board, 2.2 inches (75 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density to achieve a min R value installed of R=6.

K. Aboveground, Outdoor Duct And Plenum Insulation Schedule

1. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

2. Exposed, Supply-Air and Return Duct and Plenum Insulation: Mineral-fiber board, 4 inches (75 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density to obtain an R Value of R=8.

L. Piping Insulation Schedule, General

1. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

2. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

a. Fire-suppression piping.

b. Drainage piping located in crawl spaces.

c. Below-grade piping.

d. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

M. Indoor Piping Insulation Schedule

1. Refrigerant Suction and Hot-Gas Piping: Flexible elastomeric 1 inch (25 mm) thick.

2. Condensate Piping: Flexible elastomeric - 1 inch (25 mm) thick.

N. Outdoor Piping Insulation Schedule

1. Refrigerant Suction and Hot-Gas Piping: Insulation shall be[any of] the following:

a. Flexible elastomeric, 2 inches (50 mm) thick.

O. Indoor, Field-Applied Jacket Schedule

1. Piping, Exposed:

a. None.

b. Aluminum, stucco embossed, 0.024 inch (0.61 mm)

P. Outdoor, Field-Applied Jacket Schedule

1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

2. If more than one material is listed, selection from materials listed is Contractor's option.

3. Ducts and Plenums, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):

a. Painted aluminum, stucco embossed, 0.032 inch (0.81 mm) thick.

4. Ducts and Plenums, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):

a. Painted aluminum, stucco embossed with 1-1/4-inch- (32-mm-) deep corrugations, 0.040 inch (1.0 mm) thick.

5. Piping, Exposed:

a. aluminum, stucco embossed, 0.024 inch (0.61 mm)

END OF SECTION

SECTION 15084 PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL

A. Description

This section includes materials and installation for insulating piping, valves, and equipment.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following:

2. Submit manufacturer's catalog data and descriptive literature for the insulating and jacketing material. Show thickness of insulation and type of jacketing for each insulated pipe service in the project.

3. Submit manufacturer's installation instructions for insulation, facing, jacketing, adhesives, sealants, and paints.

PART 2 - MATERIALS

A. Fire and Smoke Hazard Ratings

Insulation, cover, and jacketing shall have composite fire and smoke hazard ratings as tested by procedure ASTM E 84, NFPA 255, and UL-723 not exceeding:

1. Flame Spread: 25.

2. Smoke Developed: 50.

B. Type 2 Piping Insulation (Fiberglass)

Piping insulation materials shall be Johns Manville MICRO-LOK, Owens-Corning fiberglass ASJ/SSL-II, or equal. Insulation shall comply with NFPA 90A and 90B and ASTM C547, Type 1, Grade A. Insulation materials around pipefittings shall be Johns Manville Microlite, Owens-Corning unfaced fiberglass duct wrap, or equal. Insulation thickness (unless otherwise indicated) shall be:

Pipe Size (inches)	Insulation Thickness (inches)
2 and smaller	1

C. Jacketing and Facing for Type 2 Insulation (Fiberglass)

1. Facing shall be foil-reinforced Kraft (FSK) or bonded white Kraft foil laminate (AP) complying with ASTM D1136.

2. Jacketing material for exposed service shall be aluminum conforming to ASTM B209, Alloys 1100 or 3003, Temper H-14, minimum 0.016 inch thick for piping and 0.032 inch thick for mechanical equipment and vessels, smooth pattern. Provide built-in isolation felt. Products: Childers "LOCK-ON" or equal.

3. Jacketing around exposed pipefittings shall be aluminum, conforming to ASTM B209, Alloys 1100 or 3003, minimum 0.024 inch thick, manufactured to conform to ASTM C450.

4. Jacketing for buried insulated piping and fittings shall be PVC that consists of a jacket, PVC-molded fitting covers, and a solvent-welded seam procedure, which forms a completely sealed, monolithic protective covering.

5. Do not use asbestos materials.

D. Insulating Cement

Insulating Cement: Ryder SC-10, Forty-Eight Insulations Super 48, or equal.

E. Insulation Protection Shields for Pipe Hangers

Provide Type 316 stainless steel or aluminum protection shields (Type 40 per MSS SP-69). Shields shall extend over the bottom 180 degrees of the pipe insulation. Length shall be at least three times the pipe outside diameter. The thickness of the shield shall be sufficient such that the insulation and jacketing are not crushed or distorted when the insulated pipe is resting on the hanger.

F. Accessories

Accessories, such as adhesives, mastics, cements, and tapes, shall have the same component ratings. Use accessory products as recommended by the insulation manufacturer. All products or their shipping cartons shall bear a label

indicating that flame and smoke ratings do not exceed those listed above. Any treatment of jackets or facings to impact flame and smoke safety shall be permanent. Do not use water-soluble treatments.

PART 3 - EXECUTION

A. Storage

1. Store insulation in a manner that will prevent contamination from external sources.

2. Store insulation and accessory materials in weathertight buildings. Storage buildings shall be situated and constructed so that they will not be subject to flooding. The floor shall be paved and well drained.

3. Place insulation on pallets or shoring to prevent direct contact with the ground or floor.

B. Piping Surfaces To Be Insulated

1. Provide insulation on piping as designated in the schedule listed below.

Piping Designation	Insulation Type
Polymer (PS-1)	2

C. Installation--General

1. Insulation shall be continuous through wall and ceiling openings and sleeves except where required by the SBCCI Standard Mechanical Code and SBCCI Standard Building Code. Provide vapor barriers. Point cracks with insulating cement. Build up fittings to the thickness of the adjacent piping with insulating cement and finish with canvas.

2. Apply insulation only after pipes have been cleaned, flushed, hydrostatically tested, and there is no evidence of leakage.

3. Insulation and jacketing shall be continuous through pipe hangers and supports. Support horizontal and vertical pipes on hangers, supports, or riser clamps with the addition of a protection shield.

4. Provide rigid insulation inserts (calcium silicate or cellular glass) between the pipe outside diameter and the protection shield to prevent the weight of the pipe from crushing the insulation. Inserts shall be the same thickness as the pipe insulation, shall cover the bottom 180-degree arc of the pipe, and shall extend at least 2 inches beyond the protection shield. The pipe insulation jacket shall be continuous over the insulation insert or cork insert.

5. Support vertical pipes by means of riser clamps per MSS SP-69 and two protection shields covering the entire 360-degree arc of the insulation.

6. Where vertical piping is supported with riser clamps or anchors attached directly to the pipe outside diameter, insulate the riser clamps or anchors with the same material used to insulate the pipe and seal the jacket.

7. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering all surfaces. Fill voids and holes. Seal raw edges.

8. Install insulation in a manner such that the insulation may be split, removed, and reinstalled with vapor barrier tape on strainers, caps, and unions.

9. Spread tarpaulins over equipment and uncovered pipes as protection from dirt and rubbish caused by the installation of the insulation.

10. Install insulation products in accordance with the manufacturer's recommendations.

11. Handle, transport, ship, store, and apply insulation for stainless steel piping per ASTM C 929.

D. Installation of Type 2 (Fiberglass) Insulation

1. Install with ends butted together. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment that would penetrate the vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.

2. When multiple layers of split insulation are used, butt horizontal joints together and stagger joints. Secure with rubber insulation adhesive.

E. Installing Insulation at Flanges

Install per ASTM F 683, Figure 16 or 17.

F. Installing Insulation at Valves

Install per ASTM F 683, Figure 15.

G. Labeling and Marking

Provide labels and arrows on piping and identification tags on valves per Section 15075. Attach labels and arrows to the jacketing.

END OF SECTION

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SECTION 15085 HEAT TRACING OF PIPING

PART 1 - GENERAL

A. Description

This section includes materials and installation of thermostat-controlled heat tracing for freeze protection of insulated piping.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following:

2. Submit manufacturer's catalog data, descriptive literature, and installation instructions for heat tracers, heat tracer power connections, splicing and tee kits, thermostat controls, and signal lights to be installed on CPVC fittings, and valves.

3. Submit heat loss calculations for the appropriate insulated pipe sizes and materials and valve types to document the thermal rating (in watts/lineal foot of pipe) required to maintain the pipe temperature as specified.

4. Submit insulation test report.

PART 2 - MATERIALS

A. General

The heat tracers, power connections, thermostat controls, splicing kits, tee kits, and signal lights shall be supplied by a single manufacturer.

B. Heat Tracers

1. The heat tracers shall be Tyco Thermal Controls BTV Series, RSCC Heat Tracer 2700 series, or equal.

2. Each heat tracer shall be capable of maintaining the temperature of the insulated pipe, pipefitting, or valve, upon which it has been mounted, at or above 60°F with an ambient temperature of 0°F. Pipe materials and

fluids conveyed that require heat tracing are tabulated below:

Piping Service	Piping Material	Pipe Spec. Section	Fluid Conveyed
Dewatering Aid	CPVC	15294	Polymer

3. The heat tracers shall utilize a service voltage of 120-volt a-c and a circuit breaker size of 20 amperes. Utilize multiple circuits if the length of heat trace exceeds the manufacturer's recommended maximum loading for a 20-ampere circuit breaker.

4. Each heat tracer shall consist of parallel copper conductors embedded in a semiconductive heating element. The heating element shall be a continuous strip extending between the copper conductors to provide a heating circuit along the entire length of the heat tracer. The heating element shall be covered by an inner insulating jacket. A tinned copper shield shall surround the inner coating and shall, in turn, be covered by an outer, corrosion-resistant fluoro-polymer coating.

5. The heating element in each heat tracer shall automatically decrease its power output as its temperature increases and thereby prevent tracer burnout. Do not use constant wattage heat tracers. The heating element's self-contained temperature regulating capability shall occur independently at each point along the heating circuit.

6. The heat tracer shall be capable of being field cut to any length without impacting its heat output per lineal foot.

7. The heat tracer shall not attain a temperature sufficient to damage the pipe, pipefitting, or valve material upon which it is mounted.

C. Aluminum Tape

Aluminum tape over heat tracers installed on plastic pipe shall be Tyco Thermal Controls Cat. No. AT-180, RSCC Heat Trace 1528-0A018, or equal.

D. Power Connection

The power connection for each heat tracer shall be Tyco Thermal Controls Cat. No. JBS-100-A, RSCC Heat Trace 1548-40000, or equal.

E. Splices

Use Tyco Thermal Controls Cat. No. T-100 splice and tee connection kit, RSCC Heat Trace 1548-40000, or equal.

F. Tees

Use Tyco Thermal Controls Cat. No. T-100 splice and tee connection kit, RSCC Heat Trace 1548-40000, or equal.

G. Thermostat Controls

1. Heating circuits shall be operated by thermostat controls.

2. Ambient temperature-sensing thermostats shall be Tyco Thermal Controls Model AMC-1A, RSCC Heat Trace 1660-15909, or equal. Provide a 40-ampere contactor in a NEMA 4X enclosure for multiple 20-ampere circuits, Tyco Thermal Controls Cat. No. E304-40-120 or equal.

H. Signal Light

Connect a signal light to the end of each heating circuit to indicate whether the heat tracer is on or off. The signal light shall be Tyco Thermal Controls Cat. No. E-100-L1-A connection kit, RSCC Heat Trace 1556-41003, or equal.

I. Piping Insulation

Apply 1-inch-thick Type 2 insulation per Section 15084 to heat traced pipes.

J. Warning Signs

Locate "Electric Traced" signs on the outer surface of the piping insulation at 10-foot intervals (each side of pipe) to indicate the presence of electric tracing.

PART 3 - EXECUTION

A. Installation

1. Install heat tracing free of nicks and cuts to its outer jacket.

2. Mount heat tracing parallel to pipe flow. Do not spiral heat tracing strips around the pipe.

3. Secure heat tracers to pipe at 1-foot intervals with a glass cloth tape with silicon pressure-sensitive adhesive. Secure heat tracers to plastic pipe with aluminum tape.

B. Field Testing

Test insulation of each heat trace circuit with a 2,500-volt d-c megger. Minimum acceptable insulation resistance is 20 megohms regardless of length. Record megger readings and submit test report. If insulation resistance is below the acceptable value, locate the faulty section and replace (do not repair). Retest replaced sections.

END OF SECTION

SECTION 15100 MANUAL, CHECK, AND PROCESS VALVES

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of manually operated process valves including gate, knife gate, ball, hose bibbs, fire hydrant, angle, eccentric plug, check, solenoid, and pet cocks.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Identify each valve by tag number to which the catalog data and detail sheets pertain.

3. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.

4. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.

5. Submit six copies of a report verifying that the valve interior linings and exterior coatings have been tested for holidays and lining thickness. Describe test results and repair procedures for each valve. Do not ship valves to project site until the reports have been returned by the Owner's Representative and marked "Resubmittal not required."

6. For eccentric plug valves, show the clear diameter or size of the port. Show the actual area of the port as a percentage of the area as calculated for the nominal valve size.

C. Proof of Design Test for Eccentric Plug Valves (Types 500, 510, 520)

1. The Contractor shall require the valve manufacturer to furnish six certified copies of reports covering the design tests for the eccentric plug valves as described in AWWA C517 and the following. One prototype valve of each size and class of a manufacturer's design shall be tested for leakage at the specified design pressure and hydrostatically tested with twice the specified design pressure. The hydrostatic test shall be performed with the plug in the open position. The leakage test shall be performed with the plug in the closed position. The duration of each test shall be 10 minutes minimum. During the leakage test, there shall be no indication of leakage past the valve plug. Valves specified to have bi-directional seats shall be leak tight in both directions. In the case of flanged valves, the valve body shall be bolted to a flanged test head.

2. No part of the valve or plug shall be permanently deformed by the hydrostatic test. During the hydrostatic test, there shall be no leakage through the metal, the end joints, or the shaft seal.

3. It is the intent that the valve manufacturer provide evidence of the adequacy of each type offered to perform under design pressures within the applicable rating for a sufficient number of test cycles simulating a full service life. The adequacy is to be proven by tests, made on one or more valves selected to represent each basic type of seat design of a size within each applicable group, in a pressure class or classes equal to or greater than that specified. The required number of test cycles appears in the following table:

TEST CYCLES REQUIRED		
Size Group (inches)	**No. of Cycles**	**Minimum Differential Pressure (psig)**
3 to 20	10,000	150
24 to 42	5,000	150

Every test cycle shall consist of applying the specified differential pressure to the plug in the closed position, then opening the plug (which will relieve the pressure) to the wide-open position and then closing the plug.

4. The valve shall be leak tight under the specified pressure differential upon completion of the cycle test without having to stop during the test to repair the valve, modify or reinforce the seat, or install shims or wedges around the seat.

5. The plug shall not be rotated past the center position to jam the plug onto the seat during the hydrostatic test, the leakage test, or the cycle test.

PART 2 - MATERIALS

A. General

1. Valves are identified in the drawings by size and type number. For example, a callout in the drawings of 2V310 refers to 2-inch Type 310 valve in these specifications, which is a 2-inch double union PVC ball valve.

2. In addition, valves are further described by a suffix letter on the type number:

Suffix Letter	Description
L	Limit switches at the fully open and/or fully closed positions
M	Motorized actuator per Section 15119

3. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.

4. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

5. For buried locations, valves with mechanical joint ends may be substituted for the flanged ends specified provided the mechanical joint ends are compatible with the pipe ends.

B. Valve Actuators

1. Provide lever or wrench actuators for exposed valves 6 inches and smaller. For larger valves, provide handwheels.

2. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 6 feet 9 inches above the floor, provide chainwheel and guide actuators.

3. Provide 2-inch AWWA operating nuts for buried and submerged valves. Provide 2-inch AWWA operating nuts with the handwheels for manually actuated valves 12 inches and larger for use with a portable electric valve actuator.

4. Provide enclosed gear actuators on ball and plug valves 6 inches and larger, unless electric valve actuators are shown in the drawings. Gear actuators for valves 12 inches and larger shall be of the worm and gear types. Gear actuators for motorized valves shall be of the worm and gear type, regardless of size.

5. Design gear actuators assuming that the differential pressure across the plug or disc is equal to the test pressure of the connecting piping unless otherwise required in the detailed valve specifications.

6. Gear actuators shall be enclosed, oil lubricated, with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves located above ground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug. Gear actuators for buried or submerged valves shall have 2-inch-square AWWA operating nuts.

7. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

8. Traveling nut and worm and gear actuators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 80 pounds on the handwheel or crank. Provide stop limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input

torque of 300 foot-pounds for operating nuts when operating against the stops.

9. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 20 inches and smaller.

10. Self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B427; or ASTM B84, Alloy C86200), accurately machine cut. Actuators for eccentric and lubricated plug valves may use ductile-iron gears provided the gearing is totally enclosed with spring-loaded rubber lip seals on the shafts. The worm shall be hardened alloy steel (ASTM A322, Grade G41500 or G41400; or ASTM A148, Grade 105-85), with thread ground and polished. Support worm-gear shaft at each end by ball or tapered roller bearings. The reduction gearing shall run in a proper lubricant. The handwheel diameter shall be no more than twice the radius of the gear sector in contact with the worm. Worm-gear actuators shall be Limitorque Model HBC, EIM Series W, or equal.

11. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

12. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

C. Portable Valve Actuator

1. Provide two portable actuators for the project. The actuator shall be suitable for manual operation of valves 24 inches and larger. Actuator shall be electrically powered, 120 volts a-c. Provide 2-inch AWWA socket. Peak torque shall be at least 800 foot-pounds. Provide the following controls:

   a. Two-speed gearbox: low speed/high torque, high speed/low torque.

   b. Overload reset button.

   c. On/off, forward/reverse, and neutral.

   d. Ground fault interrupter with test and reset.

2. Products: E. H. Wachs Company "Pow-R-Drive II" or equal.

a. The two portable actuators included within the project shall be the following two models or approved equals; the E. H. Wachs Company Handheld Valve Exerciser (WAVE) and E. H. Wachs Company RS-2.

D. Cast-Iron Valve Boxes With Debris Caps for Buried Valves

1. Valve boxes shall be two-piece sliding type, cast iron, with extension shafts. Units shall be as manufactured by Bingham/Taylor Foundry, Russco/Sigma, Star Pipe Products, or equal. Extension pipes shall be cast iron.

2. Debris cap shall be comprised of a hollow member having a cylindrical outer surface, a closure for one end, and three resilient contact pads projecting from the outer surface. Stainless steel springs under each contact pad shall hold the debris cap in position against the interior of the extension pipe or valve box. Provide handle to allow the contact pads to be extended and retracted. The cap shall have a flexible skirt providing an outward seal preventing debris from passing the cap. The cap shall withstand, without slipping, a minimum vertical force of 50 pounds when the contact pads are extended against the wall of the extension pipe or valve box. The cap shall be made of molded ABS plastic material. Color of handle shall be indicated by the Owner. The cap shall have retaining prongs to retain a copper locating wire coil. Provide locking mechanism to accept a lock furnished by the Owner. Manufacturer: Bingham/Taylor Foundry, Russco/Sigma, Star Pipe Products, or equal.

3. Coat buried cast-iron pieces per Section 09900, System No. 21 or with fusion-bonded epoxy per Section 09961.

E. Extension Stems for Buried and Submerged Valve Actuators

1. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Where the valve is submerged, provide operating extension stems to bring the operating nut to 6 inches above the high water level surface. Extension stems shall be steel, solid core, and shall be complete with 2-inch-square operating nut. The connections of the extension stems to the operating nuts and to the valves shall withstand without damage a pull of 300 foot-pounds.

2. Extension stem diameters shall be as tabulated below:

Valve Size (inches)	Minimum Extension Stem Diameter (inches)
2	3/4
3, 4	7/8
6	1
8	1-1/8
10, 12	1-1/4
14	1-3/8
16, 18	1-1/2
20, 24, 30, 36	1-3/4
42, 48, 54	2

F. Floor Stands, Extension Stems, and Extension Stem Support Brackets

1. When required by the installations, provide floor stands and extension stems for operation of valves. Floor stands shall be of the nonrising stem, indicating type, complete with steel extension stems, couplings, handwheels, stem guide brackets, and special yoke attachments as required by the valves and recommended and supplied by the stand manufacturer. Floor stands shall be cast-iron base type: Clow, Figure F-5515; Bingham and Taylor; Stockham; or equal. Handwheels shall turn counterclockwise to open the valves.

2. Provide Type 316 stainless steel anchor bolts.

3. Provide Type 316 stainless steel extension stems for valves in exposed service. Provide Type 316 stainless steel stems for valves in submerged service.

4. Provide adjustable stem guide brackets for extension stems. The bracket shall allow valve stems to be set over a range of 2 to 36 inches from walls. Provide bushings drilled to accept up to 2-inch-diameter stems. Base, arm, and clamp shall be Type 316 stainless steel. Coat ductile iron components with fusion-bonded epoxy per Section 09961. Bushing shall be bronze (ASTM B584, Alloy C86400 or C83600). Bolts, nuts, screws, and washers (including wall anchor bolts) shall be Type 316 stainless steel. Provide slots in the bracket to accept 3/4-inch bolts for mounting the bracket to the wall.

Products: Trumbull Industries, Inc., Adjustable Stem Guide or equal.

G. Chainwheels and Guides

Chainwheels and guides shall be Clow Figure F-5680, DeZurik Series W or LWG, Stockham, or equal. Chainwheels and guides shall be galvanized iron or steel. Chains shall extend to within 4 feet of the operating floor. Chains shall be Type 316 stainless steel.

H. Valve Tagging and Identification

Provide identifying valve tags per Section 15075.

I. Bolts and Nuts for Flanged Valves

Bolts and nuts for flanged valves shall be as described in Section 15050.

J. Gaskets for Flanges

Gaskets for flanged end valves shall be as described in Section 15050.

K. Limit Switches for Check Valves

Provide oiltight position limit switches for indication of open position of check valves. Provide single-pole double-throw contacts rated for 3 amperes break, minimum, at 120-volt a-c, 35% power factor. Provide an adjustable mounting bracket to permit the actuation point to be field adjustable at any point of the valve’s travel. Switch to be Square D, Allen-Bradley, or equal.

L. Painting and Coating

1. Coat metal valves located above ground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 09900, System No. 10. Apply the specified prime and intermediate coat at the place of manufacture. Finish coat shall match the color of the adjacent piping. Coat handwheels the same as the valves.

2. Coat buried metal valves at the place of manufacture per Section 09900, System No. 21.

3. Coat submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture per Section 09900, System No. 7.

4. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 09900, System No. 7. Apply lining at the place of manufacture.

5. Coat floor stands per Section 09900, System No. 10.

6. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.

7. Measure the thickness of the valve interior linings per Section 09900. Repair areas having insufficient film thickness per Section 09900.

M. Packing, O-Rings, and Gaskets

Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following nonasbestos materials:

1. Teflon.

2. Kevlar aramid fiber.

3. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.

4. Buna-N (nitrile).

N. Rubber Seats

Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/l in the fluid conveyed.

O. Valves

1. Gate Valves:

   a. Type 100--Aboveground Bronze Gate Valves 3 Inches and Smaller:

Aboveground threaded end gate valves, 1/4 inch through 3 inches, for water and air service shall be rising stem, screwed bonnet, solid wedge disc type, Class 125, having a minimum working pressure of 200 WOG psi at a temperature of 150°F. Ends shall be female threaded, ASME B1.20.1. Materials of construction shall be as follows:

Component	Material	Specification
Body and bonnet	Bronze	ASTM B61 or B62
Disc	Bronze	ASTM B61, B62, or B584 (Alloy C97600)
Stem	Bronze or copper silicon	B99 (Alloy 651), B584 (Alloy C87600), B371 (Alloy C69400)
Seat rings (Classes 200 and 300 only)	Stainless steel	AISI Type 410

Handwheels shall be aluminum, brass, or malleable iron. Packing shall be Teflon or Kevlar aramid fiber. Valves shall be American Flow Control Series 2500, Clow Series F-6100, Mueller Series A2360 or equal.

b. Type 137--Ductile-Iron Resilient Wedge Tapping Gate Valves 4 Inches Through 48 Inches (AWWA C515):

Valves shall comply with AWWA C515 and the following. Valves shall be of the bolted bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum nor more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. Ends shall be flanged, Class 125, ASME B16.1. One end shall have slotted

bolt holes per AWWA C515, paragraph 4.4.1.3.4 to fit tapping machines.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Clow, AVK, American Flow Control, Mueller, Kennedy, or equal.

c. Type 175--Buried Cast-Iron Gate Valves 4 Inches and Larger for Fire Protection Service:

Gate valves of sizes 4 inches through 12 inches for fire protection service shall be UL listed, FM approved, nonrising stem for use with indicator posts, solid wedge disc, bolted bonnet, with indicator post flange. Valves shall be rated for at least 175 psi, nonshock cold water. Ends shall be mechanical joint. Materials of construction shall be as follows:

Component	Material	Specification
Body, bonnet, disc, and indicator post flange	Cast iron	ASTM A126, Class B
Disc bushing, disc ring, backseat bushing, and seat ring	Bronze	ASTM B62 or ASTM B584 (Alloy C83600)
Stem	Copper silicon or brass	ASTM B21 or ASTM B584 or ASTM B763 (Alloys C87600, C99500)

Valves shall be Stockham G-632 or G-634, Nibco F-609, Clow F-6100 or F-6102, or equal.

d. Type 180—Cast-Iron Resilient Wedge Gate Valves 3 Inches Through 20 Inches (AWWA C509):

Valves shall comply with AWWA C509 and the following. Valves shall be of the bolted-bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Provide operating nut for buried valves. Provide handwheel for exposed valves. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum nor more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. End connections for exposed valves shall be flanged. End connections for buried valves shall be mechanical joint or push-on type.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Mueller Series A-2361, American Flow Control Series 2500, Clow Series F-6100, or equal.

Type 185 valves may be substituted for Type 180 valves.

e. Type 185—Ductile-Iron Resilient Wedge Gate Valves 2 Inches Through 36 Inches (AWWA C515):

Valves shall comply with AWWA C515 and the following. Valves shall be of the bolted-bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Provide operating nut for buried valves. Provide handwheel for exposed valves. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain

more than 2% aluminum nor more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. End connections for exposed valves shall be flanged. End connections for buried valves shall be mechanical joint or push-on type.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Clow, AVK, American Flow Control, Mueller, Kennedy, or equal.

2. Knife Gate Valves:

   a. Type 195--Stainless Steel Knife Gate Valves 2 Inches Through 24 Inches:

      Knife gate valves shall be of the solid one-piece cast body design. Minimum working pressure shall be 150 psi. Provide bevel gear actuators for valves 14 inches and larger. Materials of construction shall be as follows:

Component	Material	Specification
Body	Stainless steel	ASTM A743, Grade CF8M
Yoke, superstructure, fasteners, and packing gland	Stainless steel	AISI Type 304 or 316 stainless steel
Gate	Stainless steel	ASTM A240, Type 316
Stem	Stainless steel	ASTM A582, Grade S20300

Handwheel	Cast iron	ASTM A126, Class B
Packing	Flax or acrylic PTFE	--

Valves shall be bonnetless, wafer type with through bolting flange, for installation between two adjacent flanges. Flange holes in the body shall be Class 125, ASME B16.1. Valve leakage shall be in accordance with MSS SP-81. Valves shall have a resilient seat (neoprene or nitrile) for drip-tight shutoff. Valves shall be DeZurik Series KGS, ITT Fabri-Valve Model C67S, or equal.

3. Ball Valves:

a. Type 300--Threaded Bronze Ball Valves 3 Inches and Smaller:

Ball valves, 2 inches and smaller, for air or water service shall have bronze (ASTM B62 or ASTM B584, Alloy C83600 or C84400) body and plug ball retainer. Ball and stem shall be bronze (as specified for the body) or Type 316 stainless steel. Provide chrome-plated ball, if ball is bronze. Valves shall have screwed ends (ASME B1.20.1), nonblowout stems, reinforced Teflon seats, and have plastic-coated lever operators. Valves shall have a pressure rating of at least 600 psi WOG at a temperature of 150°F. Valves shall be Stockham S-206, Apollo 77-100 Series, or equal.

b. Type 305--Flanged Bronze Ball Valves, Class 150, 4 Inches and Smaller:

Ball valves 4 inches and smaller shall have a minimum pressure rating of 200 psi at a temperature of 150°F. Valve body shall be aluminum bronze (ASTM B148, Alloy C95400) or bronze (ASTM B62 or ASTM B584, Alloy C83600). Ball and stem shall be Type 316 stainless steel or bronze (ASTM B21, Alloy C48500). Seat and seals shall be Teflon. Ends shall be flanged, flat faced ASME B16.5, Class 150. Valves shall be Neles-Jamesbury Style 5150, McCanna Series S151-BR, or equal.

c. Type 310--Double Union PVC Ball Valves 3 Inches and Smaller:

Thermoplastic ball valves, 3 inches and smaller, for water and chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F. Body, ball, and stem shall be PVC conforming to ASTM D1784, Type 1, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Valves shall be as manufactured by Chemtrol, Hayward, R & G Sloan, Spears Manufacturing Company, Plast-O-Matic, or equal.

1. Type 314—Double Union CPVC Ball Valves 3 Inches and Smaller:

   CPVC ball valves, 3 inches and smaller, for water and chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F and rated at a pressure of 100 psi at a temperature of 150°F. Body, ball, and stem shall be CPVC conforming to ASTM D1784, Type 4, Grade 1. Seats shall be Teflon. O-ring seals shall be EPDM. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Provide stem extensions when valves are installed in insulated piping. Stem extensions shall be of a length sufficient to bring the bottom of the operating handle above the outside of the insulation; see Section for insulation thickness. Valves shall be as manufactured by Chemtrol, Hayward, R & G Sloan, Spears Manufacturing Company, Plast-O-Matic, IPEX Series VK or VKD, or equal.

d. Type 320--Regular Port Threaded Stainless Steel Ball Valves 2 Inches and Smaller:

   Stainless steel ball valves, 2 inches and smaller, for water service shall be rated at a minimum pressure of 1,500 psi WOG at a temperature of 100°F. Valve body, ball, and stem shall be Type 316 stainless steel, ASTM A276 or A351. Seat and seals shall be reinforced Teflon. Valves shall have lever actuators, plastic coated. Valves shall have screwed ends (ASME B1.20.1) and nonblowout stems. Valves shall be McCanna Figure M402, Worcester Series 48,

Stockham Figure SD 2120-SSMO-R-T, Apollo 76-100 Series, or equal.

4. Globe Valves, Angle Hose Valves, Hose Bibbs, and Fire Hydrants:

   a. Type 400—Bronze Globe Valves 2 Inches and Smaller:

      Globe valves, 2 inches and smaller, shall be all bronze (ASTM B62 or ASTM B584, Alloy C83600) with screwed ends, union bonnet, inside screw, rising stem, and composition or PTFE disc. Valves shall have a pressure rating of at least 300 psi at a temperature of 150°F. Stem shall be bronze: ASTM B371 (Alloy C69400), ASTM B99 (Alloy C65100), or ASTM B584 (Alloy C87600). Valves shall be Crane No. 7TF, Walworth Figure 3095, Stockham B-22T, or equal.

   b. Type 410--Bronze Angle Hose Valves:

      Angle-type hose valves of sizes 1-1/2 inches and 2-1/2 inches shall be brass or bronze (ASTM B62 or ASTM B584, Alloy C83600) body with rising or nonrising stem, composition disc, and bronze or malleable iron handwheel. Stem shall be bronze, ASTM B62, ASTM B584 (Alloy C83600), or ASTM B198 (Alloy C87600). Valves shall have a cold-water service pressure rating of at least 150 psi. Provide cap and chain with valve. Threads on the valve outlet shall be American National Standard fire hose coupling screw thread. Valves shall be Nibco T-301-HC, Powell Figure 151 with Figure 527 nipple adapter, Crane 17TF with hose nipple adapter, or equal.

   c. Type 420--Bronze Hose Bibbs:

      Hose bibbs of size 1/2 inch, 3/4 inch, and 1 inch shall be all bronze (ASTM B62 or ASTM B584, Alloy C83600) with rising or nonrising stem, composition disc, bronze or malleable iron handwheel, and bronze stem (ASTM B99, Alloy C65100; ASTM B371, Alloy C69400; or ASTM B584, Alloy C87600). Packing shall be Teflon or graphite. Valves shall have a pressure rating of at least 125 psi for cold-water service. Threads on valve outlet shall be American National Standard fire hose coupling screw thread (ASME B1.20.7). Provide atmospheric vacuum breaker conforming to the state of Florida health department on each hose bibb. Valves shall be Jenkins Figure

112, 113, or 372, Nibco Figure T-113-HC, Powell Figure 503H, or equal.

d. Type 490--Wet Barrel Fire Hydrants (AWWA C503):

See Section 15109.

5. Plug Valves:

a. Plug and Seating Design for Eccentric Plug Valves (Types 510 and 520):

Eccentric plug valves shall comply with AWWA C517 and the following. Provide a rectangular or circular plug design, with an associated rectangular or round seat. Provide bidirectional seating design. The valve shall seat with the rated pressure both upstream and downstream of the closed plug. Provide geared actuators sized for bidirectional operation.

b. For Types 510 and 520 eccentric plug valves, the metallic portion of the plug shall be one-piece design and shall be without external reinforcing ribs which result in there being a space between the rib and the main body of the plug through which water can pass. Valves shall be repackable without any disassembly of valve or actuator. The valve shall be capable of being repacked while under the design pressure in the open position. Nowhere in the valve or actuators shall the valve shaft be exposed to iron on iron contact. Sleeve bearings shall be stainless steel in valve sizes 20 inches and smaller and bronze or stainless steel in valve sizes 24 inches and larger. Provide enclosed worm-gear actuators for valves 6 inches and larger.

c. Rubber compounds shall have less than 2% volume increase when tested in accordance with ASTM D471 after being immersed in distilled water at a temperature of 73.4°F ±2°F for 70 hours.

d. Type 510--Eccentric Plug Valves 4 Inches Through 12 Inches:

Eccentric plug valves, 4 inches through 12 inches, shall be nonlubricated type. Minimum pressure rating shall be 175 psi. Bodies shall be cast iron per ASTM A126, Class B. Ends shall be flanged, Class 125 per ASME B16.1. Plugs shall be cast iron (ASTM A126, Class B), or ductile iron (ASTM A536, Grade 65-45-

12) with neoprene facing. Design plugs to seat over a pressure range of 0 to 5 psi. Valve body seats shall be Type 304 or 316 stainless steel or have a raised welded-in overlay at least 1/8-inch thick of not less than 90% nickel. Body capscrews and bolts and nuts shall be Type 316 stainless steel. Packing shall be butadiene-filled Teflon. Alternatively, U-cup seals may be provided. Provide 100% port area. Valves shall be Valves shall be DeZurik Series –PEC, Clow F-5412/5413, M & H 1820 or equal.

e. Type 520--Eccentric Plug Valves 14 Inches and larger:

Eccentric plug valves, 14 inches and larger, shall be nonlubricated type. Minimum pressure rating shall be 150 psi. Bodies shall be cast iron per ASTM A126, Class B. Ends shall be flanged, Class 125 per ASME B16.1. Plugs shall be cast iron (ASTM A126, Class B), or ductile iron (ASTM A536, Grade 65-45-12) with neoprene facing. Design plugs to seat over a pressure range of 0 to 5 psi. Valve body seats shall be Type 304 or 316 stainless steel or have a raised welded-in overlay at least 1/8-inch thick of not less than 90% nickel. Plug shall be of the one-piece design. Body capscrews and bolts and nuts shall be Type 316 stainless steel. Packing shall be butadiene-filled Teflon. Alternatively, U-cup seals may be provided. Provide 100% port area. Valves shall be Valves shall be DeZurik Series –PEC, Clow F-5412/5413, M & H 1820 or equal.

6. Check Valves:

a. Type 720--Cast-Iron Swing Check Valves 3 Inches and Larger, Class 125:

Swing check valves, 3 inches and larger, shall be iron body, bronze mounted with the following materials of construction:

Description	Material	Specification
Disc or clapper seat ring and valve body seat ring	Bronze or brass	ASTM B62 or B584 (Alloy C84400 or C87600)

Description	Material	Specification
Body and cap (bonnet)	Cast iron	ASTM A126, Class B
Disc and hinge or arm (valves 4 inches and smaller)	Bronze	ASTM B62 or ASTM B584 (Alloy C84400)
Disc and hinge or arm (valves larger than 4 inches)	Cast iron or bronze	ASTM A126, Class B; ASTM B62.
Hinge pin	Stainless steel	Type 303, 304, or 410 stainless
Cover bolts and nuts	Stainless steel	ASTM A193, Grade B8M; ASTM A194, Grade 8M
Internal fasteners and accessories	Bronze or Type 304 or 316 stainless steel	

Bronze or brass components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

Ends shall be flanged, Class 125, ASME B16.1. Minimum valve working pressure shall be 150 psi. Provide check valves with outside lever and spring.

The shop drawing submittal shall include a detail showing how the hinge pin extends through the valve body. Show packing gland, hinge pin gland, cap, and other pieces utilized.

Valves shall be Milliken 800, Kennedy 106, M&H Style 159, Mueller Series 2600, Clow 106, Empire 220, American Flow Control Series 600, Val-Matic Series 9800, ARI NR-040, DeZurik, or acceptable equal.

b. Type 730—PVC Ball Check Valves, 3 Inches and Smaller:

PVC check valves, 3 inches and smaller, shall be constructed of PVC per ASTM D1784, Type I, Grade 1. Ends shall be double union, socket welded. Seats and seals shall be Viton. Valve shall have a pressure rating of 150 psi at a temperature of 73°F.

7. Solenoid Valves:

a. Design and construct solenoid valves such that they can be used in both horizontal and vertical piping.

b. Type 900—-Pilot-Operated, Slow Closing, Solenoid Valves 2-1/2 Inches and Smaller:

Solenoid valves of sizes 3/8 inch through 2-1/2 inches for water and air service shall have forged brass (Alloy C23000) bodies with Teflon main seats. Solenoid enclosures shall be NEMA 7. Valve actuators shall be 120-volt a-c. Valves shall have a maximum operating pressure and a maximum differential pressure of 150 psi. Solenoid valves shall be energized to open. Valves shall be provided with snubber to slow disc closing speed to protect system against water hammer damage. Valves shall be ASCO "Redhat" Model 8221, Parker Model A66, A67, A68, or equal.

Solenoid valves shall be brass (Alloy C23000) body with the following materials of construction:

Description	Material
Seals	NBR
Body	Brass (Alloy C23000)
Disc	Buna-N
Core Tube	Type 304 or 305 Stainless Steel
Core and Plugnut	Type 430F or 430FR Stainless Steel
Springs	Type 301 or 302 Stainless Steel
Piston	Stainless Steel or Brass
Shading Coil	Copper

8. Spare Parts:

1. Provide five (5) T-handle wrenches for 2-inch nuts, as follows:

a. Two (2) 4-foot T-handle wrenches

b. Two (2) 5-foot T-handle wrenches

c. One (1) 6-foot T-handle wrench

2. Provide two (2) adjustable 4-foot to 10-foot valve wrenches for 2-inch nuts.

PART 3 - EXECUTION

A. Joints

1. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

2. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

3. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).

4. Install grooved-end couplings for valves in accordance with Section 15050.

B. Installing Exposed Valves

1. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.

2. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

C. Installing Buried Valves

1. Connect the valve, coat the flanges, apply tape wrapping or polyethylene encasement, and place and compact the backfill to the height of the valve stem.

2. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.

3. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.

4. In streets without concrete curbs and in open areas, install the valve box as for a paved area with concrete curb except include a marker post. Cut the marker post from 4-inch by 4-inch dense structural grade Douglas fir No. 2 surfaced on four sides to a length of 5 feet. Chamfer the top. Set the post in concrete, 2 feet into the ground, away from traffic, and to the side of the pipeline. Coat with a seal and finish coat of white alkyd exterior paint. On the side facing the valve, letter in black the word "VALVE" and the distance in feet from the marker post to the valve box cap.

5. Install debris cap as close as possible under the cast-iron cover without interfering with the cover operation. Trim flexible skirt to provide a smooth contact with the interior or the extension pipe. Install Owner-furnished locks.

D. Field Coating Buried Valves

1. Coat flanges of buried valves and the flanges of the adjacent piping, and the bolts and nuts of flanges and mechanical joints, per Section 09900, System No. 24.

E. Installing Eccentric Plug Valves

1. Install such that the rotation of the plug is about a horizontal axis.

2. Install such that the plug stores in the top when the valve is open.

3. Orient the valve such that the seat is opposite the high-pressure side.

F. Installing Extension Stem Guide Brackets

Install at 6- to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

G. Mounting Gear Actuators

The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment.

H. Field Installation of Gear Actuator

Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

I. Valve Leakage Testing

Test both sides of valves for leakage at the same time that the connecting pipelines are tested. See Section 15144 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

J. Valve Field Testing

1. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

2. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

END OF SECTION

SECTION 15108 AIR-RELEASE VALVES

PART 1 - GENERAL

A. Description

This section includes materials and installation of air-release valves for sewage service.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog data and detail drawings showing all valve parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings. Identify each valve by tag number to which the catalog data and detail sheets pertain.

PART 2 - MATERIALS

A. Valve Identification

Valves are identified in the drawings by size and type number.

B. Valve Tagging and Identification

Provide identifying valve tags per Section 15075.

C. Bolts, Nuts, and Gaskets for Flanged Valves

See Section 15050 and specification for the pipe to which the valve is attached.

D. Valve Design and Operation

1. The air-release and vacuum-relief valve shall be of a single chamber design with solid cylindrical HDPE control floats housed in a tubular stainless steel body with epoxy powder-coated cast iron, steel, or stainless steel ends secured by means of stainless steel tie rods or by a flanged connection. The valve shall have an integral orifice mechanism that shall operate automatically to limit transient pressure rise or shock induced by closure to twice valve rated working

pressure. Provide a double (small and large) orifice design.

2. The intake orifice area shall be equal to the nominal size of the valve. The large orifice sealing shall be affected by the flat face of the control float seating against a nitrile rubber O-ring housed in dovetail groove circumferentially surrounding the orifice. Discharge of pressurized air shall be controlled by the seating and unseating of a small orifice nozzle on a natural rubber seal affixed into the control float. The nozzle shall have a flat seating land surrounding the orifice.

3. Provide a 1/4-inch NPT test/bleed cock.

4. Prior to the ingress of liquid into the valve chamber, as when the pipeline is being filled, valves shall vent through the large orifice. At higher water approach velocities, the valve shall automatically discharge air through the orifice mechanism and reduce water approach velocity.

5. Valve shall not exhibit leaks or weeping of liquid past the large orifice seal at operating pressures of 7 psi to twice rated working pressure.

6. Valves shall respond to the presence of air by discharging it through the small orifice at any pressures within the specified design range and shall remain leak tight in the absence of air.

7. Valves shall react immediately to pipeline drainage or water column separation by the full opening of the large orifice so as to allow unobstructed air intake at the lowest possible negative internal pipeline pressure.

E. Materials of Construction

1. Materials of construction for air-release valves for sewage service shall be as follows:

Item	Material	Specification
Top flange, lower flange, screen mesh, bolts, nuts, connecting screws, float screw, and assembly screws	Stainless steel	AISI Type 304
Top cover	ABS plastic	–
Barrel	Stainless steel	AISI Type 304L
Floats	HDPE	–
Air-release nozzle or orifice mechanism	Stainless steel	AISI Type 304
Nozzle seal and seat	Natural rubber	–
Nozzle seal retaining plate	Stainless steel	AISI Type 304
Tie rod assembly and support fasteners	Stainless steel	AISI Type 304
Float O-ring seals	Nitrile rubber	–

F. Seating

Valves shall seat drip tight at a pressure of 1 psi.

G. Valve End Connections

1. Valves 2 inches and smaller shall have threaded ends. Valves 3 inches and larger shall have flanged ends.

2. Flanges for Class 150 valves shall comply with ASME B16.1, Class 125. Flanges for Class 300 valves shall comply with ASME B16.1, Class 250.

3. Threaded ends shall comply with ASME B1.20.1.

H. Valves

1. Type 1225--Sewage Air-Release Valves, 2 Through 4 Inches, Class 150: After entraining air escapes through the orifice, the orifice shall be closed by a needle on a compound lever mechanism or by a float which buoys to close the orifice by seating against the top cover to prevent the escape of sewage. The orifice shall remain closed until more gas accumulates and the cycle automatically repeats. Valve shall seat to prevent sewage from leaking through the valve at any pressure. Valves shall have an operating pressure of at least 175

psi. Venting capacity shall be at least 100 scfm. Valves shall be Vent-O-Mat Series RGX, Model 050RGX1621.

PART 3 - EXECUTION

A. Lining and Coating

1. Coat cast-iron valves the same as the adjacent piping. If the adjacent piping is not coated, then coat per Section 09900, System No. 10. Apply the specified prime and intermediate coats at the place of manufacture. Apply finish coats in field. Finish coat shall match the color of the adjacent piping.

2. Coat interior surfaces of cast-iron valves at the place of manufacture per Section 09900, System No. 7. Do not coat seating areas and plastic, bronze, stainless steel, or other high alloy parts.

B. Installation

1. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

2. Clean threaded joints by wire brushing or swabbing. Apply Teflon® joint compound or Teflon® tape to pipe threads before installing threaded valves. Joints shall be watertight.

3. Do not use duct tape and plastic for covering the ends of pipe flanges. Use a solid metal cover with rubber gasket to cover flange openings during installation. These metal covers shall remain in place until the piping is connected to the valves.

4. Do not spring flanges of connecting piping into position. Separately work connecting piping systems into position to bring the piping flanges into alignment with the matching valve flanges. Do not move valves to achieve piping alignment. Do not use electrical heating stress relieving to achieve piping alignment.

5. Line up pipe flange bolt holes with valve nozzle bolt holes within 1/16 inch maximum offset from the center of the bolt hole to permit insertion of bolts without applying any external force to the piping.

6. Flange face separation shall be within the gasket spacing ±1/16 inch. Use only one gasket per flanged connection.

C. Valve Pressure Testing

Test valves at the same time that the connecting pipelines are pressure tested. See Section 15144 for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure.

END OF SECTION

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SECTION 15109 FIRE HYDRANTS

PART 1 - GENERAL

A. Description

This section includes materials, testing, and installation of wet barrel fire hydrants.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit certificate of compliance with AWWA C502.

3. Submit manufacturer's catalog data and descriptive literature. Show materials of construction. Submit dimensional drawings. Show coatings.

PART 2 - MATERIALS

A. Fire Hydrant Selection

Provide fire hydrants of the wet barrel design.

B. Wet Barrel Fire Hydrant Design

1. Fire hydrants shall comply with AWWA C503. Provide hydrant head, barrel and bury section. Barrel connecting flange shall be drilled to the dimensions of ASME B16.1, Class 125, 6-inch size, flat face.

2. Head and barrel shall be ductile iron per AWWA C503.

3. Provide two 2-1/2-inch and one 4-1/2-inch nozzles. Threads on nozzles shall conform to Orange County Fire Department Threads. Provide cap with chain on each nozzle.

4. Bury section shall be ductile iron per Section 15240.

5. Inlet Connection of Bury: mechanical joint or ductile iron push-on with rubber gaskets.

6. Provide a double-grooved break-off riser and check valve. The valve flapper shall be bronze and be housed in a recess out of the waterway.

C. Bolts and Nuts for Flanges (Wet Barrel Hydrants)

Bolts and nuts connecting the top section to the bury section shall be steel, ASTM A307, Grade B, per AWWA C503. Provide a washer for each nut. Washers shall be of the same material as the nuts.

D. Wrenches

Provide one wrench, per hydrant supplied, in order to operate the hydrants in the project.

PART 3 - EXECUTION

A. Painting and Coating

1. Coat hydrant top section and the exposed portion of the bury section per Section 09900, System No. 21. Apply prime coat at factory. Color of finish coat shall be as specified by the Owner. Apply finish coat in field.

2. Coat buried ductile iron per Section 15240.

3. If cement-mortar coated bury sections are used, hold back the mortar coating so it does not extend more than 2 inches above grade.

B. Factory Testing

Test per AWWA C502, Section 5.

C. Installation

1. Install with the face of the bottom flange of the barrel 4 to 6 inches above the adjacent ground or paving.

2. Install hydrants so that the distance from the curb face to a hydrant outlet is no less than 2 feet and no greater than 6 feet.

3. Install per details in the drawings.

END OF SECTION

SECTION 15119 ELECTRIC MOTOR ACTUATORS FOR VALVES AND GATES

PART 1 - GENERAL

A. Description

This section includes materials and installation of electric motor actuators for valves and gates.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog data showing motor actuator parts and materials of construction, referenced by AISI, ASTM, SAE, or CDA specification and grade. Show motor actuator dimensions and weights. Show coatings.

3. Show the maximum torque required to open and close each motor-actuated valve.

4. Submit certified factory performance test records.

5. Submit motor data including nameplate data, insulation type, duty rating, and torque output at duty rating.

6. Submit electrical schematic drawings and wiring diagrams showing physical locations of components.

C. Manufacturer's Services

Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:

1. One (1) labor day per six (6) electric motorized actuators installed to check the installation and advise during start-up, testing, and adjustment of the equipment.

2. Two (2) labor days (one (1) day for each shift) to instruct the County's personnel in the operation and maintenance of the equipment. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

PART 2 - MATERIALS

A. Manufacturers

1. Electric motor actuators with torque output requirements of 750 ft-lbs and less for butterfly valves and eccentric plug valves shall be quarter-turn type and shall be Limitorque “QX” Series or Rotork “IQT” Series.

2. Other electric motor actuators for open-close service shall be multi-turn type and shall be Limitorque “MX” Series or Rotork “IQ” Series.

3. Intelligent electric motor actuators for modulating service shall be Limitorque “MX” Series or Rotork “IQ” Series.

4. Electric motor actuators for explosion proof service shall be Limitorque “MX” Series or Rotork “IQ” Series.

5. All actuators on the project shall be of one manufacturer.

6. All actuators on the project shall be compatible with Profibus DP communications.

B. Actuator Identification

1. Motorized valves are identified in the drawings by size, type number, and suffix letter "M." For example, a callout in the drawings of 10" V-510M refers to Type 510 valve in Section 15100, which is an eccentric plug valve with an electric motor actuator.

2. Motor actuators shall have the name of the manufacturer cast or molded onto the actuator body or shown on a permanently attached plate in raised letters.

C. Actuator Tagging

Provide identifying tags for electric motor-actuated valves per Section 15075. Show valve actuator tag number, name or designation as shown in the drawings, and valve size. Attach tags to actuators by means of stainless steel wire.

D. Motors for Electric Actuators

1. Motors shall be 480 volt, 3 phase and specifically designed for high torque, low inertia duty. Motors for on/off, open/close actuators shall be designed and rated

for 15-minute duty or 60 starts per hour at 104°F. Motors and starters for modulating actuators shall be designed for 30-minute duty or 600 starts per hour at 104°F.

2. Output capacity shall be sufficient to open or close the valve against the maximum differential pressure when the voltage is 10% above or below normal at the specified service conditions. Motors shall have Class F insulation. Provide motor with torque output (at duty rating) that exceeds the requirements of paragraph E below including safety factor.

3. Provide an electrical and mechanical disconnection of the motor without draining the lubricant from the actuator gearcase.

E. Actuator Torque Requirements

1. Actuators being installed on existing valves shall include the manufacturer's inspection, field testing and evaluation of the existing valve in order to apply the applicable torque requirements in order to properly actuate the existing valves.

2. The rated output torque of the motor actuator shall be at least 1.5 times the maximum torque required to open or close the valve at any position including seating and unseating conditions when subjected to the most severe operating condition including any mechanical friction and/or other restrictive conditions that are inherent in the valve assembly. Do not include hammer-blow effect in sizing the actuator to comply with this torque requirement. Coordinate with the valve manufacturer to assure that the motor actuator stall torque output does not exceed the torque limits of the valve operating stem or shaft.

3. Maximum torque shall include seating or unseating torque, bearing torque, dynamic torque, and hydrostatic torque. Assume that the differential pressure across the valve is equal to the pressure or head rating of the valve.

4. Assume a maximum pipeline fluid velocity of 16 fps with the valve fully open, unless a higher velocity is specified in the detailed valve specification.

F. Design of Electric Motor Actuators

1. Actuators shall comply with AWWA C542, except as modified herein. Output capacity of motors shall be sufficient to open or close the valve against the maximum differential pressure when the voltage is 10% above or below normal at the specified service conditions. Provide motor with torque output (at duty rating) that exceeds the requirements of the following paragraphs including safety factor.

2. Provide a reversing starter, three overloads (one in each ungrounded leg) or two motor thermal cutouts, 120-volt control power transformer, local-off-remote selector switch, stop-open-close push buttons, and open and closed indicator lights. Provide magnetic starters in actuators for open/close operation and for modulating operation. Provide dry contact for remote indication of the actuator mode of operation. The contact shall be closed when the local-off-remote selector switch is in the remote position and the internal control power exists.

3. Provide a separate (remote) 316 Stainless Steel NEMA 4X (unless otherwise noted) enclosure with local/remote selector switch, stop-open-close push buttons, and open and closed indicator lights for motor actuators over 6 feet 6 inches above floor or deck in lieu of integral controls.

4. Do not use external conduit for wiring any components within the actuator.

5. Gear actuators shall be totally enclosed and factory-grease packed or oil-bath lubricated. The power gearing shall consist of helical gears of heat-treated steel. Worm gears shall be alloy bronze accurately cut with a hobbing machine. Worm shall be hardened steel alloy. Design gears for 24-hour continuous service with an AGMA rating of 1.50.

6. Position switches shall be adjustable and capable of actuation at any point between fully opened and fully closed positions. The position switches shall operate while the actuator is either in manual or in motor operation. Provide motor actuators with position switches capable of being separately used to provide remote indication of end of travel in each direction and to stop motion at the end of travel in each direction.

7. Provide two individually adjustable torque switches to protect the valve and motor against overload in the opening and closing directions. To prevent hammering, the torque switch shall not reclose until the valve is made to travel in the opposite direction.

8. Provide a manually operated handwheel that shall not rotate during electrical operation. In the event electrical power is interrupted, handwheel operation shall be activated by a hand lever attached to the mechanism. While the valve is being operated manually, the motor shall not rotate. Upon restoration of electrical power, the handwheel shall automatically disengage. Design the handwheel diameter such that hand operation will not damage the valve.

9. The position switch and torque switch contacts shall be capable of interrupting at least 0.2-ampere inductive load at 125-volt dc or 6-ampere inductive load at 120-volt ac.

10. Provide a lost motion device for open/close operation to permit the motor to reach full speed before the load is applied. Provide lost motion action for manual operation also. Do not provide lost motion device for modulating applications.

11. "Latching" shall be provided to inhibit high torque during unseating or starting in mid-travel against high inertia loads. The actuator electrical diagram shall be identical, regardless of whether the valve is to operate on torque or position limit. Provide the actuator with means to non-intrusively calibrate torque or position and interrogate the status and performance of the actuator.

12. Motor shall de-energize in the event of a stall when attempting to unseat a jammed valve.

13. Provide a time delay to prevent instant reversal of the actuator motor.

14. Provide terminal connections for external remote controls fed from an internal 24-volt or 120-volt supply.

15. Provide two separate 3/4-inch conduit connections for control and power wiring.

G. Local Actuator Control

1. Integral to the actuator shall be local controls for Open, Close, and Stop, and a local/remote selector Switch:

   a. Local Control Only

   b. Off (No Electrical Operation)

   c. Remote Control plus Local Stop Only.

2. Provide a separate NEMA 4X enclosure with local/remote selector switch, stop-open-close push buttons, and open and closed indicator lights for motor actuators over 6'-6" above or below the floor or deck in lieu of integral controls. Mount in an accessible location closest to the valve.

3. All the necessary wiring, indication relays and terminals shall be provided in the actuator to accommodate the remote mounted push button control functions. Provide terminal connections for external remote controls fed from an internal 120-volt AC supply.

4. The following Control, Status and Alarm indication shall be available locally at the actuator:

Controls:	**Status:**	**Alarms:**
1. Open/Stop/Close	1. Motor Running Open Direction	1. Communications Failure
2. Desired Valve Position Control	2. Motor Running Closed Direction	2. Actuator Alarm
	3. Fully Open	3. Valve Alarm
	4. Fully Closed	4. Battery Low Alarm, if required
	5. Percentage Open	

5. The actuator must provide a local display of the position of the valve, even when the power supply is not present. The display shall be able to be rotated in 90 degree increments so as to provide easy viewing regardless of mounting position.

6. The actuator shall include a digital position indicator with a display from fully open to fully closed in 1% increments with +/- ½% accuracy. Red, green, and yellow

lights corresponding to Open, Closed, and Intermediate positions shall be included on the actuator. The digital display shall be maintained even when the power to the actuator is isolated.

7. The local display should be large enough to be viewed from a distance of six feet (6') when the actuator is powered up.

8. Provide a diagnostic module, which will store and enable download of historical actuator data to permit analysis of changes in actuator or valve performance. A software tool for a PDA or laptop shall be provided to allow configuration and diagnostic information to be reviewed, analyzed and reconfigured.

9. Diagnostic status screens must be provided to show multiple functions. Emergency Shut Down shall be selectable; Last-position, Full Open, Full Closed.

H. Actuator Communication Board

1. General: Communication board shall support Profibus DP communication or hardwired analog and discrete signals, as required between the electric-motor valve actuator and the protocol gateway.

2. Profibus DP:

   a. The communication board shall support Profibus DP data transmission with the plant SCADA system.

   b. The communication boards shall support assigning individual addresses, unique to the Profibus DP network.

   c. The communication board shall be powered by the actuator assembly. No external power source shall be required.

   d. The communication board shall supply the following for transmission to the host system(s)

      (1) Status: Open, Closed, Moving, Stopped mid travel, valve position.

      (2) Alarms: Local Control, High Temperature, Valve Obstructed, and Valve Jammed.

e. The communication board shall accept and act upon the following commands transmitted by the host system(s) via the protocol gateway: Open, Close, Stop mid travel, Emergency Shut Down.

f. Features:

(1) Communication boards shall be plug-in type, easily installed in the electric-motor valve actuator housing. Externally-mounted communication devices will not be accepted.

3. Hardwired

a. Capabilities shall be provided to position the valve (or gate) locally via the Local/Off/Remote selector switch and Open/Stop/Close push buttons.

b. For on/off service, when in remote, the actuator shall accept one remote signal to open the valve or gate and a second remote signal to close the valve or gate.

c. For modulating service, when in remote the actuator shall accept a 4-20mADC position control signal, and shall position the valve 0-90 degrees or gate 0-100% of travel in proportion to the control signal.

d. Valve position shall be sensed by an 18-bit, optical, absolute position encoder with redundant position sensing circuits designed for Built-In-Self-Test [BIST]. Each of the position sensing circuits shall be redundant permitting up to 50% fault tolerance before the position is incorrectly reported. The BIST feature shall discern which failures signal a warning only and which require a warning plus safe shutdown of the actuator. Open and closed positions shall be stored in permanent, nonvolatile memory. The encoder shall measure valve position at all times, including both motor and handwheel operation and with or without power present. The absolute encoder will be capable of resolving ±7 degrees of output shaft position over 10,000 output drive rotations.

e. Discrete outputs to SCADA shall be provided for all limit and torque switches, and for Local/Off/Remote switch in Remote position, as required by the Drawings.

I. Wiring and Terminals

1. Internal wiring shall be tropical grade insulated stranded cable of appropriate size for the control and three-phase power. Each wire shall be clearly identified at each end. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

2. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The terminal compartment of the actuator shall be provided with a minimum of four threaded cable entries.

3. Control logic circuit boards and relay boards must be mounted on plastic mounts to comply with double insulated standards.

4. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

   a. Serial Number

   b. External Voltage Values

   c. Wiring Diagram Number

   d. Terminal Layout

   This must be suitable for the contractor to inscribe cable core identification beside terminal numbers.

J. NFPA Hazardous Area Classification:

1. Reference the Construction Drawings for the respective NFPA Hazardous Area Classifications where the new electric motor actuators are identified.

   The General Contractor and Actuator Manufacturer shall be responsible for providing the Actuators, Local Actuator Control Panels and other respective appurtenances in compliance with the requirements to meet the NFPA Hazardous Area Classification criteria designed within the Drawings.

PART 3 - EXECUTION

A. Service Conditions

Valve Tag	Application	Fluid	Open/Close or Modulating	Separate (Remote) Control Station Required?	Fail Position on LOS	Profibus Required?
650-DG-1	Centrifuge Discharge Diverter Gate	Dewatered Sludge	Open/Close	Yes	Open	No
650-DG-2	Centrifuge Discharge Diverter Gate	Dewatered Sludge	Open/Close	Yes	Open	No
650-DG-3	Centrifuge Discharge Diverter Gate	Dewatered Sludge	Open/Close	Yes	Open	No
650-DG-4	Centrifuge Discharge Diverter Gate	Dewatered Sludge	Open/Close	Yes	Open	No
650-KG-1	Truck Loading Distribution Valve	Dewatered Sludge	Open/Close	Yes	Open	No
650-KG-2	Truck Loading Distribution Valve	Dewatered Sludge	Open/Close	Yes	Open	No
650-KG-3	Truck Loading Distribution Valve	Dewatered Sludge	Open/Close	Yes	Open	No
650-KG-4	Truck Loading Distribution Valve	Dewatered Sludge	Open/Close	Yes	Open	No
650-KG-5	Truck Loading Distribution Valve	Dewatered Sludge	Open/Close	Yes	Open	No
650-KG-6	Truck Loading Distribution Valve	Dewatered Sludge	Open/Close	Yes	Open	No

B. Factory Performance Testing of Motor Actuator

Test each actuator prior to shipment in accordance with C542, Section 5.3. The application torque shall be maximum torque required to open or close the valve at position including seating and unseating conditions.

C. Storage and Temporary Installation Before Start-Up

If actuators are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the

manufacturer's recommended procedures for extended storage. Provide temporary covers over the actuator electrical components. Exercise each actuator from its fully open to fully closed position at least once every seven days. Inspect electrical contacts before start-up.

D. Floor Stands and Extension Stems

Where shown in the drawings, mount the electric motor actuators on floor stands with extension stems as specified in Section 15100.

E. Attaching Electric Actuators

The valve manufacturer shall mount the electric motor actuator and accessories on each valve and stroke the valve prior to shipment. Adjust limit switch positions and torque switches.

F. Painting and Coating

Provide factory applied powder coating for electric motor actuators. The coating system shall be suitable for an ASTM B117 salt spray test for a minimum of 1,500 hours.

G. Field Installation

Install the valve and actuator as indicated in the drawings in accordance with the manufacturer's instructions. Keep units dry, closed, and sealed to prevent internal moisture damage during construction. Provide additional hangers and supports for actuators which are not mounted vertically over the valve or which may impose an eccentric load on the piping system.

H. Attaching Electric Actuators – Diverter Gates

The diverter gate manufacturer shall mount the electric motor actuator and accessories on each diverter gate and stroke the diverter gate prior to shipment. Adjust limit switch positions and torque switches.

I. Field Testing of Motor Actuators

1. Test motor actuators as installed by measuring the current drawn (in amperes) by each motor for unseating, seating, and running conditions. The measured current shall not exceed the current measurement recorded during the factory performance test.

2. If the measured current drawn exceeds the above value, provide a larger motor or gear drive or adjust the actuator so that the measured amperage does not exceed the value.

3. Assure that limit switches are placed at their correct settings. Open and close valves twice and assure that limit switches function.

J. Warranty

The equipment shall be warranted for three (3) years commencing from date of substantial completion of the respective unit process in which the actuators are installed.

K. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

L. 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.

END OF SECTION

SECTION 15121 MISCELLANEOUS PIPE FITTINGS AND ACCESSORIES

PART 1 - GENERAL

A. Description

This section includes materials and installation of flange insulation kits and quick-connect couplings.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit manufacturer's catalog data and descriptive literature showing dimensions and materials of construction by ASTM reference and grade. Show coatings.

PART 2 - MATERIALS

A. Flange Insulation Kits

See Section 15050.

B. Insulating Unions

See Section 15050.

C. Metallic Quick-Connect Couplings

Type 2: Quick-connect couplings shall be male adapter/ASME B16.1 Class 125 flange. Bodies shall be Type 316 stainless steel. Provide quick- connect plug or cap for each coupling. Couplings shall be Ever-Tite Model FLA, CIVACON Model 633-LAS, or equal.

D. Nonmetallic Quick-Connect Couplings

Type 6A: Quick-connect couplers shall be female coupler/female thread type with locking handles. Provide dust plug and security chain with each coupler. Bodies shall be glass fiber reinforced polypropylene. Locking handles shall be Type 302 or 304 stainless steel. Gasket shall be Viton. Couplers shall be Murray Equipment Inc. 663D, Pacific Mechanical 561 Series, or equal.

PART 3 - EXECUTION

A. Installing Quick-Connect Couplings

Attach to piping per the relevant piping specification.

END OF SECTION

SECTION 15122 FLEXIBLE PIPE COUPLINGS AND EXPANSION JOINTS

PART 1 - GENERAL

A. Description

This section includes materials and installation of flexible gasketed sleeve-type compression pipe couplings for ductile-iron pipe; flexible expansion joints; expansion loops; and couplings for connecting different pipe materials.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following;

2. Submit manufacturer's catalog data on flexible pipe couplings and expansion joints. Show manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings and joints are used. Show coatings.

3. Submit manufacturer's recommended torques to which the coupling bolts shall be tightened for the flexible gasketed sleeve-type compression pipe couplings.

4. Show materials of construction by ASTM reference and grade. Show dimensions.

5. Show number, size, and material of construction of tie rods and lugs for each thrust harness on the project.

PART 2 - MATERIALS

A. Coupling System Design and Component Unit Responsibility

The coupling manufacturer shall furnish the gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings of all types and shall design these components as an integral system. Design the gaskets for the coupling and appropriately size to provide a watertight seal at the design pressure and temperature. Ship gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings with the pipe coupling and clearly label indicating the origin of the material, including place and date of manufacture. Package the manufacturer's printed installation instructions with each pipe coupling.

B. Ductile-Iron Flexible Pipe Couplings

1. Couplings shall have center sleeves and end rings made of ductile iron conforming to AWWA C219, Section 4.

2. Sleeve bolts in exposed service shall be Type 304 stainless steel per AWWA C219, Section 4. Sleeve bolts in buried or submerged service shall be Type 316 stainless steel per AWWA C219, Section 4.

3. Couplings in air service shall have Viton gaskets rated to 250 degrees F.

C. Joint Harnesses

1. Tie bolts or studs shall be as shown in the following table. Bolt or stud material shall be Type 304 stainless steel conforming to ASTM A193, Grade B8. Nuts shall be Type 304 stainless steel conforming to ASTM A194, Grade B8. Lug material shall be Type 304 stainless steel conforming to ASTM A 240 Type 304. Lug dimensions for steel pipe shall be as shown in AWWA Manual M11 (2004 edition), Figure 13-20, using the number and size of lugs as tabulated below.

2. Lug or ear dimensions for ductile-iron pipe shall be as shown in the drawings.

TIE BOLTS OR STUD REQUIREMENTS FOR FLEXIBLE PIPE COUPLINGS FOR DUCTILE IRON PIPE

	Tie Bolt or Stud Minimum Requirements					
	150 psi(1)			300 psi(2) Pipe		
Nominal Pipe Size (inches)	No. Bolts or Studs	Size (inch)	Ear(3) Type	No. Bolts or Studs	Size (inch)	Ear(3) Type
4	2	5/8	A	2	5/8	A
6	2	5/8	A	2	5/8	A
8	2	5/8	A	2	5/8	A
10	2	5/8	A	4	5/8	A
12	2	5/8	A	4	5/8	A
14	4	5/8	A	5	3/4	A
16	4	5/8	A	5	3/4	B
18	4	3/4	B	8	3/4	B
20	4	3/4	B	8	3/4	B
24	5	7/8	B	8	7/8	B
30	4	1-1/8	B	14	7/8	B

TIE BOLTS OR STUD REQUIREMENTS FOR FLEXIBLE PIPE COUPLINGS FOR DUCTILE IRON PIPE						
	Tie Bolt or Stud Minimum Requirements					
	150 psi[1]			300 psi[2] Pipe		
Nominal Pipe Size (inches)	No. Bolts or Studs	Size (inch)	Ear[3] Type	No. Bolts or Studs	Size (inch)	Ear[3] Type
36	8	1	B	16	1	B
42	9	1	B	--	--	--
48	14	1	B	--	--	--
54	16	1	B	--	--	--

(1) Use ANSI B61.1 Class 125 flanges.
(2) Use ANSI B16.1 Class 250 flanges.
(3) Ear type as shown in the detail on the last page of Section 15122.

3. Select number and size of bolts based on the test pressure shown in the Piping Schedule in the drawings Section 15144. Stagger bolts equally around pipe circumference. Where odd number is tabulated, place odd bolt at top. For test pressures less than or equal to 150 psi, use the 150-psi design in the table above. For test pressures between 150 and 300 psi, use the 300-psi design in the table above.

4. Provide washer for each nut. Washer material shall be the same as the nuts. Minimum washer thickness shall be 1/8-inch.

D. Flexible Pipe Couplings for Plain-End Ductile-Iron Pipe

1. Couplings for pipe 12 inches and smaller shall be cast iron, Dresser Style 153, Smith-Blair Type 441, Baker Series 228, or equal.

2. Couplings for pipe larger than 12 inches shall be cast iron or steel, Dresser Style 38 or 153, Smith-Blair Style 411, Baker Series 228, or equal.

3. Couplings in air service shall have Viton gaskets.

E. Transition Couplings

Couplings for connecting different pipes having different outside diameters shall be steel: Dresser Style 62 or 162, Smith-Blair Series 413, Baker Series 212 or 220, or equal. Couplings shall have an internal full circumference ring pipe stop at the midpoint of the coupling. Inside diameter

of coupling pipe stop shall equal inside diameter of smaller diameter pipe.

F. Flanged Coupling Adapters for Cast- and Ductile-Iron Pipe

1. Adapters for cast- and ductile-iron pipe 12 inches and smaller shall be cast iron: Dresser Style 127, Smith-Blair Series 912, or equal.

2. Adapters for cast- and ductile-iron pipe larger than 12 inches shall be steel: Dresser Style 128, Smith-Blair Type 913, or equal.

3. Flange ends shall match the flange of the connecting pipe; see detail piping specifications.

4. Couplings in air service shall have Viton gaskets.

G. Type 4 Expansion Joints: Spherical Expansion Joints

1. Spherical design expansion joints shall be chlorobutyl with polyester fiber reinforcing and be provided with steel retaining rings and Type 304 stainless steel gusset plates and control rods. Expansion joints shall have flat-face flanges integral with the body to match 125/150-pound flanges. Expansion joints for hot water service shall be rated at a minimum of 150 psig at 212°F.

Joint Size	**Flange-to-Flange Length (inches)**	**Minimum Pressure Rating (150°F) (psi)**
4-8	6	225
10-12	8	225
14-20	10-12	125

2. Expansion joints shall be manufactured by Metraflex Metrasphere, Proco Series 240, or equal.

H. Type 5 Expansion Joints: Single Arch Rubber Type (24 Inches and Smaller)

1. Expansion joints shall be rubber, single arch type, with integral flat-face ANSI Class 125/150 flanges. Minimum working pressure shall be 150 psi for joints 12 inches and smaller, 120 psi for 14- and 16-inch joints, 110 psi for 18- and 20-inch joints, and 100 psi for 24-inch joints. Provide steel thrust plates, retaining rings,

and control rods. Products: Proco Style 220, General Rubber Style 1075, or equal.

I. Bolts and Nuts for Flanges

See Section 15050.

J. Threaded Caps for Protection of Nuts and Bolt Threads

See Section 15050.

PART 3 - EXECUTION

A. Installation of Flexible Pipe Couplings, Segmented Sleeve Couplings, and Expansion Joints

1. Clean oil, scale, rust, and dirt from pipe ends. Clean gaskets in flexible pipe couplings before installing.

2. Install expansion joints per manufacturer's recommendations, so that 50% of total travel is available for expansion and 50% is available for contraction.

3. Lubricate bolt threads with graphite and oil prior to installation.

B. Painting and Coating

1. Coat buried flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters per Section 09900, System No. 21. Coat buried bolt threads, tie bolt threads, and nuts per Section 09900, System No. 24.

2. Coat flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters located indoors, in vaults and structures, and above ground with the same coating system as specified for the adjacent pipe. Apply prime coat at factory.

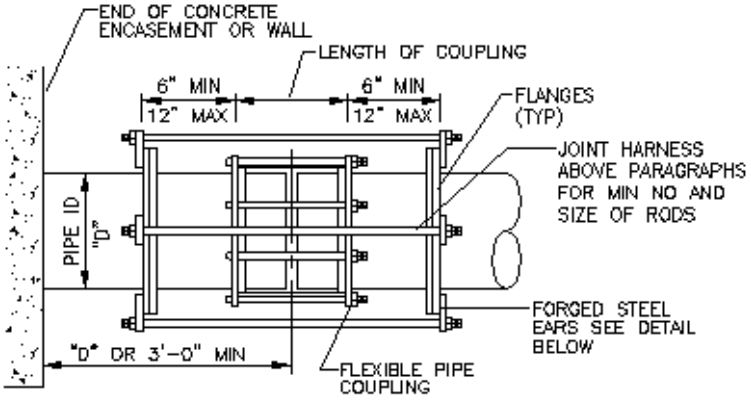
3. Line carbon steel and iron flexible pipe couplings and segmented sleeve couplings per Section 09900, System No. 7.

4. Alternatively, line and coat carbon steel and iron flexible pipe couplings and segmented sleeve couplings with fusion-bonded epoxy per Section 09961.

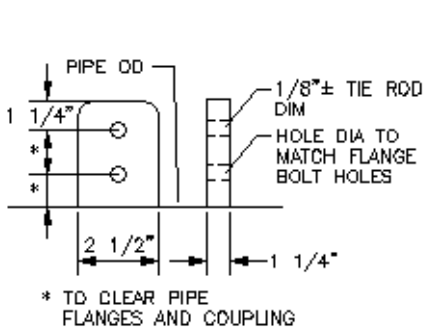
5. Coat couplings, expansion joints, expansion compensators, and alignment guides located above ground or in vaults and structures with the same coating system as specified for the adjacent pipe.

C. Hydrostatic Testing

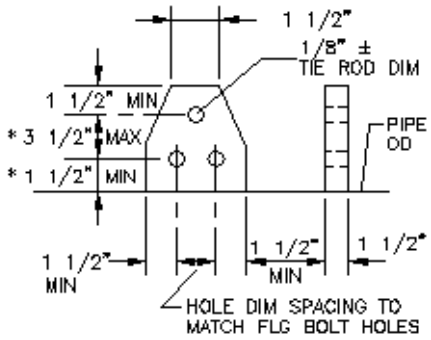
Hydrostatically test flexible pipe couplings, expansion joints, segmented sleeve couplings, and expansion compensators in place with the pipe being tested. Test in accordance with Section 15144.



FLEXIBLE PIPE COUPLING



FORGED STEEL EAR – TYPE "A"



FORGED STEEL EAR – TYPE "B"

FLEXIBLE PIPE COUPLING TIE RODS – DUCTILE IRON PIPE DETAIL

SCALE: NONE

END OF SECTION

SECTION 15123 CORPORATION STOPS AND SERVICE SADDLES

PART 1 - GENERAL

A. Description

This section includes materials and installation of service saddles and corporation stops.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit manufacturer's catalog data and descriptive literature showing dimensions and materials of construction by ASTM reference and grade. Show coatings.

PART 2 - MATERIALS

A. Corporation Stops

Corporation stops shall be bronze (ASTM B62) per Orange County Standards and Construction Specification Manual. Corporation stops shall be Ford FB1000, Mueller P25008, James Jones J-1937, McDonald 4644B, or Cambridge 214-FT.

B. Service Saddles for Ductile-Iron, Steel Pipe and PVC (AWWA C900 and C909)

1. Type 1 service saddles shall be of the double-strap type. Bodies shall be malleable iron (ASTM A47 or A197). Straps shall be forged steel (ASTM A105, A181, or A182). Tap sizes on the outlet shall be 3/4 inch through 2 inches to accommodate the connecting piping or corporation stops. Service saddles shall be Dresser Style 91, Rockwell Type 313, or equal.

2. Type 2 service saddles shall be of the double-strap type. Straps and bodies shall be bronze or silicon bronze. Tap sizes on the outlet shall be 3/4 inch through 2 inches to accommodate the connecting piping or corporation stops. Service saddles shall be James Jones J-979 (for ductile-iron and steel pipe), James Jones J-996 (for PVC pipe) Mueller, or equal.

3. Use Type 2 saddles unless plans direct otherwise.

C. Service Saddles for Schedule 40 and 80 PVC Pipe

Service saddles shall be malleable iron (ASTM A47 or A197) or bronze (ASTM B61 or B62), using interlocking lugs and a single bolt to hold the saddle in place. Tap sizes on the outlet shall be 3/4 inch or 1 inch to accommodate the connecting piping or corporation stops. Service saddles shall be Dresser Style 194, Rockwell Models 395 or 397, or equal.

PART 3 - EXECUTION

A. Installation of Service Saddles

Install service saddles with the gaskets seated on the pipe so that zero leakage is obtained. Tighten bolts to the torque recommended by the manufacturer.

B. Painting and Coating of Service Saddles

1. Coat buried service saddles per Section 09900, System No. 21.

2. Coat submerged service saddles per Section 09900, System No. 7.

3. Coat service saddles located above ground or in vaults and structures per Section 09900, System No. 10 Apply prime coat at factory. Color of finish coat shall match the color of the pipe to which the service saddle is connected.

END OF SECTION

SECTION 15141 DISINFECTION OF PIPING

PART 1 - GENERAL

A. Description

This section includes materials and procedures for disinfection of water mains by the continuous feed method. Disinfect piping in accordance with AWWA C651, except as modified below.

B. Job Conditions

1. Discharge of chlorinated water into watercourses or surface waters is regulated by the National Pollutant Discharge Elimination System (NPDES). Disposal of the chlorinated disinfection water and the flushing water is the Contractor's responsibility.

2. Use potable water for chlorination.

3. Submit request for use of water from waterlines of Owner 48 hours in advance.

4. Chemicals for use in disinfection of potable water lines shall be certified as conforming to NSF 60.

PART 2 - MATERIALS

A. Liquid Chlorine

Inject with a solution feed chlorinator and a water booster pump. Follow the instructions of the chlorinator manufacturer.

B. Calcium Hypochlorite (Dry)

Dissolve in water to a known concentration in a drum and pump into the pipeline at a metered rate.

C. Sodium Hypochlorite (Solution)

Further dilute in water to desired concentration and pump into the pipeline at a metered rate.

D. Chlorine Residual Test Kit

For measuring chlorine concentration, supply and use a medium range, drop count, DPD drop dilution method kit per

AWWA C651, Appendix A. Maintain kits in good working order available for immediate test of residuals at point of sampling.

PART 3 - EXECUTION

A. Continuous Feed Method for Pipelines

Introduce potable water into the pipeline at a constant measured rate. Feed the chlorine solution into the same water at a measured rate. Proportion the two rates so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 50 mg/L. Check the concentration at points downstream during the filling to ascertain that sufficient chlorine is being added.

B. Disinfection of Valves, Blind Flanges, and Appurtenances

During the period that the chlorine solution or slug is in the section of pipeline, open and close valves to obtain a chlorine residual at hydrants and other pipeline appurtenances. Swab exposed faces of valves and blind flanges prior to bolting flanges in place with a 1% sodium hypochlorite solution.

C. Disinfection of Connections to Existing Pipelines

Disinfect isolation valves, pipe, and appurtenances per AWWA C651, Section 4.7. Flush with potable water until discolored water, mud, and debris are eliminated. Swab interior of pipe and fittings with a 1% sodium hypochlorite solution. After disinfection, flush with potable water again until water is free of chlorine odor.

D. Disinfection of Tapping Sleeves and Line Stopping

Flush exterior of pipe with potable water after removal of existing coating. Swab exterior of pipe with a 1% sodium hypochlorite solution. Disinfect per AWWA C651, Section 4.8. After completion of tapping and line stopping, swab interior of pipe, valves, and faces of flanges to be connected to bypass piping with a 1% sodium hypochlorite solution.

E. Confirmation of Residual

1. After the chlorine solution applied by the continuous feed method has been retained in the pipeline for 24 hours, confirm that a chlorine residual of 50 mg/L minimum exists along the pipeline by sampling at air

valves and other points of access, such as tapping valves.

F. Pipeline Flushing

After confirming the chlorine residual, flush the excess chlorine solution from the pipeline until the chlorine concentration in the water leaving the pipe is within 0.5 mg/L of the replacement water. Contractor is responsible for method of removing excess chlorine residual to 0.5 mg/L of the replacement water.

G. Bacteriologic Tests

Collect two sets of samples per AWWA C651, Section 5.1, deliver to a certified laboratory within six hours of obtaining the samples, and obtain a bacteriologic quality test to demonstrate the absence of coliform organisms in each separate section of the pipeline after chlorination and refilling. Collect at least one set of samples from every 1,200 feet of the new water main and line stopping insertion point, plus one set from the end of the line and at least one set from each branch. At each connection to an existing pipeline, take two additional samples.

H. Repetition of Procedure

If the initial chlorination fails to produce required residuals and bacteriologic tests, repeat the chlorination and retesting until satisfactory results are obtained.

I. Test Facility Removal

After satisfactory disinfection, disinfect and replace air valves, restore the pipe coating, and complete the pipeline where temporary disinfection or test facilities were installed.

J. Piping to be Disinfected

Disinfect all potable water piping.

END OF SECTION

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SECTION 15144 PRESSURE TESTING OF PIPING

PART 1 - GENERAL

A. Description

This section specifies the hydrostatic and leakage testing of pressure piping for wastewater treatment plants.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.

3. Submit six copies of the test records to the Owner's Representative upon completion of the testing.

C. Test Pressures

Test pressures for the various services and types of piping are shown in the Piping Schedule in the drawings.

D. Testing Records

Provide records of each piping installation during the testing. These records shall include:

1. Date and times of test.

2. Identification of process, pipeline, or pipeline section tested or retested.

3. Identification of pipeline material.

4. Identification of pipe specification.

5. Test fluid.

6. Test pressure at low point in process, pipeline, or pipeline section.

7. Remarks: Leaks identified (type and location), types of repairs, or corrections made.

8. Certification by Contractor that the leakage rate measured conformed to the specifications.

PART 2 - MATERIALS

A. Vents and Drains for Aboveground Piping

Install vents on the high points of aboveground piping, whether shown in the drawings or not. Install drains on low points of aboveground piping, whether shown in the drawings or not. Provide a valve at each vent or drain point. Valves shall be 3/4-inch for piping 3 inches and larger and 1/2-inch for piping smaller than 3 inches. Valves shall be as specified in Section 15100, Type 100, unless otherwise shown in the drawings.

B. Manual Air-Release Valves for Buried Piping

Provide temporary manual air-release valves at test bulkheads for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and after use, seal with a blind flange, pipe cap, or plug and coat the same as the adjacent pipe.

C. Test Bulkheads

Design and fabricate test bulkheads per Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of said code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70% of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

D. Testing Fluid

1. Testing fluid shall be reclaimed water, unless otherwise noted.

2. For potable water pipelines, obtain and use only potable water for hydrostatic testing.

3. Submit request for use of water from waterlines of Owner 48 hours in advance.

4. The Contractor may obtain potable and reclaimed water from the Owner at no charge.

E. Testing Equipment

Provide calibrated pressure gauges, pipes, bulkheads, pumps, compressors, chart recorder, and meters to perform the hydrostatic testing. The Contractor shall supply all temporary plugs, blocking, taps and testing equipment as required to test all the sections of piping installed.

PART 3 - EXECUTION

A. Testing Preparation

1. Pipes shall be in place, backfilled, and anchored before commencing pressure testing.

2. Conduct pressure tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.

3. For buried piping, the pipe may be partially backfilled and the joints left exposed for inspection during an initial leakage test. Perform the final pressure test, however, after completely backfilling and compacting the trench.

4. Provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the specifications, disconnect and remove temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid was obtained.

5. Provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing. Pipes shall remain full after testing.

6. Prior to starting the test, the Contractor shall notify the County's Representative.

B. Cleaning

1. Before conducting hydrostatic tests, flush pipes with water to remove dirt and debris. Maintain a flushing

velocity of at least 3 fps for water testing. Flush pipes for time period as given by the formula

$$T = \frac{2L}{3}$$

in which:

T = flushing time (seconds)

L = pipe length (feet).

2. For pipelines 24 inches or larger in diameter, acceptable alternatives to flushing are use of high-pressure water jet, sweeping, or scrubbing. Water, sediment, dirt, and foreign material accumulated during this cleaning operation shall be discharged, vacuumed, or otherwise removed from the pipe.

C. Testing and Disinfection Sequence for Potable Water Piping

1. Perform required disinfection after hydrostatic testing, except when pipeline being tested is connected to a potable waterline.

2. Locate and install test bulkheads, valves, connections to existing pipelines, and other appurtenances in a manner to provide an air gap separation between existing potable water pipelines and the pipeline being tested. Disinfect water and pipeline being tested before hydrostatic testing when connected to a potable waterline.

D. Length of Test Section for Buried Piping

The maximum length of test section for buried pipe is 1,000 feet. Provide intermediate test bulkheads where the pipeline length exceeds these limits.

E. Initial Pipeline Filling for Hydrostatic Testing

Maximum rate of filling shall not cause water velocity in pipeline to exceed 1 fps. Filling may be facilitated by removing automatic air valves and releasing air manually.

F. Testing New Pipe Which Connects to Existing Pipe

Prior to testing new pipelines that are to be connected to existing pipelines, isolate the new line from the existing line by means of test bulkheads, spectacle flanges, or blind

flanges. After the new line has been successfully tested, remove test bulkheads or flanges and connect to the existing piping.

G. Hydrostatic Testing of Aboveground or Exposed Piping

1. Open vents at high points of the piping system to purge air while the pipe is being filled with water. Venting during system filling may also be provided by temporarily loosening flanges.

2. Subject the piping system to the test pressure indicated on the Piping Schedule in the drawings. Maintain the test pressure for a minimum of four hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show zero leakage or weeping. Correct leaks and retest until zero leakage is obtained.

H. Hydrostatic Testing of Buried Piping

1. Where any section of the piping contains concrete thrust blocks or encasement, do not make the pressure test until at least 10 days after the concrete has been placed. When testing mortar-lined or PVC piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.

2. Apply and maintain the test pressure by means of a positive displacement hydraulic force pump.

3. Maintain the test pressure for the following duration by restoring it whenever it falls an amount of 5 psi:

Pipe Diameter (inches)	**Hours**
18 and less	4
20 to 36	8
Greater than 36	24

4. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formula

$$L = \frac{HND(P)^{1/2}}{C}$$

in which:

L = allowable leakage (gallons)
H = specified test period (hours)
N = number of rubber-gasketed joints in the pipe tested
D = diameter of the pipe (inches)
P = specified test pressure (psig)
C = 7,400

5. The allowable leakage for buried piping having threaded, brazed, or welded (including solvent welded) joints shall be zero.

6. Repair and retest any pipes showing leakage rates greater than that allowed in the above criteria.

7. Test piping subject to the National Fire Code requirements per NFPA 24. Test such piping hydrostatically at not less than 200-psi pressure for two hours or at 50 psi in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psi. The amount of leakage in piping shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints irrespective of pipe diameter. The piping subject to this testing requirement is shown in the Piping Schedule in the drawings.

8. The allowable leakage for buried piping having threaded, brazed, or welded (including solvent welded) joints shall be zero.

9. Repair and retest any pipes showing leakage rates greater than that allowed in the above criteria.

I. Repetition of Test

If the actual leakage exceeds the allowable, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair. Eliminate visible leakage.

J. Bulkhead and Test Facility Removal

After a satisfactory test, remove the testing fluid, remove test bulkheads and other test facilities, and restore the pipe coatings.

END OF SECTION

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SECTION 15150 HVAC CONDENSATE WASTE PIPING

PART 1 - GENERAL

A. SUMMARY

This Section includes condensate waste piping.

B. PERFORMANCE REQUIREMENTS

Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Condensate Piping: 10-foot head of water (30 kPa).

C. SUBMITTALS

Field quality-control inspection and test reports.

D. QUALITY ASSURANCE

1. Piping materials shall bear label, stamp, or other markings of specified testing agency.

2. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - EXECUTION

A. PIPING APPLICATIONS

1. Condensate piping shall be the following:

a. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

B. PIPING INSTALLATION

1. Basic piping installation requirements are specified in Division 15 Section 15055 "Mechanical Piping Materials and Methods."

2. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section 15055 "Basic Mechanical Materials and Methods."

3. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 15 Section 15055 "Mechanical Piping Materials and Methods."

4. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

5. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

6. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

7. Install condensate drainage piping at the following minimum slopes, unless otherwise indicated:

   a. Horizontal Drainage Piping: 2 percent downward in direction of flow.

8. Install PVC piping according to ASTM D 2665.

9. Install underground PVC drainage piping according to ASTM D 2321.

10. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

C. JOINT CONSTRUCTION

1. Basic piping joint construction requirements are specified in Division 15 Section 15055 "Mechanical Piping Materials and Methods."

2. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

D. VALVE INSTALLATION

1. Backwater Valves: Install backwater valves in piping subject to backflow.

   a. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.

   b. Install backwater valves in accessible locations.

E. HANGER AND SUPPORT INSTALLATION

1. Note: install hangers to not conflict with process piping. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

   a. Vertical Piping: MSS Type 8 or Type 42, clamps.

   b. Individual, Straight, Horizontal Piping Runs: According to the following:

      1) 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.

      2) Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

      3) Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

c. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

d. Base of Vertical Piping: MSS Type 52, spring hangers.

2. Install supports according to Division 15 Section "Hangers and Supports."

3. Support vertical piping and tubing at base and at each floor.

4. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

5. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

a. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.

b. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.

6. Install supports for vertical PVC piping every 48 inches (1200 mm).

7. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

F. CONNECTIONS

1. Connect condensate piping to storm system as indicated on the drawings. Use transition fitting to join dissimilar piping materials.

2. Connect drainage piping to the following:

a. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

G. FIELD QUALITY CONTROL

1. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

   b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

2. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

3. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

4. Test piping according to procedures of authorities having jurisdiction.

   a. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

   b. Prepare reports for tests and required corrective action.

H. CLEANING

1. Clean interior of piping. Remove dirt and debris as work progresses.

2. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

3. Place plugs in ends of uncompleted piping at end of day and when work stops.

I. PROTECTION

Exposed PVC Piping: Protect piping exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

SECTION 15225 RUBBER AND PLASTIC HOSE AND TUBING

PART 1 - GENERAL

A. Description

This section includes materials and accessories for rubber and plastic hoses and tubing:

1. SBR hose for water service (Type 5).

2. Flexible white translucent or color-coded polyethylene tubing (Type 13).

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit manufacturer's catalog data and descriptive literature for hoses, tubing, and couplings. Show pressure rating and materials of construction for tube, carcass, and cover. Show design of hose and tubing ends.

3. Submit procedures for making up insert fittings and joints and compression fittings and joints.

PART 2 - MATERIALS

A. Hose and Tubing Identification

Hoses and tubing are identified in the drawings by size, type number, and in some cases (Types 1 through 5 hoses) by a suffix letter denoting the type of end connection. For example, a callout of 2" Type 1A means a 2-inch, abrasive slurry service hose, with grooved-end nipples at both ends.

B. Hose Design (Type 5)

Design hose for the material conveyed as described in the subsection on "Service Conditions." Provide hose design consisting of cover, carcass, and tube. Design carcass reinforcement to provide a minimum 4:1 safety factor for the working pressure specified in the subsection on "Service Conditions."

C. Type 5: SBR Hose for Potable Water Service

1. Cover: SBR.

2. Reinforcement: Minimum of two horizontal braids or two plies of synthetic fabric.

3. Tube: SBR.

4. Minimum Pressure Rating: 150 psi.

5. Products: Uniroyal H-3400, Goodall N-320, Goodyear, Gates “Steel Head,” or equal.

D. Type 13: Flexible White Translucent or Color-Coded Polyethylene Tubing (1/4 Through 5/8 Inch)

1. Provide odorless and tasteless flexible orange and yellow polyethylene tubing extruded from high molecular weight resin with smooth inside bore and smooth outside. Use the following color codes for the various service conditions in the project:

Tubing Service	**Color Code**
Sodium Hypochlorite	Yellow
Polymer	Orange

2. Minimum operating pressures shall be 120 psi for 1/4 through 3/8 inch, 90 psi for 1/2 inch, and 70 psi for 5/8 inch. Minimum operating pressure shall be 1/4 of the burst pressure of the tubing. Minimum bending radius shall be 2 inches. Joints and fittings shall be of the compression type utilizing a ferrule nut. Tubing shall comply with ASTM D1248, Type I, Class A, Category 4, Grade E.

3. Products: Parker “Parflex Polyethylene Tubing” with Parker “Fast & Tite” joints and fittings or equal.

4. Provide fitting material that are compatible with the chemical usage.

E. End Connections for Type 5 Hoses

1. Type A: Schedule 80S, Type 316 stainless steel grooved-end nipples built into the hose. Grooved-end nipples shall be flexible, square cut grooved, per AWWA C606,

Table 3. Connect hoses to each other with grooved-end couplings.

2. Type B: Schedule 80S, Type 316 stainless steel nipples built into the hose. Ends shall be male threaded, per ASME B1.20.1. Connect hose sections to each other with unions.

3. Type C: Hose shank couplings of the quick-connect type. Fasten couplers and adapters to the hose with clamps. The couplers, adapters, and clamps shall be Type 316 stainless steel. Couplers shall be Evertite Part C, Civicon 633-C, Parker-Hannifin Style C, or equal. Adapters shall be Evertite Part E, Civicon 633-E, Parker-Hannifin Style E, or equal. Where hoses connect to piping, fasten hose shank adapters to the hose end and female couplers to the pipe end. Where hoses are connected in series, fasten one female coupler and one male adaptor to each hose. Fasten male adapters to both ends of a hose only where necessary to accommodate connections with pipes. Do not fasten female couplers to both ends of any hose.

4. Type D: Shaped to the dimensions of Class 125, ASME B16.1, flanges. Construct as an integral part of the hose utilizing the same tube, cover, and carcass material as the hose. Provide Type 316 stainless steel retaining ring for each flange. Bolts and nuts: ASTM A193 (Grade B8M) for bolts and ASTM A194 (Grade 8M) for nuts. Provide washer under each nut and bolthead. Washers shall be of the same material as the nuts.

5. Type E: Hose shank couplings shall be of the quick-connect type. Fasten couplers and hose adapters to the hose with clamps. Coupler and adapters shall be polypropylene: Dixon or equal. Clamps shall be Type 316 stainless steel. Where hoses connect to piping, fasten hose shank adapters to the hose end and female couplers to the pipe end. Where hoses are connected in series, fasten one female coupler by hose shank on one end and one male adapter by hose shank on the other end. Fasten male adapters to both ends of hose only where necessary to accommodate connections with pipes. Do not fasten female couplers to both ends of any hose.

F. Unions for Type 5 Hoses

Unions shall be 3,000-pound WOG forged stainless steel, with dimensions conforming to MSS SP-83. Material shall conform

to ASTM A182, Grade F316. Ends shall be threaded per ASME B1.20.1.

G. Insert Fittings for Tubing

1. When insert fittings are specified, they shall be of the single-barb type. The completed tubing and fitting system shall have the same operating pressure ratings as specified for the tubing.

2. Rigid PVC pipe to PVC tubing transition fittings shall be solvent cement socket by single barb fittings with stainless steel clamps.

H. Quantities

1. See drawings for total hose lengths or quantities. Provide hoses in maximum 50-foot-long sections.

2. See drawings for total tubing lengths or quantities for the sodium hypochlorite service provides tubing in minimum 300-foot lengths or sections.

PART 3 - EXECUTION

A. Storage

Store hoses in a protected room or building at a temperature range of 50°F to 70°F. Do not store hoses near sources of heat such as radiators or base heaters. Do not store hoses so that they are exposed to sunlight; provide covers to protect hoses from sunlight and from fluorescent or mercury lamps. Storage areas shall be cool and dark, free of dampness and mildew. Protect hoses from rodents and insects. Store hose that is shipped in coils so that the coils are in a horizontal plane.

B. Hose Installation

Prior to assembling hose and components such as fittings and connectors, carefully examine components for correct material, style, size, catalog number, and length. Examine hoses for cleanliness, obstructions, blisters, cover looseness or damage, kinks, cracks, cuts, or any other visible defects. Inspect the fitting and sealing surfaces for burrs, nicks, corrosion, or other imperfections. Do not use any components that display such signs of nonconformance.

C. Service Conditions

1. Service and design conditions for hoses and tubing shall be as follows:

   a. Type: 5

   b. Minimum Working Pressure: 100 psig.

   c. Material Conveyed: Reclaimed Water

   d. Hose or Tubing Size: See drawings inches.

   e. Type: 13

   f. Minimum Working Pressure: 30 psig.

   g. Material Conveyed: Sodium Hypochlorite (10% to 15%)

   h. Hose or Tubing Size: See drawings inches.

   i. Type: 13

   j. Minimum Working Pressure: 30 psig.

   k. Material Conveyed: Polymer

   l. Hose or Tubing Size: See drawings inches.

D. Field Testing

1. Hydrostatically test hose for leakage in accordance with Section 15144. Leakage shall be zero. Perform pressure testing using water. Fill hoses with water with the outlet ends raised and any outlet valves open to allow the complete removal of air. When the air has been expelled, close outlet valves or install blind flanges or plugs on the outlets and lower the raised ends. Raise the pressure to the specified test pressure. Examine hose for leaks at couplings, fitting slippage, or any indication of weakness in the hose structure. Remove and replace the hose or couplings or fittings if there are any signs of leakage, fitting slippage, or weakness in the hose. Drain the water from the hoses after completion of the pressure tests. See the Piping Schedule in the drawings for test pressures. Some chemicals, such as concentrated acids, may react with water and become even more corrosive than the standard acid. An example is sulfuric acid. Check the compatibility of the hose material you are specifying

and describe the required cleaning procedure accordingly. Identify exactly which hose services need to be purged of moisture. If there is no problem adding the anticipated chemicals to the hoses containing moisture, then delete paragraph below.

2. After completing the pressure testing and draining the water out of the hoses and before filling the hoses with the specified chemicals, flush the following hoses with alcohol to remove moisture. Then blow clean, dry, oil-free air having a dew point of at least 40°F through the hoses. Circulate the air through the hoses until the exiting air has the same dew point as the applied air. Dispose of the effluent from the hoses in accordance with local water quality requirements.

END OF SECTION

SECTION 15240 DUCTILE-IRON PIPE

PART 1 - GENERAL

A. Description

This section describes materials, testing, and installation of ductile-iron pipe and fittings 64 inches and smaller.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Provide an affidavit of compliance with standards referenced in this specification, e.g., AWWA C151. Submit copy of report of pressure tests for qualifying the designs of all sizes and types of AWWA C153 fittings that are being used in the project. The pressure test shall demonstrate that the minimum safety factor described in AWWA C153, Section 5.5 is met.

3. Provide the following information:

   a. Mortar lining thickness.

   b. Wall thickness.

   c. Material test data for this project.

   d. Show deflections at push-on and mechanical joints.

   e. Submit joint and fitting details and manufacturer’s data sheets.

4. Submit calculations and test data proving that the proposed restrained joint arrangement can transmit the required forces with a minimum safety factor of 1.5.

5. Submit certificate that cement for mortar lining complies with ASTM C150, designating type and AWWA C104.

6. Submit test report on physical properties of rubber compound used in the gaskets.

7. Submit drawing or manufacturer's data sheet showing flange facing, including design of facing serrations.

8. Submit weld procedure specification, procedure qualification record, and welder's qualifications prior to any welding to ductile-iron pipe.

9. Submit leak free results of factory air tests for all fittings with welded bosses or outlets.

PART 2 - MATERIALS

A. Pipe

Pipe shall be cast ductile (nodular) iron, conforming to AWWA C151.

B. Pipe Wall Thickness

1. Minimum wall thickness for pipe having push-on or mechanical joints, restrained joints, plain ends, or cast flange ends shall be Class 150, unless otherwise shown in the drawings.

2. Minimum wall thickness for pipe having threaded flanges shall be Special Class 53.

3. Minimum pipe wall thickness required for corporation stops and tapped outlets shall be in accordance with Table A.1 of AWWA C151 for three full threads for design pressures up to 250 psi and four full threads for design pressures over 250 to 350 psi.

C. Fittings

1. Fittings 48 inches and smaller shall conform to AWWA C110 with a minimum pressure rating of 250 psi. Material shall be ductile iron. Flanges shall be flat faced.

2. Mechanical joint fittings conforming to AWWA C153 may be used in lieu of AWWA C110 fittings.

3. Material for fittings with welded-on bosses shall have a Charpy notch impact value of minimum 10 ft-lbs under the conditions defined in AWWA C151. Manufacturer shall submit leak free results of factory air tests for all such welded bosses or outlets.

D. Flanges

1. Flanges shall be solid back, Class 125 per AWWA C115. Flanges on pipe shall be either cast or threaded. Material shall be ductile iron.

2. Flanged pipe and fittings shall be shop fabricated, not field fabricated. Threaded flanges shall comply with AWWA C115. Flanges shall be individually fitted and machine tightened in the shop, then machined flat and perpendicular to the pipe barrel. Flanges shall be backfaced parallel to the face of flange. Prior to assembly of the flange onto the pipe, apply a thread compound to the threads to provide a leak-free connection. There shall be zero leakage through the threads at a hydrostatic test pressure of 250 psi.

E. Pipe Lining-- Ceramic Epoxy

1. Line the interior of the following pipe and fittings with an amine cured novalac epoxy containing at least 20 percent by volume of ceramic quartz pigment, Protecto 401 ceramic epoxy: Line the interior of the pipes as identified in the Flow Stream Identification chart in the drawings.

2. Before application of the lining, prepare the pipe surfaces in accordance with the applicator's recommendations. Apply the lining to a thickness of 40 mils nominal dry film thickness. Do not line the face of flanges.

3. For bell sockets and spigot ends, coat the gasket area and spigot end up to 6 inches back from the end of the spigot with 6 mils nominal, 10 mils maximum of Protecto Joint Compound. Apply the joint compound with a brush without causing excess buildup in the gasket seat or on the spigot ends.

4. Test lining thickness using a magnetic film thickness gauge. Conduct testing in accordance with SSPC-PA-2, Film Thickness Rating. Test for pinholes with a non-destructive 2,500 volt test. Repair all defects prior to shipment.

F. Pipe Lining-Cement Mortar

1. Unless unlined pipe or ceramic epoxy lining is specified above, line the pipe interior and fittings with cement-mortar per AWWA C104. Lining thickness shall be the double thickness listed in AWWA C104, Section 4.8. Lining material shall conform to ASTM C 150, Type V. This shall include the following pipes: Line the interior of the pipes as identified in the Flow Stream Identification chart in the drawings.

2. Line blind flanges per Section 09900, System No. 7.

3. Remove and reconstruct lining in areas where quality is defective per AWWA C104.

G. Gaskets for Flanges

See Section 15050.

H. Gaskets for Mechanical, Push-On, and Restrained Joints in Water Service

Synthetic or natural rubber in accordance with AWWA C111.

I. Gaskets for Mechanical, Push-On, and Restrained Joints in Air Service

Provide Viton gaskets rated for 250 F.

J. Bolts and Nuts for Flanges

See Section 15050.

K. Outlets and Nozzles

1. Provide outlets 2 inches and smaller by using a threaded welded-on boss.

2. For outlets larger than 2 inches use a tee with a flanged outlet.

L. Joints

1. Joints in aboveground or submerged piping or piping located in vaults and structures shall be flanged.

2. Joints in buried piping shall be of the restrained type per AWWA C111 except where flanged joints are required to connect to valves, meters, and other equipment.

3. All buried joints shall be restrained.

4. Restrained joint devices shall be accordance with the Orange County Utilities Standards and Construction Specifications Manual List of Approved Products in Appendix A.

5. Restrained joints for piping 4 to 36 inches shall be American Cast Iron Pipe “Fast Grip Gaskets”, U.S. Pipe “Field Loc Gaskets” or equal. Joint restraint shall be certified to a rated pressure of 250 psi. Restrained

joints for piping 36 inches to 64 inches shall be American Cast Iron Pipe “Flex-Ring”, or “Lok-Ring”, U.S. Pipe “TR Flex” or “HP Lok”, or equal.

6. Where thrust restraint is called for in the drawings, provide pipe with restrained joints capable of transmitting 1.5 times the thrust, as calculated by the following equation:

$$T = 1.5 * (0.785 * P * D^2)$$

where:

P = Pressure class of pipe in psi.
D = Outside diameter of pipe in inches.
T = Thrust in pounds.

7. Existing unrestrained bell & spigot joints are to be restrained using Series 1100HD restraint devices by EBBA Iron, Inc. Restraint may also be provided by a thrust collar constructed in accordance with the Orange County Utilities Standards and Construction Specifications, Figure A105-1 & -2. Existing unrestrained fittings and appurtenances are to be restrained using Series 1100SD by EBBA Iron, Inc.

M. Mechanical Joint Restraint System Using Follower Ring and Wedges

The restraining mechanism shall consist of a follower gland having a seal gasket and individually actuated wedges that increase their resistance to pullout as pressure or external forces increase. The system manufacturer shall provide all the components (follower ring, wedges, and gaskets) for the restraining device. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be constructed of ductile iron conforming to ASTM A 536, Grade 60-42-10. The wedges shall be ductile iron, heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with mechanical joint bells conforming to AWWA C111 and AWWA C153. The design shall use torque limiting twist-off nuts to provide actuation of the restraining wedges. The mechanical joint restraint shall be available in the size range of 3 through 48 inches. Minimum rated pressure shall be 350 psi for sizes 16 inches and smaller and 250 psi in sizes 18 inches and larger. Products: Megalug Series 1100 as manufactured by EBAA Iron, Inc., or equal.

N. Ductile-Iron Pipe Weldments

1. All welding to ductile-iron pipe, such as for bosses, joint restraint, and joint bond cables, shall be done at the place of manufacture of the pipe. Perform welding by skilled welders experienced in the method and materials to be used. The manufacturer shall have a fully documented welding quality assurance system and maintain resident quality assurance records based on ANSI/AWS D11.2, the guide for Welding Iron Castings. The manufacturer shall maintain appropriate welding procedures specification, procedure qualification, and welder performance qualification test records.

2. Welds shall be of uniform composition, neat, smooth, full strength, and ductile. Completely grind out porosity and cracks, trapped welding flux, and other defects in the welds in such a manner that will permit proper and complete repair by welding.

3. Prior to the application of any coating or lining in the outlet area all weldments for branch outlets shall be subjected to an air pressure test of at least 15 psi. Air leakage is not acceptable. Any weldment that shows signs of visible leakage shall be repaired and retested in accordance with the manufacturer’s written procedures.

PART 3 - EXECUTION

A. Delivery, Unloading, and Temporary Storage of Pipe at Site

1. Use unloading and installation procedures that avoid cracking of the lining.

2. Do not move pipe by inserting any devices or pieces of equipment into the pipe barrel. Field repair linings damaged by unloading or installation procedures.

B. Sanitation of Pipe Interior

1. During laying operations, do not place tools, clothing, or other materials in the pipe.

2. When pipe laying is not in progress, close the ends of the installed pipe by a child- and vermin-proof plug.

C. Installing Flanged Pipe and Fittings

Install in accordance with Section 15050. Cut the bore of the gaskets such that the gaskets do not protrude into the pipe when the flange bolts are tightened.

D. Installing Buried Piping

1. Install in accordance with Section 02223 and as follows.

2. Assemble restrained joints per manufacturer's instructions.

E. Joint Deflections for Buried Pipe

No pipe deflection of buried piping is allowed unless approved by the County’s Representative. Approval will be on a case by case basis.

F. Installing Aboveground or Exposed Piping

See Section 15050.

G. Painting and Coating

1. Prior to finish coating, trim excess gaskets protruding from flanged connections and caulk the joint.

2. Coat pipe located above ground and in vaults and structures as shown in the Piping Schedule in the drawings. Apply prime coat in the shop before transporting pipe to the jobsite.

3. Apply intermediate and finish coats in the field before installing the pipe, then touch up after installation.

4. All field cut pipe ends shall be coated, no bare metal shall be permitted.

5. Provide asphaltic coating on buried pipe per AWWA C151.

6. Coat buried flanges and buried mechanical and restrained joint bolts, nuts, and glands per Section 09900, System No. 21.

7. Coat submerged pipe with fusion-bonded epoxy per Section 09961 or system 6 per Section 09900.

H. Interior Joint Recesses for Buried Piping 30 Inches and Larger

Working inside the pipe, remove foreign substances from joint recesses and pack with cement-mortar. Finish the surface with a steel trowel to match adjoining pipe.

I. Cleaning Pipe

Sweep pipe clean of all dirt and debris. If hardened mud exists in the pipe, remove with the use of pressurized water hoses.

J. Field Hydrostatic Testing

Test pressures are shown in the Piping Schedule in the drawings. Test in accordance with Section 15144.

K. Pipe Labeling

Label exposed pipe above grade or in buried vaults per Section 15075.

L. Buried Warning and Identification Tape

Provide detectable warning tape per Section 15075. Warning and identification shall read “CAUTION BURIED WATER PIPING BELOW” or similar wording.

END OF SECTION

SECTION 15278 STAINLESS STEEL TUBING

PART 1 - GENERAL

A. Description

1. This section includes materials and installation of stainless steel tubing and fittings 2 inches in diameter and smaller.

2. Stainless steel pipe conforming to Section 15276 may be substituted for stainless steel tubing. However, tubing (Section 15278) may not be substituted for pipe (Section 15276).

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit materials list showing material of pipe and fittings with ASTM reference and grade. Submit manufacturer's catalog data for swaged fittings and joints.

3. Submit fitting manufacturer's instructions for assembling fittings and joints.

PART 2 - MATERIALS

A. Tubing

1. Tubing shall conform to ASTM A269, Grade TP 316, seamless. Hardness shall not exceed Rockwell B80. Tube wall thicknesses shall be as follows:

Tube O.D. (inches)	Minimum Wall Thickness (inches)
1/8	0.028
3/16	0.028
1/4	0.028
5/16	0.035
3/8	0.035
1/2	0.042
5/8	0.058
3/4	0.065
7/8	0.072
1	0.083
1 1/4	0.109
1 1/2	0.134
2	0.165
3	

2. Tubing shall be free of scratches. Tubing shall be suitable for bending and flaring.

3. Tubing shall be heat-treated, which shall consist of quenching in water or rapidly cooling by other means at a rate sufficient to prevent precipitation of carbides, as demonstrated by the capability of passing practice ASTM A262, Practice E (Supplementary Requirement S4 in ASTM A269).

B. Fittings and Joints

1. Fittings and joints shall be of the SWAGELOK type as manufactured by Crawford Fitting Company, utilizing a nut and dual ferrule design to connect to tubing. Fitting and joint material shall comply with ASTM A479, Type 316, or ASTM A182, Grade F316. End connections shall be of the union type.

2. Joints connecting two straight tubes together shall be of the nut and ferrule union type.

C. Protective End Caps

Provide protective end caps on each piece of tubing, completely sealing the piece from contamination during shipment and storage. Provide the same type of seals on each

fitting, or ship and store fittings in sealed boxes or containers.

D. Outlets and Nozzles

Use a tee with nut and ferrule union ends to connect to the tubing and with an outlet to match the connecting valve or instrument.

E. Connections to Threaded-End Valves

When connecting tubing to threaded-end valves, provide tube to female NPT connectors. Provide a threaded Schedule 80S Type 316 stainless steel nipple (ASTM A312, seamless) between the connector and the valve end.

F. Spare Parts

1. Provide the following spare parts:

Quantity	Description
6	Nuts of each size used on the project
2	Hydraulic swaging units

2. Pack the 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 therein.

PART 3 - EXECUTION

A. Installing Tubing

1. Do not drag tubing out of tube racks. Do not drag tubing across any surface that could scratch it.

2. Keep tube cutters and saws sharp. Do not cut too deeply with each turn of the cutter or motion of the saw.

3. Deburr tube ends before inserting into fittings and joints. Clean both the inside and outside of fitting and pipe ends before making up joints. Do not miter joints for elbows or notch straight runs of pipe for tees. Do not kink tubing.

4. Bends in tubing shall be long sweep. Provide the straight length of tubing recommended by the fitting and joint manufacturer to allow the tube to be inserted into

the fitting. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning the tubing wall at any point. Do not use bends to make turns greater than 45 degrees. Use fittings to make turns greater than 45 degrees.

B. Installing Exposed Tubing

1. Install tubing without springing, forcing, or stressing the tubing or any adjacent connecting valves or equipment.

2. Provide pipe hangers and supports as specified in Section 15064.

C. Installing Fittings and Joints

1. Follow the manufacturer's instructions for installing fittings and joints.

2. For fittings and joints larger than 1 inch, use the manufacturer's hydraulic swaging unit to make up the connections.

D. Field Hydrostatic Testing

1. See Section 15144.

2. Do not allow test water to remain in the tubing for more than five days. Drain and dry the tubing after completing the testing.

END OF SECTION

SECTION 15290 PVC PIPE, 3 INCHES AND SMALLER

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of PVC pipe and fittings of size 3 inches and smaller for use in process piping having a maximum design pressure of 150 psi and having a maximum design temperature of 105°F.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

2. Submit materials list showing materials of pipe and fittings with ASTM reference and grade. Submit manufacturer's certification of compliance with referenced standards, e.g., ASTM D1784, D1785, and D2467. Show wall thickness of pipe and fittings. Show fitting dimensions.

3. Submit data sheets for solvent cement and demonstrating compliance with ASTM D2564 and F656.

PART 2 - MATERIALS

A. Pipe

Pipe shall be Schedule 80, Type I, Grade 1 (Class 12454-B), conforming to ASTM D1784 and D1785.

B. PVC Pipe Coloring and Marking for Reclaimed Water

PVC pipe shall be purple (Pantone 522) and shall be marked on both sides of the pipe with the wording "CAUTION: RECLAIMED WATER--DO NOT DRINK." The lettering shall be minimum 1-inch-high black letters and shall be repeated every 36 inches. The purple coloring shall be achieved by adding pigment to the PVC material as the pipe is being manufactured.

C. Fittings

Fittings shall be Schedule 80 and shall conform to ASTM D2464 for threaded fittings and ASTM D2467 for socket-type fittings.

D. Flanges

PVC flanges shall be of the one-piece solid socket design and shall be made of the same material as the pipe. Pressure rating shall be at least 150 psi at a temperature of 73°F. Minimum burst pressure shall be 500 psi. Flanges shall match the dimensions of ASME B16.5, Class 150, steel flanges for outside diameter, bolt circle, and bolt holes. Do not use Van Stone flanges.

E. Unions

Unions shall have socket-type ends, Viton O-rings, and shall be Schedule 80. Material shall be Type I, Grade 1 PVC, per ASTM D1784.

F. Joints

Pipe and fitting joints shall be socket welded except where threaded and flanged joints are required to connect to valves and equipment.

G. Solvent Cement

Solvent cement for socket joints shall comply with ASTM D2564 and F656.

H. Gaskets for Flanges

See Section 15050.

I. Bolts and Nuts for Flanges

See Section 15050.

J. Lubricant for Stainless Steel Bolts and Nuts

See Section 15050.

K. Wye Strainers

PVC wye strainers shall be manufactured of the same material as the pipe, with 30-mesh screens and Viton seals.

Connecting ends shall be the socket type, solvent welded. Provide one spare screen for each strainer.

PART 3 - EXECUTION

A. General

1. Do not install PVC pipe when the temperature is below 40°F or above 90°F. Store loose pipes on racks with a maximum support spacing of 3 feet. Provide shades for pipe stored outdoors or installed outdoors until the pipe is filled with water.

2. Store fittings indoors in their original cartons.

3. Store solvent cement indoors or, if outdoors, shade from direct sunlight exposure. Do not use solvent cements that have exceeded the shelf life marked on the storage container.

4. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section of pipe.

5. Do not drag PVC pipe over the ground, drop it onto the ground, or drop objects on it.

B. Solvent-Welded Joints

1. Prior to solvent welding, remove fittings and couplings from their cartons and expose them to the air at the same temperature conditions as the pipe for at least one hour.

2. Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings. Bevel solvent-welded pipe ends as recommended by the pipe manufacturer.

3. Wipe away loose dirt and moisture from the inside and outside of the pipe end and the inside of the fitting before applying solvent cement. Clean the surfaces of both pipes and fittings that are to be solvent welded with a clean cloth moistened with acetone or methylethyl ketone. Do not apply solvent cement to wet surfaces.

4. The pipe and fitting socket shall have an interference fit. The diametrical clearance between pipe and entrance of the fitting socket shall not exceed 0.04 inch. Check the fit at every joint before applying solvent cement.

5. Make up solvent-welded joints per ASTM D2855. Application of cement to both surfaces to be joined and assembly of these surfaces shall produce a continuous bond between them with visual evidence of cement at least flush with the outer end of the fitting bore around the entire circumference.

6. Allow at least eight hours of drying time before moving solvent-welded joints or subjecting the joints to any internal or external loads or pressures.

7. Acceptance criteria for solvent-welded joints shall be as follows:

   a. Unfilled Areas in Joint: None permitted.

   b. Unbonded Areas in Joint: None permitted.

   c. Protrusion of Material into Pipe Bore, Percent of Pipe Wall Thickness: Cement, 50%.

C. Flanged Joints

1. Lubricate carbon steel bolt threads with graphite and oil before installation.

2. Tighten bolts on PVC flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages and the final torque values shall be as shown in the following table:

Pipe Size (inches)	**Final Torque (foot-pounds)**
1/2 to 1-1/2	10 to 15
2 to 3	20 to 30

D. Installation of Stainless Steel Bolts and Nuts

See Section 15050.

E. Threaded Joints

1. Cut threaded ends on PVC to the dimensions of ASME B1.20.1. Ends shall be square cut. Follow the pipe manufacturer's recommendations regarding pipe hold-down methods, saw cutting blade size, and saw cutting speed.

2. Pipe or tubing cutters shall be specifically designed for use on PVC pipe. Use cutters manufactured by Reed Manufacturing Company, Ridge Tool Company, or equal.

3. If a hold-down vise is used when the pipe is cut, insert a rubber sheet between the vise jaws and the pipe to avoid scratching the pipe.

4. Thread cutting dies shall be clean and sharp and shall not be used to cut materials other than plastic.

5. Apply Teflon® thread compound or Teflon® tape lubricant to threads before screwing on the fitting.

F. Installing Unions

Provide unions on exposed piping 3 inches and smaller as follows:

1. At every change in direction (horizontal and vertical).

2. 6 to 12 inches downstream of valves.

3. Every 40 feet in straight pipe runs.

4. Where shown in the drawings.

G. Installing Buried Pipe

1. Install in accordance with Section 02223 and as follows.

2. Trench bottom shall be continuous, smooth, and free of rocks. See the details in the drawings for trench dimensions, pipe bedding, and backfill.

3. After the pipe has been solvent-welded and the joints have set, snake the pipe in the trench per the pipe manufacturer's recommendations in order to allow for thermal expansion and contraction of the pipe.

4. Do not backfill the pipe trench until the solvent-welded joints have set. Support the pipe uniformly and

continuously over its entire length on firm, stable soil. Do not use blocking to change pipe grade or to support pipe in the trench.

5. Install buried PVC pipe in accordance with ASTM D2774 and the pipe manufacturer's recommendations. Backfill materials in the pipe zone shall be imported sand per Section 02223. If water flooding is used, do not add successive layers unless the previous layer is compacted to 90% relative compaction.

H. Installing Aboveground or Exposed Piping

1. See Section 15050.

2. Fill empty piping with water, provide temporary shading, or other means to keep the surface temperature of the pipe below 100°F.

I. Painting and Coating

Coat piping per Section 09900, System No. 41.

J. Hydrostatic Testing

Perform hydrostatic testing for leakage in accordance with Section 15144.

END OF SECTION

SECTION 15294 CPVC PIPE, 3 INCHES AND SMALLER

PART 1 - GENERAL

A. Description

This section includes materials, installation, and testing of chlorinated polyvinyl chloride (CPVC) pipe and fittings of size 3 inches and smaller for use in process piping having a maximum design pressure of 150 psi at a maximum operating temperature of 105°F and a maximum design pressure of 100 psi at a temperature of 140°F.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following.

2. Submit materials list showing materials of pipe and fittings with ASTM reference and grade. Submit manufacturer's certification of compliance with referenced standards, e.g., ASTM D1784, F441, and F439. Show wall thickness of pipe and fittings. Show fitting dimensions.

3. Submit data sheets for solvent cement demonstrating compliance with ASTM F493.

PART 2 - MATERIALS

A. Pipe

Pipe shall be Schedule 80, Type IV, Grade 1 (Class 23477-B), conforming to ASTM D1784 and F441.

B. Fittings

Fittings shall be Schedule 80 and shall conform to ASTM F437 for threaded fittings and ASTM F439 for socket-type fittings.

C. Flanges

CPVC flanges shall be of the one-piece solid socket design and shall be made of the same material as the pipe. Pressure rating shall be at least 150 psi at a temperature

of 73°F. Minimum burst pressure shall be 500 psi. Flanges shall match the dimensions of ASME B16.5, Class 150, steel flanges for outside diameter, bolt circle, and bolt holes. Do not use Van Stone flanges.

D. Unions

1. Unions shall have socket-type ends, Viton O-rings, and shall be Schedule 80. Material shall be Type IV, Grade 1 CPVC, per ASTM D1784.

2. Union connections to other metal piping materials shall comply with MSS SP-107. The fitting end for connection to CPVC pipe shall be a female socket. Provide wrought or cast copper tailpieces for connection to copper piping and tubing. Provide Type 316 stainless steel tailpieces for connection to steel piping.

E. Joints

Pipe and fitting joints shall be socket-welded except where threaded and flanged joints are required to connect to unions, valves, and equipment.

F. Solvent Cement

Solvent cement for socket joints shall comply with ASTM F493. Use the type of solvent cement as recommended in ASTM F493, Appendix X2.

G. Gaskets For Flanges

See Section 15050.

H. Bolting and Nuts For Flanges

See Section 15050.

I. Lubricant For Stainless Steel Bolts and Nuts

See Section 15050.

J. Wye Strainers

CPVC wye strainers shall be manufactured of the same material as the pipe, with 30-mesh screens and Viton seals. Connecting ends shall be the socket type, solvent-welded. Provide one spare screen for each strainer.

PART 3 - EXECUTION

A. General

1. Do not install CPVC pipe when the temperature is below 40°F or above 90°F. Store loose pipes on racks with a minimum support spacing of 3 feet. Provide shades for pipe stored outdoors or installed outdoors until the pipe is filled with water.

2. Store fittings indoors in their original cartons.

3. Store solvent cement indoors or, if outdoors, shade from direct sunlight exposure. Do not use solvent cements that have exceeded the shelf life marked on the storage container.

4. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section of pipe.

5. Do not drag CPVC pipe over the ground, drop it onto the ground, or drop objects on it.

B. Solvent-Welded Joints

1. Prior to solvent welding, remove fittings and couplings from their cartons and expose them to the air for at least one hour to the same temperature conditions as the pipe.

2. Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings. Bevel solvent-welded pipe ends as recommended by the pipe manufacturer.

3. Wipe away loose dirt and moisture from the inside and outside of the pipe end and the inside of the fitting before applying solvent cement. Clean the surfaces of both pipes and fittings that are to be solvent-welded with a clean cloth moistened with acetone or methylethyl ketone. Do not apply solvent cement to wet surfaces.

4. The pipe and fitting socket shall have an interference fit. Perform a dry fit test at each joint before applying solvent cement. The pipe shall enter the

fitting socket between one-third and two-thirds of the full socket depth when assembled by hand.

5. Make up solvent-welded joints per ASTM F493, Appendix X1. Application of cement to both surfaces to be joined and assembly of these surfaces shall produce a continuous bond between them with visual evidence of cement at least flush with the outer end of the fitting bore around the entire joint perimeter.

6. Allow at least eight hours of drying time before moving solvent-welded joints or subjecting the joints to any internal or external loads or pressures.

7. Acceptance criteria for solvent-welded joints shall be as follows:

   a. Unfilled Areas in Joint: None permitted.

   b. Unbonded Areas in Joint: None permitted.

   c. Protrusion of Material into Pipe Bore, Percent of Pipe Wall Thickness: Cement, 50%.

C. Flanged Joints

1. Lubricate carbon steel bolt threads with graphite and oil before installation.

2. Tighten bolts on CPVC flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages and the final torque values shall be as shown in the following table:

Pipe Size (inches)	**Final Torque (foot-pounds)**
1/2 to 1 1/2	10 to 15
2 to 3	20 to 30

D. Installation Of Stainless Steel Bolts and Nuts

See Section 15050.

E. Assembling Threaded Joints

1. Cut threaded ends on CPVC to the dimensions of ASTM F1498. Ends shall be square cut. Follow the pipe

manufacturer's recommendations regarding pipe holddown methods, saw cutting blade size, and saw cutting speed. Gauges, gauge tolerances, and gauging procedures shall comply with ASTM F1498, Sections 7 and 8. Perform field gauging on every field-cut threaded connection.

2. Pipe or tubing cutters shall be specifically designed for use on CPVC pipe. Use cutters manufactured by Reed Manufacturing Company, Ridge Tool Company, or equal.

3. If a hold-down vise is used when the pipe is cut, insert a rubber sheet between the vise jaws and the pipe to avoid scratching the pipe.

4. Thread cutting dies shall be clean and sharp and shall not be used to cut materials other than plastic.

5. Apply Teflon® thread compound or Teflon® tape lubricant to threads before screwing on the fitting.

6. Assemble threaded flanges and fittings per ASTM F1498, Sections 4, 7, and 8. Do not tighten threaded connections more than two turns past finger tightness for both internal and external threads.

F. Installing Unions

Provide unions on exposed piping 4 inches and smaller as follows:

1. At every change in direction (horizontal and vertical).

2. Six to twelve inches downstream of valves.

3. Every 40 feet in straight piping runs.

4. Where shown in the drawings.

G. Installing Buried Pipe

1. Install in accordance with Section 02223 and as follows.

2. Trench bottom shall be continuous, smooth, and free of rocks. See the details in the drawings for trench dimensions, pipe bedding, and backfill.

3. After the pipe has been solvent-welded and the joints have set, snake the pipe in the trench per the pipe

manufacturer's recommendations in order to allow for thermal expansion and contraction of the pipe.

4. Do not backfill the pipe trench until the solvent-welded joints have set. Support the pipe uniformly and continuously over its entire length on firm, stable soil. Do not use blocking to change pipe grade or to support pipe in the trench.

5. Install buried CPVC pipe in accordance with ASTM D2774 and the pipe manufacturer's recommendations. Backfill materials in the pipe zone shall be imported sand per Section 02223. If water flooding is used, do not add successive layers unless the previous layer is compacted to 90% relative compaction.

H. Installing Aboveground or Exposed Piping

See Section 15050.

I. Painting And Coating

Coat piping per Section 09900, System No. 41.

J. Hydrostatic Testing

Perform hydrostatic testing for leakage in accordance with Section 15144.

END OF SECTION

SECTION 15738 - SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

A. SUMMARY

This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

B. SUBMITTALS

1. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

2. Operation and maintenance data.

C. QUALITY ASSURANCE

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

3. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

4. Units shall be designed to operate with HCFC-free refrigerants.

D. WARRANTY

Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within five years from date of Substantial Completion. Manufacturer shall also be responsible for providing five

years preventative maintenance of split system air-conditioning units from date of Substantial Completion.

PART 2 - PRODUCTS

A. MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Carrier Air Conditioning; Div. of Carrier Corp.

   b. Lennox Industries Inc.

   c. Trane Co. (The); Unitary Products Group.

   d. York International Corp.

B. EVAPORATOR-FAN UNIT

1. Concealed Unit Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

   a. Insulation: Faced, glass-fiber duct liner.

   b. Drain Pans: Galvanized steel, with connection for drain; insulated.

2. Floor-Mounting, Unit Cabinet: Enameled steel with removable panels on front and ends.

3. Insulation: Faced, glass-fiber, duct liner.

4. Drain Pans: Galvanized steel, with connection for drain; insulated.

5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve. Provide black epoxy, heresite or phenolic coating providing a 1000 salt spray test.

6. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.

7. Fan Motor: Multispeed.

8. Filters: 1 inch (25 mm) thick, in fiberboard frames.

C. AIR-COOLED, COMPRESSOR-CONDENSER UNIT

1. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

2. Compressor: Hermetically sealed scroll type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.

   a. Refrigerant Charge: R-410A.

3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler. Provide black epoxy, heresite or phenolic coating providing a 1000 salt spray test.

4. Fan: Aluminum-propeller type, directly connected to motor.

5. Motor: Permanently lubricated, with integral thermal-overload protection.

6. Low Ambient Kit: Permits operation down to 40 deg F (7 deg C).

7. Mounting Base: Steel/Fibermesh reinforced Concrete Pad.

D. ACCESSORIES

1. Thermostat: Programmable Low voltage with sub base to control compressor and evaporator fan.

2. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and

sealed; factory-insulated suction line with flared fittings at both ends.

3. Low ambient controls.

PART 3 - EXECUTION

A. INSTALLATION

1. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

2. Install ground-mounted, compressor-condenser components on reinforced concrete base; 6 inches (100 mm) larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

B. CONNECTIONS

1. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

2. Connect supply and return water coil with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

3. Connect supply and return condenser connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

4. Install piping adjacent to unit to allow service and maintenance.

C. FIELD QUALITY CONTROL

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect[, test, and adjust] field-assembled components and equipment installation, including connections[, and to assist in field testing]. Report results in writing.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

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SECTION 15815 - METAL DUCTS

PART 1 - GENERAL

A. SUMMARY

1. This Section includes metal, rectangular ducts and fittings for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa).

2. See Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

B. QUALITY ASSURANCE

NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

A. MANUFACTURERS

In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. SHEET METAL MATERIALS

1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless

otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2. Stainless Sheet Steel: Lock-forming quality; complying with ASTM A 480/A 480M and having No. 2D finish surfaces are exposed to view.

3. Reinforcement Shapes and Plates: Stainless-steel reinforcement where installed on stainless sheet metal ducts.

4. Tie Rods: Stainless steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

C. SEALANT MATERIALS

1. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber-reinforced fabric.

2. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

3. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

4. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

5. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

6. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

D. HANGERS AND SUPPORTS

1. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

a. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.

b. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

2. Hanger Materials: Galvanized sheet steel or threaded steel rod.

a. Hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

b. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.

3. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

4. Trapeze and Riser Supports: Stainless-steel shapes and plates complying with ASTM A 36/A 36M.

E. RECTANGULAR DUCT FABRICATION

1. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

a. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
b. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

2. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

a. Manufacturers:

1) Ductmate Industries, Inc.

2) Nexus Inc.

3) Ward Industries, Inc.

3. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

a. Manufacturers:

1) Ductmate Industries, Inc.

2) Lockformer.

b. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.

c. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

4. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.

PART 3 - EXECUTION

A. DUCT APPLICATIONS

Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following: (Applies to ERV-1 and Exhaust Fans)

1. Supply Ducts: 2-inch wg (500 Pa).

2. Return Ducts (Negative Pressure): 1-inch wg (250 Pa).

B. DUCT INSTALLATION

1. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

2. Install ducts with fewest possible joints.

3. Install fabricated fittings for changes in directions, size, and shape and for connections.

4. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.

5. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

6. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

7. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

8. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

9. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

10. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

11. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

12. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).

13. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and

firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."

14. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction.

C. SEAM AND JOINT SEALING

1. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

   a. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.

2. Seal ducts before external insulation is applied.

D. HANGING AND SUPPORTING

1. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

2. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.

3. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

4. Install concrete inserts before placing concrete.

5. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

   a. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

E. CONNECTIONS

1. Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories."

2. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

END OF SECTION

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SECTION 15820 DUCT ACCESORIES

PART 1 - GENERAL

A. SUMMARY

This Section includes the following:

1. Volume dampers.

2. Turning vanes.

3. Flexible connectors.

4. Motorized control dampers

B. SUBMITTALS

1. Product Data: For the following:

   a. Volume dampers.

   b. Turning vanes.

   c. Flexible connectors.

   d. Motorized control dampers

2. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

   a. Special fittings.

   b. Manual-volume damper installations.

   c. Motorized-control damper installations.

C. QUALITY ASSURANCE

Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

A. MANUFACTURERS

In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. SHEET METAL MATERIALS

1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

2. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

3. Stainless Steel: ASTM A 480/A 480M.

4. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

5. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.

6. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

7. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

C. VOLUME DAMPERS

1. Manufacturers:

   a. Greenheck

   b. Nailor Industries Inc.

   c. Ruskin Company.

2. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

3. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating and suitable for horizontal or vertical applications.

   a. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.

   b. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized sheet steel.

   c. Blade Axles: Galvanized steel.

   d. Bearings: Stainless-steel sleeve.

   e. Tie Bars and Brackets: Galvanized steel.

4. Jackshaft: 1-inch- (25-mm-) diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

   a. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

5. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

D. TURNING VANES

1. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

2. Manufactured Turning Vanes: Fabricate 1-1/2-inch- (38-mm-) wide, double-vane, curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.

   Manufacturers:

   a. Ductmate Industries, Inc.

   b. Duro Dyne Corp.

   c. METALAIRE, Inc.

   d. Ward Industries, Inc.

3. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

E. FLEXIBLE CONNECTORS

1. Manufacturers:

   a. Ductmate Industries, Inc.

   b. Duro Dyne Corp.

   c. Ventfabrics, Inc.

   d. Ward Industries, Inc.

2. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

3. Flexible Connector Fabric: Glass fabric double coated with neoprene.

   a. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

   b. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.

   c. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. MOTORIZED CONTROL DAMPERS

1. Manufacturers:

   a. Greenheck

   e. Ruskin Company

   f. Air Balance, Inc.

2. Ratings:

   a. Leakage:

      1) Dampers shall have a maximum leakage of 4 cfm/ sq. ft. @ 1 in. wg or 8 cfm/sq. ft. at 1 in. wg.

      2) Damper shall meet or exceed the IECC (International Energy Conservation Code) requirements for damper leakage ratings of 3 cfm/ sq. ft @ 1 in. wg or 8 cfm/sq. ft. @ 4in. wg or less when integral to the building envelope.

   b. Differential Pressure: Dampers shall have a maximum differential pressure rating of 6 in. wg (1.5 kPa)

   c. Velocity: Dampers shall have a maximum velocity rating of 6000 fpm (30.5 m/s).

3. Construction:

   a. Frame: Damper frame shall be heavy gauge aluminum frame formed into a 4″ x 1″ structural hat channel. Top and bottom frame members on dampers less than

17” high shall be low profile design to maximize the free area of these smaller dampers

b. Blades: Blades: Damper blades shall be extruded airfoil shaped, aluminum construction (.125 in.) thick with metal blade to metal blade overlap. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening. Blade orientation is horizontal. Blade operation is parallel or opposed. Blades shall be contained within the damper frame

c. Blade Stops: Each blade stop (at top and bottom of damper frame) shall occupy no more than ½” of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.

d. Linkage: Concealed in Jamb.

e. Axles: Minimum ½ inch dia. plated stainless steel.

f. Bearings: Stainless Steel Axle bearings

g. Finish: Mill galvanized finish

4. Actuators

a. Type: Electric, 120V AC, 2-position, fail close

b. Mounting: Internal

c. Flange Frame: 1½ inches, rolled formed as part of frame

PART 3 - EXECUTION

A. APPLICATION AND INSTALLATION

1. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

2. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-

steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

3. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

4. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

5. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.

6. Install dampers square and free from racking.

7. Install electric actuators as specified.

8. Provide test holes at fan inlets and outlets and elsewhere as indicated.

B. ADJUSTING

1. Adjust duct accessories for proper settings.

2. Adjust fire and smoke dampers for proper action.

3. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION

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SECTION 15850 FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES

PART 1 - GENERAL

A. Description

The odor control system duct work consists of dampers, actuators, gauges, piping, ductwork, and ancillary items, as indicated and specified.

The fiberglass reinforced plastic (FRP) ductwork shall be designed and fabricated for odor control service to carry warm, moisture-laden air with hydrogen sulfide, mercaptans and other organic and inorganic compounds typically associated with wastewater treatment.

B. References

1. American Society of Mechanical Engineers (ASME)

2. American National Standards Institute, Inc. (ANSI)

3. Underwriters' Laboratories (UL)

4. National Electric Code (NEC)

5. Air Moving and Conditioning Association (AMCA)

6. Sheet metal and Air Conditioning Contractors National Association, Inc. (SMACNA)

7. National Institute of Standards (NIST)

8. National Electrical Manufacturers Association (NEMA)

9. American Standard of Testing Materials (ASTM)

10. ASTM D 3567 Practice for Determining Dimensions of Fiberglass (Glass- Fiber Reinforced-Thermosetting-Resin) Pipe and Fittings.

    a. ASTM C 582 Standard Specification for Contact - Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion -Resistant Equipment.

    b. ASTM D 3982 Standard Specification for Contact Molded Fiberglass Duct and Hoods or

c. ASTM D 231 0 "Standard Classification for Machine-Made "Fiberglass" Pipe.

d. ANSI/ABMA 11-90 (R1999) Load Ratings and Fatigue Life for Roller Bearings.

11. National Bureau of Standards (NBS).

a. NBS PS 15-69 "Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment

C. Submittals

1. Submit material for review in one submission. Partial submittals will not be reviewed.

2. Sales bulletins or other general publications are not acceptable as submittals for review. Submit only when necessary to provide supplemental technical data.

3. Shop Drawings: Submit the following in accordance with Section 01300:

a. Certified shop and working drawings.

(1) Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

(2) Files shall include Tag Names, Parts List (identifying each component), Dimensions, and connection sizes.

(3) Files shall be drawn to scale.

(4) Drawings shall be in conformance with all other requirements as specified in this specification.

b. Submit a certificate from the resin manufacturer listing the type of resin to be used, describing the manufacturer's brand name or designation, composition, characteristics and that the material used for this project will comply with the specification and meet all corrosion requirements.

c. Submit manufacturer's certification that fabrication complies with the referenced standards, e.g., ASTM D3567, C582, D3982, and D2310.

d. Submit manufacturer's catalog data for the duct and fittings. Show wall thickness of duct and fittings. Show fitting dimensions. Show glass and resin content of walls.

e. Submit calculations signed and sealed by a Florida licensed Professional Engineer, showing determination of duct and fitting wall thickness and reinforcement based on internal pressure, external loading, and the allowable values used in the design criteria.

f. Submit manufacturer's recommended torques for tightening bolts on flanged connections.

g. Provide ASTM E-84 Steiner Tunnel test results attached as part of the submittal packet.

h. Samples, representative of the ductwork, construction method and material used to be supplied on this project.

i. Clearly mark all drawings and data to show only items applicable to work. Show all data, schedules, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.

j. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.

k. List of 5 operating installations to demonstrate compliance with the requirements.

   (1) Provide current (verified) contact information for each installation.

l. Paint manufacturer’s product data and specifications indicated conformance to shop painting requirements specified including statement of compliance for compatibility.

m. Manufacturer’s literature as needed to supplement certified data.

n. Submit details of:

(1) Resin Type

(2) Types and amounts of filler

(3) Corrosion liner description

(4) Reinforcement types for hand lay-up or chopped laminates

(5) For filament-wound laminates:

(6) Helix angle

(7) Glass content range

(8) Strand yield

(9) Strand by inch in the winding band

(10) Ply thickness

(11) Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate.

(1) For all Fabricated parts:

(a) Construction type

(a) Laminate thickness

(b) Ply sequences

(c) Glass content range

(12) For all secondary overlays (both interior and exterior):

(a) Laminate thickness

(a) Ply sequences and widths

(b) Construction details for all other special configurations and fabricated parts.

o. Submit manufacturer's documentation verifing AMCA licensed/Certified FRP dampers. Submit leakage and pressure drop information from testing performed in a n AMCA accredited lab

p. Shop and Field inspections reports.

q. Recommendations for short and long term storage.

r. Number of service technician days provided and per diem field service rate.

s. Manufacturer’s product data, specifications, and color charts for shop painting.

t. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.

u. Material Certification:

(1) Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

(2) Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

4. A copy of the contract drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. All changes and clarifications shall be indexed to a list detailing each change and clarification If no changes are required,

mark all drawings with “No changes required” or provide a statement that no changes are required.

a. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

5. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

D. Quality Assurance

1. Provide in accordance as specified herein.

2. Duct work and appurtenances shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

3. Shop tests as specified.

4. Ductwork and appurtenances regardless of manufacturer as a complete integrated system to ensure proper coordination, compatibility and operation of the system.

5. The duct manufacturer shall have a qualified Service Technician, at the job site to insure proper installation procedures are followed for a minimum of two days.

6. When duct system is complete the duct manufacturer shall have a qualified Service Technician inspect the duct

system and provide a written certification that it is installed properly and is ready for operation.

a. Service Technician must have a minimum of five (5) years of experience servicing the type and size of equipment specified, all within the last seven (7) years.

b. Any additional time required of the factory trained service technician to assist in placing the equipment in operation or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

E. Delivery, Storage and Handling

Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

PART 2 - PRODUCTS

A. FRP Duct

1. Materials and Fabrication:

a. Type: Filament wound.

b. Minimum wall thickness, inches, in accordance with SMACNA Table 5-7 and as specified:

(1) 2-inch through 14-inch: 0.145

(2) 16-inch through 22-inch: 0.180

(3) 24-inch through 30-inch: 0.220

(4) 32-inch through 36-inch: 0.260

(5) 42-inch through 48-inch: 0.300

(6) 54-inch through 60-inch: 0.340

(7) Wall thickness of the duct furnished shall not at any point be less than specified minimum wall thickness when measured in accordance with ASTM D3567.

(8) Provide all buried duct designed per AWWA M-45 Standards and rated for H-20 Loading.

(9) Rectangular ductwork thickness: As specified in SMACNA and as specified and indicated. In no case shall the rectangular duct thickness be less than substituting the long side of the rectangular duct for the round equivalent thickness.

c. Provide all ducts designed for not less than 60 inches water column pressure, and 20 inches water column vacuum.

d. The design, applicable construction, and inspections shall be in accordance with SMACNA, and visual inspection criteria in accordance with ASME RTP-1. Table 6, Visual Level II.

e. Provide a minimum structural safety factor of 4 in the design of all ducting.

f. Maximum deflection of rectangular ducts under deadload and operating conditions: Not to exceed 1 percent of the width of the longest side.

g. Resin: Hetron 992FR, Derakane 510 or equal, selected to meet the exposures and temperatures of the air to be exhausted.

h. The resin system should provide a class 1 flame spread rating, Antimony, Nyacol or any other additives are not allowed.

i. Minimum barcol hardness: 36.

j. A thixotropic agent for viscosity control may be used as recommended by the resin manufacturer. No thixotropic agent is to be used in the corrosion liner or on surfaces to be in contact with the corrosive environment.

k. Flame spread rating: 25 or less per ASTM E-84.

l. Catalyst: DHD9 or High Point 90 per resin manufacturer.

m. Corrosion liner:

Inner surface: One ply of 10 ml thick minimum C-glass surfacing veil saturated with vinylester resin.

(1) Provide the surface veil overlapped a minimum of 1 inch with two (2) layers of 1-1/2 oz./sq. ft. chopped strand mat following the surface veil layers.

(2) Corrosion liner is to gel completely before proceeding with structural laminates. In no case shall the interruption exceed 12 hours.

(3) Total liner thickness: 100 mils minimum.

(4) No thixotropic agent or fire retardant additive is to be used in the liner resin.

(5) Corrosion liner: Not less than 20% or more than 30% glass by weight.

(6) Provide liner passing ASME RTP-1 Table 6, level II visual inspection. Total glass content 25% to 30 %.

n. Structural layer: Filament wound of Hetron 992FR, or Derakane 510 premium grade, vinylester resin and Type E 250 strand yield continuous glass roving.

(1) Band width: 2.25 inches using (7) strands per inch.

(2) Filament winding cycle thickness: 0.06 inches maximum.

(3) Glass content 55% to 65 %.

(4) Winding angle: 65 to 90 degrees ± 2 degrees for increased vacuum service.

o. Provide the exterior of all laminates containing sufficient resin to insure a relatively smooth surface free from exposed glass fibers or sharp projections.

p. Provide an ultraviolet stabilizer added to the final gelcoat.

q. Provide ductwork located outdoors with an exterior gelcoated colored surface.

(1) Color: White or as selected by Owner.

r. Provide ductwork located indoors with two (2) coats of PPG 42-7 Intumescent paint to provide a class 1 flame and smoke rating.

s. ASTM E-84 Steiner Tunnel test results shall be attached as part of the submittal packet.

t. Standard lengths: Provide in accordance with the manufacturers published product data sheets and approved shop drawings.

u. Duct stiffness: Minimum rated stiffness in accordance with ASTM D2412 for the pipe laying conditions.

v. Markings on duct and spool pieces shall be in accordance with shop drawings.

2. Manufacturers:

a. Spunstrand

b. Harrington Plastics

c. Ershigs/Belco Manufacturing

d. Augusta Fiberglass

e. Midwestern Fabricators

f. ECS Environmental

B. Fittings and Joints

1. Fittings:

a. Hand-lay up construction fabricated from the same resin and have the same strength as the FRP ductwork.

b. Internal diameter of all fittings: Equal to the adjacent duct.

c. Tolerance on angles of all fittings: +/- 1 degree for 24 inch [300 mm] diameter and smaller and +/- 1/2 degree for 30 inch [750 mm] diameter and larger.

d. Geometry of all fittings shall be per SMACNA standards.

2. Elbows:

   a. Radius: 1.5 times the duct diameter.

   b. 24-inch and smaller: Smooth radius.

   c. 30-inch and larger: Mitered.

   d. Bends 30 degrees and less: 1 miter, 2 piece

   e. Bends 31 degrees to 60 degrees: 2 miter, 3 piece

   f. Bends 61 degrees to 90 degrees: 4 miter, 5 piece

3. Turning Vanes

   a. Provide turning vanes and splitters at all single mitered bends 46 degrees and greater and similar fittings that are not one-piece smooth radius fittings per SMACNA and ASHRAE standards.

   b. Turning Vanes: Filament wound and reinforced with unidirectional glass, metallic vanes are not acceptable.

4. Flange Joints:

   a. Provide flanged connections at flexible connectors, expansion joints, vessels, grease filters, fans, and other locations as indicated.

   b. Flanges:

      (1) Hand lay-up construction with dimensions in accordance with ASTM D3982 and the Duct Dimension Schedule.

      (2) For locations to connect duct to ductile iron drain piping, flanges shall be furnished to connect to a standard solid back, Class 125 flange per AWWA C115.

   c. Flanges shall be drilled in accordance with ASTM D3982. Backs of flange face shall be flat so that washer seats fully on bolt face and flange backing.

   d. Flange Faces: Perpendicular to the axis of the duct within 1/2 degree.

e. Flange Faces: Flat to within +/- 1/32 inch for sizes 18-inch and smaller and flat within +/- 1/16 inch for sizes 20-inch and larger.

f. Gaskets: EPDM, full face, minimum 1/8-inch thick.

g. Hardware: Type 316 stainless steel.

5. Duct Joints:

a. Butt and wrap joint type connections.

b. Fittings: Butt and wrap joint type connections.

c. Apply adhesive material for field joining in rolls and resin containers no larger than five gallons.

d. Provide all joints per SMACNA standard, and per manufacturer’s laminate schedule and procedures.

C. Expansion Joints

1. Expansion Joints:

a. Provide expansion joints where indicated and where required for flexibility and to accommodate the pipe support system.

b. Provide flanged joints where connecting ductwork to vessels, grease filters, fans, equipment and other locations as indicated.

c. Provide slip-type joints where flanges joints are not specified or indicated.

d. Type: W-design configuration with integral flanges suitable for service with FRP duct under the conditions specified and indicated.

e. Material: EPDM

f. Backing Rings: 3/8 inch thick, 2 inches wide, Type 316 stainless steel.

g. Extension: 3 inches.

h. Compression: 2.5 inches.

i. Lateral Offset: 2.5 inches.

j. Thickness: 1/4 inch minimum.

k. Bolts, Nuts and Washers: Type 316 stainless steel.

2. Manufacturers:

a. RM-Holz

b. Metraflex

c. Garlock

d. Mercer

e. Or acceptable equivalent product

D. Duct Drains

1. Provide 1-1/2 inch minimum schedule 80 PVC pipe and Type 301 Ball Valve duct drains with traps as indicated on all low points in all main, branch and riser ducts to allow removal of condensate.

a. Provide piping in accordance with Section 15294 and valves in accordance with Section 15100.

b. Insulate all exterior above-grade drain, traps and piping with 1-inch of insulation.

c. Coating of pipe shall be in accordance with section 09900. Pipe labeling shall be in accordance with section 15075.

E. Dampers

1. Dampers to be AMCA licensed/Certified FRP Dampers.

2. Provide factory fabricated dampers conforming to AMCA 500D requirements and as specified.

3. Provide FRP dampers manufactured from the same materials and resin as specified for duct.

4. Materials and Construction:

a. Blades: Two (2) piece, molded premium vinyl ester including blade stiffeners. Provide damper blade offset 5 degrees in the closed position to form a normal stop.

b. Axle: Pultruded FRP made of the same resin as specified for the duct and continuous strand roving.

c. Control Shaft: Provide axle extending 6 inches beyond frame, full length vinylester with Type 316 stainless steel pins embedded transverse of axle.

d. Bearings: Molded PTFE with 10% carbon and graphite fill.

e. O-Rings: Viton.

f. Metallic parts in contact with the air stream are not acceptable.

5. Provide the following type of dampers for the service specified:

a. Unless otherwise noted, all dampers are assumed to be for isolation purposes.

b. Isolation damper:

(1) Butterfly type, Swartout Model 914, Belco Model 203, ECS Model X02 or acceptable equal. Must be licensed to bear the AMCA seal.

(2) Dampers shall be equipped with shaft seal, and full circumference extruded double tadpole blade seals.

(3) Butterfly damper leakage: Shall be AMCA leakage rated not to exceed 0.75 CFM/SQ. FT. at 30 inches wg.

(4) 30 inch wg. maximum pressure, 200 degrees F maximum temperature.

(5) All isolation dampers shall bear AMCA seal for both air leakage and performance

(6) Provide motor operator for each isolation damper.

c. Volume damper:

(1) Same as isolation damper except full circumference blade stop in lieu of blade seal.

(2) Provide manual operator for each volume damper.

6. Provide manual dampers with manual operator identified with OPEN and CLOSE positions.

7. Dampers shall be of self-supporting construction and shall not deflect or deform while free standing.

8. Dampers shall have flanged ends for connection to ductwork and equipment.

9. Manual Operators:

    a. Dampers 16-inch and larger: Provided gear operators with an epoxy coating.

    b. Dampers 14-inch and smaller: Provide hand quadrant actuators fabricated of Type 316 stainless steel with a 5-stage locking quadrant indicator.

    c. Volume Dampers: Provide a fully adjustable slot with an extra hole drilled in the handle for contractor to "drill and pin-in place" once system is balanced so handle cannot vibrate loose.

    d. Chain wheel operators: Provide galvanized steel chainwheels with galvanized steel chain and chain guides for all dampers with operator or gear operators higher than 6.5 feet above operating floor level.

        (1) Provide chain that reaches to within 3 feet of the operating floor level.

        (2) For dampers with gear operator mount with chainwheel in the vertical position.

10. Motor Operators:

    a. Provide 120 VAC electric or electronic actuators for isolation dampers.

    b. Provide direct-drive actuators except where indicated otherwise. Each actuator shall deliver the torque required for continuous uniform motion and shall have internal end switches to limit the travel, or be capable of withstanding continuous stalling without damage. Provide actuators with hardened steel running shafts and gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch-pounds. Provide two-position actuators of spring return type.

Actuators shall be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments, as applicable. Each actuator shall have distinct markings indicating the full-open and full-closed position, and the points in-between.

c. Actuators shall function as specified within 85 to 110 percent of their power supply rating. Actuators shall fail to their spring return positions on signal or power failure. Actuators shall have visible position indicators. Actuators shall open or close the devices to which they are applied within 60 seconds after a full scale signal input change.

d. Damper actuators shall be rated for at least 150 percent of the motive power necessary to operate the connected damper. The actuator stroke shall be limited by an adjustable stop in the direction of the return stroke. Actuators shall be provided with mounting and connecting hardware.

F. Air Inlets

1. Material compatible with ductwork system specified.

2. Provide Type 316L stainless steel wire mesh bird screen for all fresh air intakes.

3. Each air exhaust shall have a volume damper as indicated and specified.

G. Duct System Supports

1. Duct Support:

a. Provide supports for all ducts designed and furnished by the duct system supplier in accordance with Division 15 and as specified herein.

b. Provide hanger spacing as indicated in ASTM D 3982.

c. Provide ductwork supported from structure by straps or rods. Provide Type 316L stainless steel angle iron brackets to support ducts where structure is not available.

d. For exterior duct, design and provide free standing duct supports to meet specified duct spacing requirements and specified loads.

e. Provide anchors, inserts or clamps to secure hangers to structures. Provide Type 316 stainless steel anchors, screws and bolts. Provide in accordance with manufacturers recommendations and Factory Mutual limitations and restrictions.

H. Exterior UV resistant Coating

1. Factory applied corrosion resistant gel coat with UV inhibitors. White or as selected by the Engineer shall be used as standard color.

I. Spare Parts

1. Provide in accordance with Division 1 and as specified herein.

2. Provide the following spare parts, all identical and interchangeable with similar parts installed in Work:

a. Two spare gaskets of all types, materials and sizes.

b. One (1) set of all special tools

PART 3 - EXECUTION

A. Installation

1. General:

a. Install ducts, dampers and appurtenances in accordance with manufacturer’s recommendations.

b. Prior to installation, inspect each duct length and all fittings, flush clean of any debris or dust, and straightened, if not true. All duct and fittings shall be equally cleaned before assembly.

c. Provide all materials and equipment required.

B. Ductwork

1. Assemble per SMACNA, or NIST Standards as specified hereinbefore.

2. Do not exceed 6-ft. spacing of hangers on horizontal ducts; 4-ft. on vertical ducts.

3. Support ductwork from structure by 16-gauge straps. Use hanger material compatible with ducts; use angle brackets to support vertical ducts.

4. Use anchors, inserts or clamps to secure hangers to structures; use stainless steel anchors if drilled-in type are installed.

5. Install duct connections to masonry openings airtight. Pack the space between the sleeve and framed prepared opening and the duct and the duct insulation with mineral wool or other FM approved fire resistant material.

6. Flanged connections to equipment, 3-in. minimum length.

7. FRP ductwork:

   a. Joints, finished joints in accordance with ASTM D3982 Standards.

C. System Balancing:

1. The testing and balancing shall be performed by an independent certified testing and balancing company not associated with the manufacturer or the contractor that is competent, experienced and has formerly done similar work and whose qualifications and performance shall be subject to the approval of the Engineer.

2. The testing and balancing company shall be responsible for all testing and balancing of all odor control ductwork up to and including the odor control fan.

3. Furnish the necessary labor, materials, instruments and devices required to test, adjust and balance the air system.

4. Adjust manual and automatic control devices to balance air flows so they perform as indicated and specified.

5. Balance air systems so each outlet is within 10-percent and each fan is within 5-percent of values indicated.

6. Submit a certified report to the Owner outlining balancing procedures used; report to include:

a. Type of measuring devices used.

b. Air quantities at each outlet, damper and fan.

c. Fan speeds.

d. Fan suction and discharge pressures.

e. Air quantities through fan, by test and by summation of air quantities at outlets.

D. Field Touch-Up Painting

After installation and approved testing by the Engineer. Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

E. Contract Closeout

Provide in accordance with Section 01700.

END OF SECTION

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SECTION 15855 DIFFUSERS, REGISTERS & GRILLES

PART 1 - GENERAL

A. SUMMARY

This Section includes registers, and grilles.

B. SUBMITTALS

Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

A. MANUFACTURERS

In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2. Products: Subject to compliance with requirements, provide one of the products specified.

3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

5. See plans for schedule of basic of design.

B. SOURCE QUALITY CONTROL

Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

A. INSTALLATION

1. Install diffusers, registers, and grilles level and plumb.

2. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

B. ADJUSTING

After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 15857 ODOR CONTROL SYSTEMS – CARBON

PART 1 - GENERAL

A. Description

(NTS: Revise this Section by inserting the required percent removal and expected PPM hydrogen sulfide at the scrubber influent to suit the project conditions.)

Provide dual-bed carbon odor control systems as indicated and in compliance with Contract Documents.

Scope includes:

a. Furnish, install and test an odor abatement system capable of handling and removing hydrogen sulfide and sewage vapors, complete, with all appurtenances to make it operable, as indicated and as specified.

b. The odor abatement system consists of a vertical dual bed activated carbon adsorber system, complete with fans, fan sound enclosures, grease filter/mist elimination, grounding, motors, valves, gauges, piping, ductwork, control panel and appurtenances, as indicated and specified.

c. Provide system and components rated for 24 hour per day operation, continuous duty.

d. Carbon Replacement Guidelines:

1) Odor control equipment provided shall allow for carbon removal and replacement by means of a vacuum truck.

e. Fans shall be suited for moist, dirty, corrosive air without the need for up-stream filtration of air entering the fan.

f. Obtain all state, local or federal permits.

B. References

1. Air Movement and Control Association (AMCA):

a. 210 Test Code

b. 300 Test Code

c. 500D: Laboratory method for Testing Dampers for Rating.

2. American Society for Testing and Materials International (ASTM):

a. A36: Standard Specification for Carbon Structural Steel.

b. C582: Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment

c. D2867: Standard Test Method for Moisture in Activated Carbon.

d. D3299: Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

e. D4097: Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

f. D4167: Standard Specification for Fiber-Reinforced Plastic Fans and Blowers

g. D5158: Standard Method for Determination of Particle Size of Powered Activated Carbon by Air Jet Sieving

h. D6646: Standard Test Method for Determination of the Accelerated Hydrogen Sulfide Breakthrough Capacity of Granular and Pelletized Activated Carbon

i. E84: Standard Test method for Surface Burning Characteristics of Building Materials.

3. Fiberglass Reinforced Plastics Institute, Inc. (FRPI):

a. Laminate Certification Manual.

4. National Bureau of Standards (NBS):

a. PS 15: Custom Contact Molded Reinforced Chemical Resistant Process Equipment.

C. Qualifications

1. Manufacturer is required to provide satisfactory experience in the design and manufacturing of odor abatement equipment for removal of hydrogen sulfide and other odorous compounds at municipal wastewater treatment facilities.

2. As of the date in which Bids are submitted, the manufacturer shall have a minimum of ten (10) operating installations with equipment of the equivalent size and similar service conditions as specified herein operating for not less than three (3) consecutive years from final completion of the respective project of the installation. The installations must be within the contiguous lower forty-eight (48) States of the United States of America.

D. Submittals

Submit the following in accordance with Section 01300:

1. When the Contractor proposes tanks which requires an arrangement differing from that indicated on the drawings or specified, prepare and submit for review detailed structural, mechanical, and electrical drawings and equipment lists, utilities consumption schedule and operating instructions, showing all necessary changes and embodying all special features of the equipment he proposes to furnish. Make changes, if accepted at no additional cost to Owner.

2. Certified shop and working drawings. Drawings for the vessels and fans shall also include a complete description of the laminate construction as specified within this section and be accompanied by a detailed postcure procedure that will be utilized.

    a. Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provide a statement indicating that the information is proprietary and is being omitted.

    b. Files shall include Tag Names, Parts List (identifying each component), Dimensions, and connection sizes.

c. Files shall be drawn to scale.

d. Drawings shall be in conformance with all other requirements as specified in this specification.

3. Provide signed and sealed design calculations for unit to include construction, internal support system and anchoring system by a structural engineer, registered in the State of Florida.

4. The Contractor shall submit Certificates of Analysis from the activated carbon supplier indicating the proposed carbon meets the specifications. Test Reports on the representative samples of GAC shall contain the following information.

   a. Hydrogen sulfide (H2S) capacity,

   b. Mesh size confirmation

   c. Moisture, (percent as packed)

5. Provide a written statement certifying that the sample of the carbon material is representative of the carbon media that will be shipped and installed under this contract.

6. Schematic and wiring schematic with interconnection diagram showing description of operations. List component identification of schematic diagrams as stated herein, along with component instruction manual references.

7. Manufacturer’s literature and specifications. Show catalog dates.

8. Operating and maintenance instructions and parts list.

   a. In operating instructions incorporate a functional description of entire system including system schematics.

   b. In maintenance instructions, clearly define requirements for particular system and show special calibration and test procedures.

9. Clearly mark all drawings and data to show only items applicable to work. Show all data, nozzle schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.

10. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.

11. Submit details of:

    a. Resin Type

    b. Types and amounts of filler

    c. Corrosion liner description

    d. Reinforcement types for hand lay-up or chopped laminates

12. Shop test results.

13. Motor shop test results.

14. Qualifications of field service technician.

15. Schematic control and power wiring diagrams.

16. Shop and Field inspections reports.

17. List of recommended spare parts other than those specified.

18. Recommendations for short and long term storage.

19. Special tools.

20. Shop and field testing procedures and equipment to be used.

21. Number of service technician days provided and per diem field service rate.

22. Manufacturer’s product data, specifications, and color colour charts for shop painting.

23. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.

24. The most recent ISO 9000 series certification.

25. Material Certification:

    a. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated. Provide proposed materials at no additional cost to the Owner.

    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

26. In order to demonstrate satisfactory experience and qualifications, provide an installation list for a minimum of ten (10) operating installations with equipment of the equivalent size and similar service conditions as specified herein operating for not less than three (3) consecutive years from final completion of the respective project of the installation. The installations must be within the contiguous lower forty-eight (48) States of the United States of America. At a minimum the reference information shall include the following;

    a. Current Owner Reference Contact Information

    b. Installation Service Conditions

    c. Equipment Model Numbers

    d. Date of Final Completion of the Project

27. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".

    a. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.

28. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

    a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

    b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in rejection of the entire submittal with no further review and consideration.

E. Spare Parts

1. Provide in accordance with Section 01600 and as specified herein.

2. Furnish and deliver to Owner at site of Work the following spare parts, all identical and interchangeable with similar parts installed in Work:

    a. One of each type pressure gauge, with diaphragm seals or plain, as necessary.

    b. Two spare gaskets of all types, materials and sizes.

    c. Complete set of replacement belts.

F. Special Tools

Provide one 40-inch long grain sampler for obtaining carbon samples from adsorber vessel. Sampler to consist of two polished brass telescoping slotted tubes.

G. Quality Assurance

1. Comply with the requirements specified in Section 01410.

2. Systems shall be the product of one manufacturer.

3. Systems shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

4. Do work required by and in accordance with applicable State and local codes; arrange for permits, inspections and tests required by these codes; and provide complete systems ready for use. Provide tanks and accessories that conform to applicable safety standards including those for safety of personnel.

5. Provide components to manufacturer's standard for service specified and indicated unless otherwise required.

6. Provide components and accessories of manufacturers' latest and proven design.

7. Coordinate the work schedule of other parts of the chemical systems manufacturer's service personnel during construction, testing, start-up, and acceptance, to coordinate with the tank manufacturer.

8. Services of Manufacturer's Representative as stated in Section 01600 and as specified herein.

9. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

   a. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

b. Preliminary Matters, per Section 01664: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

1) 1 person-days.

c. System Start-Up Testing, , per Section 01664: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

1) 2 person-days.

d. System Testing, per Section 01664: Field performance test equipment specified.

1) 3 person-days.

e. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

1) 1 person-days.

f. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

g. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

10. Manufacturer of odor abatement systems shall have a minimum of five (5) operating installations with control systems of the size specified and in the same service as specified operating for not less than five (5) years.

11. If equipment proposed is heavier, larger, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

a. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

H. Delivery, Storage and Handling

Comply with the requirements specified in Section 01600.

PART 2 - PRODUCTS

A. Activated Carbon

1. Provide activated carbon to fill each reactor vessel. Volume of carbon required shall be based upon the performance criteria as specified within this specification.

2. The activated carbon shall be virgin, un-impregnated granular activated carbon, derived from bituminous, sub-bituminous or lignite coal.

3. The activated carbon shall be suitable for vapor phase adsorption of Hydrogen Sulfide and other odor odour causing compounds such as mercaptans typically found in vapors emitted by the wastewater treatment process.

4. Activated carbon shall conform to the following minimum requirements:

H_2S breakthrough capacity (Per ASTM D6646)	g H_2S removed/cc	0.3 minimum
Moisture (per ASTM D2867)	wt. percent	8 maximum
Mesh size (per ASTM D5158) Greater than 4 Mesh (4.75 mm) Less than 8 Mesh (2.36 mm)	 percent percent	 10 maximum 5 maximum

5. Submit a certificate certifying that the carbon meets the specified requirements.

B. Adsorber Vessel

1. Provide carbon bed adsorber of filament-wound fiber glass conforming to ASTM D3299 or contact-molded

fiberglass conforming to ASTM D4097. Fabricated in conformance to NBS PS-15-69 Standard.

2. Provide equipment suitable for continuous exposure to saturated water vapor, hydrogen sulfide gas, and associated acidic products. Provide a certification from the resin manufacturer listing the nomenclature, composition, and characteristics of the resin supplied with the submittal data. The exterior of the vessel shall incorporate a UV resistant coating.

3. Resin shall be Ashland Derakane 411 or Hetron 922, Reichhold 9800, or CORVE 8401. Resin shall be suitable for continuous immersion in the liquid described herein and shall be resistant to those fluids as defined by ASTM C581.

4. The resin system should provide a class 1 flame spread rating. Antimony, Nyacol or any other additives are not allowed.

5. The visual defects, per ASTM D2563, shall not exceed Level II on the vessel interior and Level III on the vessel exterior.

6. Wall Laminate:

   a. Inner corrosion barrier, resin rich barrier of 10-15 mils minimum not to exceed 20 percent +/- 5 percent glass by weight. Glass shall be of non-continuous fiber.

   b. Provide the inner corrosion barrier followed by not less than two layers of chopped-strand mat or two passes of chopped roving to a total of 3 ounces/square foot. The interior layer shall be formed, not sprayed. Should the chopped roving technique be employed, the chopped fibers shall be 1/2-inch length.

   c. The inner corrosion barrier plus the two mat layers shall total 100 mils, minimum and be 27 percent plus or minus 5 percent glass by weight.

   d. The exterior layer shall be comprised of 1.5 ounces per square foot chopped strand mat or equivalent weight of chopped roving.

e. In addition to the above requirements provide vessel with average glass content by weight of 55 percent, plus or minus 5 percent.

f. Minimum adsorber vessel wall thickness: 3/8-inch.

g. The manufacturer will submit certified test results on physical properties of laminate with submittal data. Vessels not to be painted, but have clear ultraviolet adsorbers in the final resin coat. Final gel coat color shall be selected by the owner.

7. Ultraviolet Protection: Provide ultraviolet protection in the form of a surface coating of a permanent resin-rich exterior layer, pigmented white. Surfaces shall be smooth, hard, and glossy.

8. All nozzle fittings: Flanged, one-piece, contact-molded construction, except pressure taps threaded replaceable Type IV Grade 1 CPVC bulkhead fittings with gaskets. Face and drill flanges to 125-pound ANSI Standard, pressure rated for 25 psig. Project flanges 4-inch from vessel surface and reinforce with four well-bonded gusset plates which extend to outside edge of flange. Do not use laminated or encapsulated bolts and fasteners, but make them replaceable.

9. All cut-walls shall be reinforced as required.

10. The adsorber vessel, if necessary, constructed in sections of appropriate height with flanged or other acceptable joints to allow the equipment to be placed in the building. Furnish suitable gasket for flanged joint.

11. Locate all fittings as indicated and specified. Provide adsorber with inspection-access hatch, drain nozzles, chemical feed nozzles, pressure gage taps, air inlet and outlet connections.

12. Design adsorber vessel to withstand full range of pressure conditions to which it may be subjected, including flooded tank due to the operation of the fire suppression sprinkler system.

13. Equip adsorber with anchor pads, bolts, washers, and lifting lugs necessary for field erection. Anchor bolts and washers 316 stainless steel, 1/2-inch minimum bolt.

14. Provide three samples probes at 9-inch intervals below the top of each carbon, extending into the carbon bed 1 foot minimum. Probe sized for adequate extraction of air samples from the carbon bed and be nonblinding. Extend probes outside the vessels wall and blocked off with a ball valve and cap.

15. Carbon bed support system as recommended by the manufacturer.

16. Grease Filter/Mist Elimination (GFME):

    a. Provide a particulate filter consisting of a Type 316L stainless steel pad for grease and particulate filtration in front of a polypropylene (PPL) pad with Type 316 stainless steel grid for mist elimination, housed inside a PPL, FRP, or HDPE enclosure.

    b. Minimum combined thickness of 8 inches.

    c. Provide the pads removable for cleaning and the housing with a hinged door and quick-latches or drop-out flange on either side of the filter housing, to allow removal and replacement of the filter pads.

    d. Particle removal efficiency shall be 99% of particles 10 microns or larger.

    e. Provide a Dwyer Series 2000 Magnehelic differential pressure gauge installed on the housing to indicate pressure drop through the unit. Provide the PPL or FRP housing flanged and drilled per NBS PS 15-69 and complete with EPDM gaskets, ready for installation.

    f. GFME shall be installed in the orientation as indicated. Provide supports. Elevate unit sufficiently to allow drain line with minimum 8 inch deep trap. Drain line shall be full size of combined drain connections on GFME unit or 1-1/2 inch, whichever is larger. Drain line shall be in accordance with duct drains specified in Section 15855.

    g. The Contractor is responsible to provide a structural support system, spray and drain piping as specified by the GFME manufacturer for a complete

operating system. Provide isolation valves and pressure reducing valves as specified by the GFME manufacturer.

C. Structural Design

Design tower, stacks, baseplate, anchors, anchor bolts, fan sound enclosure and top flange per the following requirements:

1. Design the fan sound enclosure, stacks, tower and anchorage system per the 2010 Florida Building Code (FBC) requirements supplemented by ASCE 7-10 for wind loading requirements:

BASIC WIND SPEED, MPH:	150
RISK CATEGORY:	3
EXPOSURE:	B

2. 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. Maximum hoop stress shall not exceed 1/10 of the ultimate hoop strength of the laminate.

3. Provide with the Certificate of Unit Responsibility, certification for all equipment signed by a structural engineer, registered in the State of Florida, stating that computations were performed and that all components have been sized for the wind load specified and indicated. Provide signed and sealed calculations by a structural engineer, registered in the State of Florida.

D. Static Grounding Of Carbon Bed

Include provisions to adequately ground the carbon bed. Details should be submitted to demonstrate that the carbon bed will be adequately grounded. Provide stainless steel 2-hole ground pads at each vessel and associated grounding materials and hardware for connection to the system grounding grid.

E. Fiberglass Reinforced Plastic (FRP) Ductwork

Provide in accordance with Section 15850.

F. Dampers

Provide in accordance with Section 15850.

G. Motors

1. Motors shall be provided in accordance with Section 16150.

2. Equipment Tag Numbers: 650-B-1 & 650-B-2

Location:	Odor Control System (Process 650)
Rated capacity:	12,200 cfm
Differential pressure at rated capacity:	12-inch W.C.
Motor horsepower (minimum):	75.0

3. Motor enclosure and speed: As indicated in the Fan Schedule within the Drawings.

4. Provide flex-coupled motors with base supports.

5. In addition to the requirements for bearings specified under Electric Motors in Section 16150, provide motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

6. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

7. Operate without overheating at the speeds specified and indicated.

8. Service Factor: 1.15.

9. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

10. Rating: 480575V, 3-phase, 60 Hertz.

11. Insulation: Class F with Class B temperature rise, 50 degrees C ambient.

12. Site Altitude: 90 feet above Sea level.

H. Gasketing and Sealing

1. Flanged nozzles: Viton or hypalon full face gaskets of 50 to 60 Shore “A” Durometer hardness.

2. Fabricated gaskets: Machine-made or die-stamped with inside and outside edges parallel or concentric, as applicable. Make bolt holes oversized to prevent crimping of gasket when installed.

I. Carbon Adsorber Accessories

1. Overflow, and drain connections furnished with Schedule 80 CPVC pipe, fittings and ball valves. Provide clear PVC pipe for overflow.

2. Piping: Provide in accordance with Division 15.

3. Valves: Provide in accordance with Division 15.

4. Provide a Magnehelic differential pressure gauge installed on the housing to indicate differential pressure across each carbon bed. Tank mount with enclosure, calibrated in inches of water and column.

5. Blank flanges, material same as vessel, with bolts for air inlet connection.

6. Lifting and hold down lugs.

J. Fans

1. Manufacturers:

a. Hartzell

b. New York Blower Company

c. Verantis Environmental Solutions Group

2. General:

a. AMCA rated and constructed.

b. Impeller wheels statically and dynamically balanced within vibration and noise limits.

c. Provide electric motor, drive equipment, belt guard, vibration isolators, supports and appurtenances.

d. Design fan with non-overloading characteristics for the horsepower indicated.

e. V-belt drive rated 50 percent greater than motor horsepower with adjustable sheaves to provide fan speeds 10 percent above or below rating point.

f. Provide electric motors mounted on adjustable ASTM A36 steel plate.

g. Provide fans with backward-inclined blades designed to operate within motor nameplate rating at all speeds provided by adjustable-pitch sheaves.

h. Provide integral or supplementary vibration or sound-adsorbing fan mountings.

3. Centrifugal Fan:

a. Single-width, single-inlet, multiblade design, backward-inclined blades. Drive motor, fan and casing mounted on common rail or support base with vibration isolators.

b. Construct fan of fiber glass reinforced polyester. Encase Type 316 stainless steel shaft in an FRP sleeve.

c. Flanged inlet and outlet connections.

d. Provide a casing drain with ball valve and cap.

e. Shaft Seal: Viton

f. Fan shaft shall be ground and polished Type 316 stainless steel. Bearings shall be located in an enclosed drive compartment and shall be heavy-duty, self aligning, with extended lube tubes for continuous service, with a minimum of 50,000 hrs. L10 life. A neoprene shaft seal shall be located where the shaft enters the inner bearing housing with a neoprene shaft slinger between the seal and wheel.

g. Fan assembly:

1) Dynamically balanced and completely assembled at the factory prior to shipping. All fans shall meet balance requirements of the Acoustical Society of American Standards. Fan construction shall conform to ASTM Standard D4167 for fiber reinforced plastic fans and blowers. Fan performance shall be tested in an AMCA Registered Test Laboratory in accordance with AMCA 210 Test Code for air performance and AMCA 300 Test Code for sound. Fans shall be licensed to bear the AMCA Certified Air Performance Rating Seal.

h. Accessories:

1) Provide motor cover and belt guard of epoxy coated steel.

2) Provide a belt guard of epoxy coated steel for covering belts and motor sheave.

3) Provide electrical grounding of fan housing to motor frame.

4) Provide Type 316 stainless steel hardware.

i. Provide motors in conformance with Section 16150 and as specified and indicated.

K. Acoustical Enclosure

1. Structural design of the enclosure shell be provided in conformance with 2.03.

2. Sound Transmission Classification of each enclosure shall not be less than STC 40. Enclosures shall be weatherproof with single pitch or double pitch minimum 1:12 sloped roof. Inside dimensions of enclosure shall be minimum 2.0 feet greater than overall Provide the sound enclosure of materials compatible with the environment in which it is operating and enclosing the entire fan assembly.

3. Fabricate the exterior of the enclosure of fiberglass or Type 316 stainless steel.

4. Provide an enclosure of unitized welded, bolted or screwed panel construction.

5. Access Covers:

    2. Provide hinged access covers on all sides and top of the enclosure with lockable latches, locks and keys, 2 sets.

    3. Checking, changing and adding lubricant to be capable of being performed without unmounting or removing enclosure and without the use of tools to open the enclosure.

6. Cooling and Insulation:

    a. Fabricate the enclosure so that the air is controlled and directed over the motor.

    b. Provide sound attenuation for cooling air outlet. Interior surface of the enclosure: 2-inch urethane foam with a protective film that is washable and free of perforations and/or materials that would accumulate oil and dust.

    c. Provide acoustical make-up air louver, exhaust fan and reverse acting thermostat set for 90 degrees F sized to remove all heat gains inside the enclosure.

7. Provide the enclosure as an integral part of the blower assembly and if size permits ship the blower assembly with the enclosure mounted so that factory quality, as tested, shall be consistent with all units.

8. Maximum noise level at 3 feet from enclosure: 80 dB(A).

L. Shop Painting

1. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with Section 09900.

2. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

3. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

M. Interconnecting Ductwork

1. Provide the ductwork between the reactor vessel and the odor control fan by odor control manufacturer.

2. Provide the ductwork assembly and design compatible with the fan and vessel.

3. Material: Provide in accordance with Section 1585015855.

4. Provide an expansion joint in the ductwork and installed at the outlet of the exhaust fan. The expansion joint shall dampen axial, lateral, and vibrational duct movement. The expansion joint shall be resistant to ultraviolet degradation and to the corrosive gases being processed.

    a. Provide expansion joints in accordance with Section 15850.

N. Flow Control Damper (Balancing)

Provide an opposed multi-blade type damper to regulate airflow through the reactor vessel. The damper shall be supplied loose and be ready for installation into the reactor system supply ductwork. The damper shall be positioned on the outlet side of the fan or as indicated. The damper shall be furnished by the manufacturer of the odor control system.

1. Provide type of operator as indicated.

2. Provide balancing damper in accordance with Section 15850.

O. Control Panel

1. Enclosure:

    a. NEMA 4X Type 316L stainless steel.

2. Completely wire components to terminal boards.

3. Provide with hinged front cover and the following instruments flush mounted:

    a. LOCAL/REMOTE Switch.

b. START-STOP pushbuttons, momentary-contact type with lock-out latch.

P. Equipment Schedule

1. Manufacturers:

a. ECS Environmental Solutions

b. Harrington Industrial Plastics

c. PureAir Filtration

d. Siemens Water Technologies, LLC

e. BioREM

2. Carbon Adsorber:

a. System Air Flow Capacity: 12,200 cfm

b. Carbon Unit Capacity: 12,200 cfm

c. Minimum Carbon Volume: 679 cf

d. Minimum Influent H2S Concentration: 1 ppm

e. Average Influent H2S Concentration: 25 ppm

f. Maximum Influent H2S Concentration: 50 ppm

g. Inlet Air Temperature: 30-110 F

h. Inlet Air Relative Humidity 30-100%

i. Number of Vessels: 1

j. Number of Beds/Vessel: 2

k. Vessel Diameter: 144 inches

l. Vessel Overall Height: 192 inches

m. Vessel Pressure Drop at Design Flow Rate: 9.3 inches WC

n. Maximum Vessel Weight, empty: 5,100 lbs

o. Maximum Weight of Vessel with Carbon: 23,100 lbs

p. Effluent H2S Removal Efficiency: 95% H_2S removal or an effluent concentration of less than 0.1 ppm, whichever is greater.

3. Demister/Grease Filter:

a. System Flow Capacity: 12,200 cfm

b. Maximum System Capacity: 12,200 cfm

c. Pressure Drop at Maximum System Capacity: 1 inch WC

4. Fans: See fan schedule on the drawings\

PART 3 - EXECUTION

A. Installation

General:

1. Install equipment and appurtenances in accordance with manufacturer’s recommendations.

2. Provide all materials and equipment required.

B. Adsorber

1. Install adsorber and all components in accordance with manufacturer’s recommendations.

2. Install adsorber on a concrete pad as indicated on the drawings.

C. Field And Functional Testing

After installation, perform all of the following full operational tests in presence of the Owner. Furnish all labor, materials and equipment required for such tests.

1. Adsorber Vessel:

a. Factory test with water to the height of the overflow or the straight side height of the vessel, greater amount. Submit test data.

b. The water level must be unchanged after 24 hours with no visible signs of leakage or wall deflection exceeding 1/4 percent of span.

c. Hydrostatic test shall be witnessed by the CM.

2. Start-up:

a. Provide the services of a factory-trained service technician, certified by the manufacturer to service the type of equipment herein specified, to assist in start-up operation.

b. Tests to be performed consist of start-up and operation of entire system at design capacity, and verification of operation of drives and other components, without, overheating, leakage, cracking of parts, structural damage, jamming, binding, or other defects.

c. During tests, make observations of fan head, capacity, and motor input. Promptly correct or replace all equipment not conforming to the requirements of this section revealed by or noted during tests at no additional cost to the Owner.

3. In case of failure to demonstrate ability to function as indicated and specified, modify, rebuild or replace equipment or parts thereof at no additional cost to Owner, until equipment is in accordance with specifications. After three (3) unsuccessful test attempts, replace non-conforming equipment at no additional cost to the Owner. Repeat tests until specified requirements have been met, at no additional cost to the Owner.

D. SYSTEM TESTING:

Following the Owner approval of start-up results, provide services of an independent State qualified air testing laboratory to measure and report on efficiency and performance of the odor control system. Submit testing procedures of testing laboratory to the Owner at least 15 days prior to tests. Have manufacturer’s service technician present during system testing.

E. SYSTEM BALANCING:

1. The testing and balancing shall be performed by an independent certified testing and balancing company not associated with the manufacturer or the contractor that is competent, experienced and has formerly done similar work and whose qualifications and performance shall be subject to the approval of the Engineer.

2. The testing and balancing company shall be responsible for all testing and balancing of all odor control ductwork up to and including the odor control fan.

3. Furnish the necessary labor, materials, instruments and devices required to test, adjust and balance the air system.

4. Adjust manual and automatic control devices to balance air flows so they perform as indicated and specified.

5. Balance air systems so each outlet is within 10-percent and each fan is within 5-percent of values indicated.

6. Submit a certified report to the Owner outlining balancing procedures used; report to include:

   a. Type of measuring devices used.

   b. Air quantities at each outlet, damper and fan.

   c. Fan speeds.

   d. Fan suction and discharge pressures.

   e. Air quantities through fan, by test and by summation of air quantities at outlets.

F. FIELD TOUCH-UP PAINTING:

After installation and approved testing by the Engineer, Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

G. CONTRACT CLOSEOUT:

Provide in accordance with Section 01700.

H. Warranty

A. The Manufacturer shall furnish a written warranty covering materials and workmanship for the equipment provided for a period of three (3) years. The warranty period shall begin at the date of substantial completion of the respective process in which the equipment is installed.

B. The manufacturer shall furnish, deliver, and install new parts to replace the defective parts. The manufacturer shall furnish all supervision, labor, equipment, and materials to repair or replace components which have failed as defined by the warranty at no cost to the Owner.

I. Additive Warranty

Reference Specification Section 01025 for two (2) years in additional warranty duration to warranty stated above.

J. 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 stating that the equipment is operating normally. Make all necessary corrections and adjustments at no additional cost to the Owner.

END OF SECTION

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SECTION 15900 – HVAC CONTROLS

PART 1 - GENERAL

A. SUMMARY

1. SUMMARY

a. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

2. SUBMITTALS

a. Product Data: For each control device indicated.

b. Shop Drawings:

1) Schematic flow diagrams.

2) Power, signal, and control wiring diagrams.

3) Details of control panel faces.

4) Damper schedule.

5) Retain two subparagraphs below for DDC systems.

6) DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.

7) Control System Software: Schematic diagrams, written descriptions, and points list.

c. Software and firmware operational documentation.

d. Field quality-control test reports.

e. Operation and maintenance data.

3. QUALITY ASSURANCE

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

A. SECTION INCLUDES

1. General Description

2. Architecture/Communication

3. Operator Interface

4. Application and Control Software

5. System Controllers

6. General Programmable Controllers

7. Terminal Unit Programmable Controllers

B. GENERAL DESCRIPTION

1. The Building Automation System (BAS) shall be a web-based Trane Tracer SC™ or equivalent. Supervisory controller or System Controller shall be capable of communication via BACnet MS/TP and LonTalk™ protocol simultaneously at the system level to allow for seamless integration with future equipment expansions and with the site SCADA network. User interface shall be web based with access available via any standard internet browser. Systems employing local workstations or proprietary PC software to facilitate remote access shall not be acceptable.

2. The BAS shall interface with the existing SCADA network via MODBUS communication protocol and serve up control points which shall be visible through the SCADA interface for monitoring and alarming purposes. Refer to mechanical plans for points of interface specific to each building.

   a. Interface between BAS and SCADA network shall be facilitated by a LynxSpring JENsys PC1000 series controller. PC1000 shall communicate with SCADA system via MODBUS TCP protocol.

C. ARCHITECTURE/COMMUNICATION

1. The BAS installed in accordance with this contract shall be comprised of a high speed Ethernet network utilizing BACnet/IP communications between System Controllers and

Workstations. Communications between System Controllers and sub-networks of Custom Application Controllers shall utilize BACnet MS/TP communications.

a. Each System Controller shall perform communication to a network of Custom Application Controllers using BACnet MS/TP as prescribed by the BACnet standard.

1) Each System Controller shall function as a BACnet Router to each unit controller providing a unique BACnet Device ID for all controllers within the system.

2) Above indicated requirement for LonTalk™ capability does not constitute approval for substitutions of LonTalk™ systems. The basis of design for this project is a BACnet “top to bottom” installation. The purpose of the requirement is to provide flexibility to the system owner and facilitate a change of desired protocol in the future if applicable.

2. The Owner will provide all communication media, connectors, repeaters, network switches, and routers necessary for the high speed Ethernet network. An active Ethernet port will be provided adjacent to each System Controller and for connection to this high speed Ethernet network.

D. OPERATOR INTERFACE

1. A dedicated PC shall not be required to access the operator interface. The interface shall be Web-Based. Systems employing local workstations or proprietary PC software to facilitate remote access shall not be acceptable.

2. The operator interface shall reside on the Enterprise wide network, which is same high-speed communications network as the System Controllers. The Enterprise wide network will be provided by the owner and support the Internet Protocol (IP).

a. Operator Interface

1) The operator interface shall be accessible via a web browser.

2) The operator interface shall support the following Internet web browsers:

a) Internet Explorer 8.0+

b) Firefox 4.0+

c) Chrome 10.0+

b. The operator interface shall support the following mobile web browsers:

1) iOS (iPad/iPhone) V4.0+

2) Android (Tablet) V4.0+

3) Android (Phone) V2.3+

c. System Security

1) Each operator shall be required to login to the system with a user name and password in order to view, edit, add, or delete data.

2) User Profiles shall restrict the user to only the objects, applications, and system functions as assigned by the system administrator.

3) Each operator shall be allowed to change their user password

4) The System Administrator shall be able to manage the security for all other users

5) The system shall include pre-defined “roles” that allow a system administrator to quickly assign permissions to a user.

6) User logon/logoff attempts shall be recorded.

7) The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

8) All system security data shall be stored in an encrypted format.

d. Database

1) Database Save. A system operator with the proper password clearance shall be able to archive the database on the designated operator interface PC.

2) Database Restore. The system operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.

e. On-Line Help and Training

1) Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.

2) On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.

f. System Diagnostics

1) The system shall automatically monitor the operation of all network connections, building management panels, and controllers.

2) The failure of any device shall be annunciated to the operators.

g. Equipment & Application Pages

1) The operator interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:

a) Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes:

(1) Each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These graphics shall show all points dynamically as specified in the points list.

(2) Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog

outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.

b) Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.

c) Historical Data (As defined in Automatic Trend Log section below) for the equipment or application without requiring a user to navigate to a data log page and perform a filter.

h. System Graphics: Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using colors to represent zone temperature relative to zone set point.

1) Functionality: Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point and-click navigation between zones or equipment, and to edit set points and other specified parameters.

2) Graphic imagery: graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.

3) Animation: Graphics shall be able to animate by displaying different Image lies for changed object status.

4) Alarm Indication: Indicate areas or equipment in an alarm condition using color or other visual indicator.

5) Format: Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on

browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).

i. Custom Graphics

1) The operator interface shall be capable of displaying custom graphics in order to convey the status of the facility to its operators.

2) Graphical Navigation: The operator interface shall provide dynamic color graphics of building areas, systems and equipment.

3) Graphical Data Visualization: The operator interface shall support dynamic points including analog and binary values, dynamic text, static text, and animation files.

4) Custom background images: Custom background images shall be created with the use of commonly available graphics packages such as Adobe Photoshop. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as GIF and JPEG.

j. Graphics Library: Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.

k. Manual Control and Override.

1) Point Control: Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.

2) Temporary Overrides: The user shall be able to perform a temporary override wherever an override

is allowed, automatically removing the override after a specified period of time.

3) Override Owners: The system shall convey to the user the owner of each override for all priorities that an override exists.

4) Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.

l. Engineering Units

1) Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system.

2) Unit selection shall be able to be customized by locality to select the desired units for each measurement.

3) Engineering units on this project shall be IP.

m. Scheduling: A user shall be able to perform the following tasks utilizing the operator interface:

1) Create a new schedule, defining the default values, events and membership.

2) Create exceptions to a schedule for any given day.

3) Apply an exception that spans a single day or multiple days.

4) View a schedule by day, week and month.

5) Exception schedules and holidays shall be shown clearly on the calendar.

6) Modify the schedule events, members and exceptions.

n. Trend Logs

1) Trend Logs Definition:

a) The operator interface shall allow a user with the appropriate security permissions to

define a trend log for any data in the system.

b) The operator interface shall allow a user to define any trend log options as described in the Application and Control Software section.

o. Trend Log Viewer:

1) The operator interface shall allow Trend Log data to be viewed and printed.

2) The operator interface shall allow a user to view trend log data in text-based (time –stamp/value).

3) The operator shall be able to view the data collected by a trend log in a graphical chart in the operator interface.

4) Trend log viewing capabilities shall include the ability to show a minimum of 5 points on a chart.

5) Each data point trend line shall be displayed as a unique color.

6) The operator shall be able to specify the duration of historical data to view by scrolling and zooming.

7) The system shall provide a graphical trace display of the associated time stamp and value for any selected point along the x-axis.

p. Export Trend Logs

1) The operator interface shall allow a user to export trend log data in CSV or PDF format for use by other industry standard word processing and spreadsheet packages.

3. Alarm/Event Notification

a. An operator shall be notified of new alarms/events as they occur while navigating through any part of the system via an alarm icon.

b. Alarm/Event Log: The operator shall be able to view all logged system alarms/events from any operator interface.

1) The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.

2) Alarm/event messages shall use full language, easily recognized descriptors.

3) An operator with the proper security level may acknowledge and clear alarms/events.

4) All alarms/events that have not been cleared by the operator shall be stored by the building controller.

5) The alarm/event log shall include a comment field for each alarm/event that allows a user to add specific comments associated with any alarm.

c. Alarm Processing

1) The operator shall be able to configure any object in the system to generate an alarm when transitioning in and out of a normal state.

2) The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.

d. Reports and Logs

1) The operator interface shall provide a reporting package that allows the operator to select reports.

2) The operator interface shall provide the ability to schedule reports to run at specified intervals of time.

3) The operator interface shall allow a user to export reports and logs from the building controller in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Acceptable formats include:

a) CSV, HTML, XML, PDF

4) Provide a means to list and access the last 10 reports viewed by the user.

5) The following standard reports shall be available without requiring a user to manually configure the report:

a) All Points in Alarm Report: Provide an on demand report showing all current alarms.

b) All Points in Override Report: Provide an on demand report showing all overrides in effect.

c) Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.

d) Points report: Provide a report that lists the current value of all points

E. APPLICATION AND CONTROL SOFTWARE

1. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator interface.

a. Scheduling: Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to [10] events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:

1) Weekly Schedule: Provide separate schedules for each day of the week.

2) Exception Schedules: Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.

3) Holiday Schedules: Provide the capability for the operator to define up to 99 special or holiday

schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.

4) Optimal Start: The scheduling application outlined above shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less then and greater than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

b. Trend Log Application

1) Trend log data shall be sampled and stored on the System Controller panel and shall capable of being archived to a BACnet Workstation for longer term storage.

a) Trend logs shall include interval, start-time, and stop-time.

b) Trend log intervals shall be configurable as frequently as 1 minute and as infrequently as 1 year.

c. Automated Trend Logs

1) The system controller shall automatically create trend logs for defined key measurements for each controlled HVAC device and HVAC application.

2) The automatic trend logs shall monitor these parameters for a minimum of 7 days at 15 minute intervals. The automatic trend logs shall be user adjustable.

3) The following is a list of key measurements required for Automatic Trending:

d. Alarm/Event Log

1) Any object in the system shall be configurable to generate an alarm when transitioning in and out of a normal or fault state.

2) Any object in the system shall allow the alarm limits, warning limits, states, and reactions to be configured for each object in the system.

3) An alarm/event shall be capable of triggering any of the following actions:

a) Route the alarm/event to one or more alarm log

(1) The alarm message shall include the name of the alarm location, the device that generated the alarm, and the alarm message itself.

b) Route an e-mail message to an operator(s)

c) Log a data point(s) for a period of time

d) Run a custom control program

e. Point Control: User shall have the option to set the update interval, minimum on/off time, event notification, custom programming on change of events.

f. Timed Override: A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, operator interface, or the local operator display. The amount of time that the override takes precedence will be selectable from the operator interface.

g. Anti-Short Cycling: All binary output points shall be protected from short cycling.

F. SYSTEM CONTROLLERS

1. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in Application and Control Software section (Trane Tracer SC™ or approved equivalent)

a. The System Controller shall have sufficient memory to support its operating system, database, and programming requirements.

b. The controller shall provide a USB communications port for connection to a PC

c. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

d. All System Controllers shall have a real time clock.

e. The System Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

    1) Assume a predetermined failure mode.

    2) Generate an alarm notification.

    3) Create a retrievable file of the state of all applicable memory locations at the time of the failure.

    4) Automatically reset the System Controller to return to a normal operating mode.

f. Environment: Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at -40 F to 122 F.

g. Clock Synchronization:

    1) All System Controllers shall be able to synchronize with a NTP server for automatic time synchronization.

    2) All System Controllers shall be able to accept a BACnet time synchronization command for automatic time synchronization.

    3) All System Controllers shall automatically adjust for daylight savings time if applicable.

h. Serviceability

1) Provide diagnostic LEDs for power, communications, and processor.

2) The System Controller shall have a display on the main board that indicates the current operating mode of the controller.

3) All wiring connections shall be made to field removable, modular terminal connectors.

4) The System controller shall utilize standard DIN mounting methods for installation and replacement.

i. Memory: The System Controller shall maintain all BIOS and programming information indefinitely without power to the System controller

j. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage

k. BACnet Test Labs (BTL) Listing. Each System Controller shall be listed as a Building Controller (B-BC) by the BACnet Test Labs.

G. GENERAL PROGRAMMABLE CONTROLLERS

1. Controllers shall be Trane UC600 fully programmable units or approved equivalent. Application specific controllers not capable of accepting custom programs shall not be acceptable. Controller operation shall not be dependent upon presence of a BAS. If no BAS exists, communication with the BAS is lost, the controller shall be capable of standalone operation utilizing local programming and set points.

2. Operation:

a. Shall operate a schedule in a standalone application using a Real Time Clock.

1) The Controller shall have a built in schedule (assessable with or without a display)

2) Support will be for at least 3 schedules with up to 10 events for each day of the week.

3) Each of the 3 schedules can be Analog, Binary or Multi-State

4) The controller shall support a minimum of 25 exceptions each with up to 10 events.

b. For ease of troubleshooting, the Controller shall support data trend logging

1) 25,000 samples minimum

2) Trends shall be capable of being collected at a minimum sample rate of once every second

3) Trends shall be capable of being scheduled or triggered.

c. To meet the sequence of operation for each application, the Controller shall use library programs provided by the controller manufacturer that are either factory loaded or downloaded with service tool to the Controller.

d. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1) Storage conditions:

a) Temperature: -67°F to 203°F (-55°C to 95°C)

b) Humidity: Between 5% to 100% RH (non-condensing)

2) Operating conditions:

a) Temperature: -40°F to 158°F (-40°C to 70°C)

b) ‘Humidity: Between 5% to 100% RH (non-condensing)

3) Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum

4) Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof

enclosures, and shall be rated for operation at -40 F to 158 F [-40 C to 70 C].

e. Input/Output: The Controller shall have on board or through expansion module all I/O capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment. In addition other controls must meet the following requirements:

1) Shall support flexibility in valve type, the controllers shall be capable of supporting the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.

2) Shall support flexibility in sensor type, the Controller shall be of reading sensor input ranges of 0 to10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.

3) Shall support flexibility in sensor type, all Analog Outputs shall have the additional capability of being programmed to operate as Universal Inputs or Pulse Width Modulation Outputs.

4) Shall support flexibility in sensor type, the Controller and/or expansion modules shall support dry and wetted (24VAC) binary inputs.

5) The controller support pulse accumulator for connecting devices like energy meters.

6) In order to support a wide range of devices, the Controller’s binary output shall be able to drive at least 10VA each.

7) Any I/O that is unused by functionality needed for the equipment shall be available to be used by custom program on the Controller and by any other controller on the network.

8) The Controller shall provide 24VAC and 24VDC power terminals sensors and other devices required.

9) The Controller shall provide a dedicated static pressure input.

f. Input/Output Expandability – The Controller shall provide the following functionality in order to meet current and future application needs:

1) For the application flexibility, the Controller shall be capable of expanding to a total of at least 100 hardware I/O terminations.

2) Expansion I/O can be mounted up to 200m from control

3) Expansion I/O can be added in as small as 4 point increments.

4) To keep BACnet MS/TP network traffic to a minimum, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed)

g. Serviceability – The Controller shall provide the following in order to improve serviceability of the Controller.

1) Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.

2) Binary and analog inputs and outputs shall use removable connectors or be connected to terminal strip external to the control box

3) Software service tool connection through all of the following methods: direct cable connection to the Controller, connection through another controller on BACnet link and through the Controller’s zone sensor.

4) For configuration, programming, and testing of controller programs must, for safety purposes, be able to be accomplished with the power off to the equipment and the controller.

5) The Controller software tool service port shall utilize standard of-the-shelf USB printer cable.

6) Capabilities to temporarily override the BACnet point values with built-in time expiration in the Controller.

7) To aid in service replacement, the Controller shall easily attached to standard DIN rail mounting.

8) For future expansion, the Controller shall be capable of adding sequence of operation programming utilizing service tools software with a graphical programming interface (editing or programming in line code is not permissible).

9) To aid in service replacement, the Controller shall allow for setting its BACnet address must be rotary switches that correspond to a numerical value for the address to allow the setting of the address without the need of a service tool or the control being powered (DIP switch methodologies are not allowed).

10) Controller data shall persist through a power failure.

h. Software Retention: All Controller operating parameters, set points, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

i. Transformer for the Controller must be rated at minimum of 115% of ASC power consumption, and shall be fused or current limiting type. 24 VAC, +/- 15% nominal, 50-60 Hz, 24 VA plus binary output loads for a maximum of 12 VA for each binary output.

j. Controller must meet the following Agency Compliance:

1) UL916 PAZX, Open Energy Management Equipment

2) UL94-5V, Flammability

3) FCC Part 15, Subpart B, Class B Limit

4) BACnet Testing Laboratory (BTL) Listed

5) cUL Marked for international compliance

6) CE Marked for international compliance

PART 3 - EXECUTION

A. INSTALLATION

1. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above the floor.

   a. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

2. Install guards on thermostats in the following locations:

3. Where indicated.

4. Install automatic dampers according to Division 15 Section "Duct Accessories."

5. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

6. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."

7. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."

8. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.

9. Install electronic and fiber-optic cables according to Division 16 Section "Voice and Data Communication Cabling."

B. ELECTRICAL WIRING AND CONNECTION INSTALLATION

1. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."

2. Install building wire and cable according to Division 16 Section "Conductors and Cables."

3. Install signal and communication cable according to Division 16 Section "Voice and Data Communication Cabling."

   a. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.

   b. Install exposed cable in raceway.

   c. Install concealed cable in raceway.

   d. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

   e. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

   f. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

   g. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

4. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

5. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

C. FIELD QUALITY CONTROL

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

2. Perform the following field tests and inspections and prepare test reports:

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.

4. Test and adjust controls and safeties.

5. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

    a. Test each point through its full operating range to verify that safety and operating control set points are as required.

    b. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.

    c. Test each system for compliance with sequence of operation.

    d. Test software and hardware interlocks.

6. DDC Verification:

    a. Verify that instruments are installed before calibration, testing, and loop or leak checks.

    b. Check instruments for proper location and accessibility.

    c. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.

    d. Check instrument tubing for proper fittings, slope, material, and support.

    e. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.

    f. Check temperature instruments and material and length of sensing elements.

    g. Check control valves. Verify that they are in correct direction.

h. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.

i. Check DDC system as follows:

j. Verify that DDC controller power supply is from emergency power supply, if applicable.

k. Verify that wires at control panels are tagged with their service designation and approved tagging system.

l. Verify that spare I/O capacity has been provided.

m. Verify that DDC controllers are protected from power supply surges.

7. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

D. DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

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SECTION 15950 TESTING, ADJUSTING & BALANCING

PART 1 - GENERAL

A. SUMMARY

This Section includes TAB to produce design objectives for the following:

1. Air Systems:

   a. Constant-volume air systems.

2. HVAC equipment quantitative-performance settings.

3. Verifying that automatic control devices are functioning properly.

4. Reporting results of activities and procedures specified in this Section.

B. SUBMITTALS

1. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

2. Warranties specified in this Section.

C. QUALITY ASSURANCE

1. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

2. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

   a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

   b. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

3. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

D. PROJECT CONDITIONS

1. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

2. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

E. COORDINATION

1. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

2. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

F. WARRANTY

1. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

2. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

a. The certified TAB firm has tested and balanced systems according to the Contract Documents.

b. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - (No Products)

PART 3 - EXECUTION

A. EXAMINATION

1. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

   a. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

2. Examine approved submittal data of HVAC systems and equipment.

3. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

4. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

5. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under

conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

6. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

7. Examine system and equipment test reports.

8. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

9. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

10. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

11. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

12. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

13. Examine strainers for clean screens and proper perforations.

14. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

15. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

16. Examine system pumps to ensure absence of entrained air in the suction piping.

17. Examine equipment for installation and for properly operating safety interlocks and controls.

18. Examine automatic temperature system components to verify the following:

    a. Dampers, valves, and other controlled devices are operated by the intended controller.

    b. Dampers and valves are in the position indicated by the controller.

    c. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.

    d. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.

    e. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.

    f. Sensors are located to sense only the intended conditions.

    g. Sequence of operation for control modes is according to the Contract Documents.

    h. Controller set points are set at indicated values.

    i. Interlocked systems are operating.

    j. Changeover from heating to cooling mode occurs according to indicated values.

19. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

B. PREPARATION

1. Prepare a TAB plan that includes strategies and step-by-step procedures.

2. Complete system readiness checks and prepare system readiness reports. Verify the following:

   a. Permanent electrical power wiring is complete.

   b. Hydronic systems are filled, clean, and free of air.

   c. Automatic temperature-control systems are operational.

   d. Equipment and duct access doors are securely closed.

   e. Balance, smoke, and fire dampers are open.

   f. Isolating and balancing valves are open and control valves are operational.

   g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

   h. Windows and doors can be closed so indicated conditions for system operations can be met.

C. GENERAL PROCEDURES FOR TESTING AND BALANCING

1. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.

2. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

3. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

1. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

2. Prepare schematic diagrams of systems' "as-built" duct layouts.

3. For variable-air-volume systems, develop a plan to simulate diversity.

4. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

5. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

6. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

7. Verify that motor starters are equipped with properly sized thermal protection.

8. Check dampers for proper position to achieve desired airflow path.

9. Check for airflow blockages.

10. Check condensate drains for proper connections and functioning.

11. Check for proper sealing of air-handling unit components.

    a. Check for proper sealing of air duct system.

E. PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

1. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Measure fan static pressures to determine actual static pressure as follows:

        1) Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

        2) Measure static pressure directly at the fan outlet or through the flexible connection.

        3) Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

        4) Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

    b. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

        1) Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

    c. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.

    d. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

e. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.

f. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

2. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

   a. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

      1) Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

   b. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

3. Measure terminal outlets and inlets without making adjustments.

   a. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

4. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

   a. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without

generating noise levels above the limitations prescribed by the Contract Documents.

b. Adjust patterns of adjustable outlets for proper distribution without drafts.

F. PROCEDURES FOR CONDENSING UNITS

1. Verify proper rotation of fans.

2. Measure entering- and leaving-air temperatures.

3. Record compressor data.

G. PROCEDURES FOR HEAT-TRANSFER COILS

1. Electric-Heating Coils: Measure the following data for each coil:

a. Nameplate data.

b. Airflow.

c. Entering- and leaving-air temperature at full load.

d. Voltage and amperage input of each phase at full load and at each incremental stage.

e. Calculated kilowatt at full load.

f. Fuse or circuit-breaker rating for overload protection.

2. Refrigerant Coils: Measure the following data for each coil:

a. Dry-bulb temperature of entering and leaving air.

b. Wet-bulb temperature of entering and leaving air.

c. Airflow.

d. Air pressure drop.

e. Refrigerant suction pressure and temperature.

H. PROCEDURES FOR TEMPERATURE MEASUREMENTS

1. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

2. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

3. Measure outside-air, wet- and dry-bulb temperatures.

I. TEMPERATURE-CONTROL VERIFICATION

1. Verify that controllers are calibrated and commissioned.

2. Check transmitter and controller locations and note conditions that would adversely affect control functions.

3. Record controller settings and note variances between set points and actual measurements.

4. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

5. Check free travel and proper operation of control devices such as damper and valve operators.

6. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

7. Check the interaction of electrically operated switch transducers.

8. Check the interaction of interlock and lockout systems.

9. Check main control supply-air pressure and observe compressor and dryer operations.

10. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

11. Note operation of electric actuators using spring return for proper fail-safe operations.

J. TOLERANCES

Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.

2. Air Outlets and Inlets: 0 to minus 10 percent.

3. Heating-Water Flow Rate: 0 to minus 10 percent.

K. FINAL REPORT

1. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

2. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

   a. Include a list of instruments used for procedures, along with proof of calibration.

3. Final Report Contents: In addition to certified field report data, include the following:

   a. Pump curves.

   b. Fan curves.

   c. Manufacturers' test data.

   d. Field test reports prepared by system and equipment installers.

   e. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

4. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

a. Title page.

b. Name and address of TAB firm.

c. Project name.

d. Project location.

e. Architect's name and address.

f. Engineer's name and address.

g. Contractor's name and address.

h. Report date.

i. Signature of TAB firm who certifies the report.

j. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

k. Summary of contents including the following:

    1) Indicated versus final performance.

    2) Notable characteristics of systems.

    3) Description of system operation sequence if it varies from the Contract Documents.

l. Nomenclature sheets for each item of equipment.

m. Data for terminal units, including manufacturer, type size, and fittings.

n. Notes to explain why certain final data in the body of reports varies from indicated values.

o. Test conditions for fans and pump performance forms including the following:

    1) Settings for outside-, return-, and exhaust-air dampers.

    2) Conditions of filters.

    3) Cooling coil, wet- and dry-bulb conditions.

    4) Face and bypass damper settings at coils.

5) Fan drive settings including settings and percentage of maximum pitch diameter.

6) Inlet vane settings for variable-air-volume systems.

7) Settings for supply-air, static-pressure controller.

8) Other system operating conditions that affect performance.

5. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

   a. Quantities of outside, supply, return, and exhaust airflows.

   b. Water and steam flow rates.

   c. Duct, outlet, and inlet sizes.

   d. Pipe and valve sizes and locations.

   e. Terminal units.

   f. Balancing stations.

   g. Position of balancing devices.

END OF SECTION

SECTION 15990 - HVAC COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

A. SUMMARY

Commissioning shall be the responsibility of the contractor. Contractor shall engage a certified commissioning agent to perform all commissioning, and coordinate commissioning activities between all trades.

B. DEFINITIONS

1. Consultant: Includes Consultant identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

2. BoD: Basis of Design.

3. BoD-HVAC: HVAC systems basis of design.

4. CxA: Commissioning Authority.

5. OPR: County's Project Requirements.

6. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

7. TAB: Testing, Adjusting, and Balancing.

C. CONTRACTOR'S RESPONSIBILITIES

1. Contractor:

a. Engage and include in contractor’s cost services required by CxA.

b. Attend procedures meeting for TAB Work.

c. Certify that TAB Work is complete.

2. Mechanical Contractor:

    a. Attend TAB verification testing.

    b. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

3. HVAC Instrumentation and Control Contractor: With the CxA, review control designs for compliance with the OPR and BoD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

4. TABContractor:

    a. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

        1) Verify the following:

            a) Accessibility of equipment and components required for TAB Work.

            b) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.

            c) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.

            d) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.

            e) Air and water flow rates have been specified and compared to central equipment output capacities.

        2) Identify discontinuities and omissions in the Contract Documents.

3) This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 15 Section "Testing, Adjusting, and Balancing."

b. Additional Responsibilities: Participate in tests specified in Division 15 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation."

5. Electrical Contractor:

a. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems.

b. Attend TAB verification testing.

D. COMMISSIONING DOCUMENTATION

1. The following are in addition to documentation specified in Division 1 Section "General Commissioning Requirements."

2. BoD HVAC: Owner will provide BoD-HVAC documents, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

3. Test Checklists: CxA shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 1 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

a. Calibration of sensors and sensor function.

b. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and

operating conditions that impact the results of test.

c. Control sequences for HVAC systems.

d. Strength of control signal for each set point at specified conditions.

e. Responses to control signals at specified conditions.

f. Sequence of response(s) to control signals at specified conditions.

g. Electrical demand or power input at specified conditions.

h. Power quality and related measurements.

i. Expected performance of systems, subsystems, and equipment at each step of test.

j. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.

k. Interaction of auxiliary equipment.

l. Issues log.

E. SUBMITTALS

1. The following submittals are in addition to those specified in Division 1 Section "General Commissioning Requirements."

2. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

3. Certificate of Readiness: CxA shall compile certificates of readiness from each Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.

4. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Contractor as specified in Division 15 Section "Testing, Adjusting, and Balancing."

5. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.

6. Corrective Action Documents: CxA shall submit corrective action documents.

7. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

A. TESTING PREPARATION

1. Prerequisites for Testing:

a. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.

b. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded.

c. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

d. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.

e. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

f. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.

g. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.

h. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

i. Annotate checklist or data sheet when a deficiency is observed.

j. Verify equipment interface with monitoring and control system and TAB criteria; include the following:

    1) Supply and return flow rates for VAV and constant volume systems in each operational mode.

    2) Operation of terminal units in both heating and cooling cycles.

    3) Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.

    4) Building pressurization.

    5) Total exhaust airflow and total outdoor-air intake.

6) Operation of indoor-air-quality monitoring systems.

k. Verify proper responses of monitoring and control system controllers and sensors to include the following:

1) For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
2) Report deficiencies and prepare an issues log entry.

l. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 15 Sections.

2. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load indicated in BoD. Operational modes include the following:

a. Occupied and unoccupied.

b. Warm up and cool down.

c. Smoke control.

d. Fire safety.

e. Temporary upset of system operation.

f. Partial occupancy conditions.

g. Special cycles.

B. TAB VERIFICATION

1. TAB Contractor shall coordinate with CxA for work required in Division 15 Section "Testing, Adjusting, and Balancing." TAB contractor shall copy CxA with required reports, sample forms, checklists, and certificates.

2. TAB Preparation:

a. TAB Contractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 15 Section "Testing, Adjusting, and Balancing."

1) CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

3. Verification of Final TAB Report:

a. CxA shall select, at random, 10 percent of report for field verification.

b. CxA shall notify TAB Contractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB contractor shall use the same instruments (by model and serial number) that were used when original data were collected.

c. Failure of an item is defined as follows:

1) For all readings other than sound, a deviation of more than 10 percent.

a) For sound pressure readings, a deviation of 3 dB. (Note: Variations in background noise must be considered.)

d. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

4. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and consultant in writing, and shall take action to remedy the deficiency. Consultant shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

5. CxA shall certify that TAB Work has been successfully completed.

C. TESTING

1. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

2. Perform tests using design conditions whenever possible.

   a. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

   b. Alter set points when simulating conditions is not practical and when written approval is received from CxA.

   c. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

3. Scope of HVAC Contractor Testing:

   a. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.

b. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

4. HVAC Instrumentation and Control System Testing:

   a. Field testing plans and testing requirements are specified in Division 15 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation." The CxA, HVAC contractor, and the HVAC Instrumentation and Controls contractor shall collaborate to prepare testing plans.

   b. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

5. HVAC Distribution System Testing: HVAC contractor shall prepare a testing plan to verify performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:

   a. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

   b. Tracking checklist for managing and ensuring that all pipe sections have been tested.

6. Vibration and Sound Tests: HVAC contractor shall prepare testing plans to verify performance of vibration isolation and seismic controls. CxA shall witness and certify tests and inspections.

7. Deferred Testing:

   a. If tests cannot be completed because of a deficiency outside the scope of the HVAC system,

the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

b. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

8. Testing Reports:

a. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.

b. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.

c. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.

9. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

END OF SECTION

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DIVISION 16 – ELECTRICAL

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SECTION 16010 BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

A. SECTION INCLUDES

1. Basic Electrical Requirements specifically applicable to Division 16 sections in addition to Division 1 - General Requirements.

B. GENERAL CONDITIONS FOR ALL WORK

1. All Work must closely be coordinated among the electric utility, the construction manager, and the Owner.

C. SCOPE OF WORK

1. Provide complete electrical system for the proposed Centrifuge Dewatering Improvements.

2. Provide conduits to serve the electrical system as shown on the drawings.

3. Provide surge suppressors where indicated on the drawings.

4. Provide site grounding, lightning protection and lighting.

5. Provide all testing and startup services.

6. Each bidder or his authorized representatives shall, before preparing a bid, visit all areas of the proposed site in which work will take place and be performed to inspect carefully the present conditions. The submission of the bid by this bidder shall be considered evidence that the bidder has visited the project and noted the locations and conditions under which the work will be performed and that the bidder takes full responsibility for a complete knowledge of all factors governing his work.

7. All necessary temporary power, control and instrumentation requirements are the responsibility of the Contractor and shall be furnished at no extra cost to the Owner. Power and controls shall be furnished to all existing equipment at all times.

8. Pay all fees required for permits, inspections, and connections.

D. REFERENCES

1. ANSI/NFPA70-National Electrical Code.

E. SUBMITTALS

1. Include products specified in the following sections:

   a. Section 16100 – Raceways, Boxes and Cabinets
   b. Section 16108 – Miscellaneous Equipment
   c. Section 16120 – Wires and Cables
   d. Section 16150 – Motors
   e. Section 16160 – Panelboards
   f. Section 16195 – Electrical Identification
   g. Section 16370 – Variable Frequency Drives
   h. Section 16410 – Unit Substations
   i. Section 16430 – 480 Volt Switchgear
   j. Section 16440 – Underground Ductbank System
   k. Section 16450 – Grounding System
   l. Section 16476 – Disconnects and Circuit Breakers
   m. Section 16482 – 480V Motor Control Centers
   n. Section 16500 – Lighting Systems
   o. Section 16709 – Surge Protection
   p. Section 16720 – Fire Alarm System
   q. Section 16800 – Surveillance System

2. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

3. Mark dimensions and values in units to match those specified.

4. Indicate applicable specification section on each submitted document.

F. REGULATORY REQUIREMENTS

1. Conform to applicable Building Codes for project location.

2. Electrical: Conform to NFPA 70 - 2011 Edition.

3. Occupational Safety and Health Administration (O.S.H.A.).

4. Utility company rules and regulations.

5. Obtain permits and request inspections from authority having jurisdiction.

G. COORDINATION, SHORT CIRCUIT AND FLASH ARC HAZARD STUDY

1. General:

a. The Contractor shall provide a Power System Study and Flash Arc Study for the electrical power distribution and motor control equipment. The studies shall be a totally independent effort to verify adequacy of all of the existing equipment as well as new additions being implemented under these Specifications. The studies shall be prepared by a Professional Engineer, registered in the State of Florida, with demonstrated experience in the performance of industrial power system and fault arc hazard analysis. The Engineer may be an employee of an equipment manufacturer or supplier.

b. The Contractor shall provide data necessary to perform the study. This includes feeder cable sizes, approximate feeder length motor data, generator data, existing protective relay settings and any other information relevant to the study.

c. A summary of the short circuit analysis shall be provided to the Contractor at the time shop drawings for all of the new equipment is submitted for approval.

d. The Contractor shall provide complete sets of motor control center and emergency generator shop drawings for use in the studies.

2. Scope:

a. The short circuit study shall be in accordance with ANSI Standard C37.010 and C37.13, shall be performed to check the adequacy, and to verify the correct application of circuit protective devices and other system components specified. The study shall address the case when the system is being powered from the normal source as well as from the on-site generating facilities. Minimum as well as maximum possible fault conditions shall be adequately covered in the study.

b. Fault contribution of all motors shall be considered. The Contractor shall be responsible for

obtaining all required data of equipment. All back-up calculations shall become part of the final report. The calculations shall be in sufficient detail to allow easy review.

c. The flash arc analysis study shall include the calculations of flash protection boundary limits and the incident energy exposure for the maximum arc producing flash expected from the electrical equipment. The study will determine incident energy exposure level and flash arc protection boundaries for the electrical equipment, based on IEEE-1584 and NFPA-70E. The study shall be based on the protective device settings and interrupting device clearing time.

3. Contents:

a. The study shall include representation of the power company's system, the base quantities selected, impedance source-data, calculation methods and tabulations, one-line and impedance diagrams, conclusions and recommendations. Short-circuit momentary duties, shall be calculated on the basis of an assumed bolted three-phase short circuit at the main breaker, ATS, 480 volt motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the systems. The short circuit tabulations shall include significant X to R ratios, asymmetry factors, KVA, and symmetrical fault current.

b. A protective device time current coordination study shall be included with coordination plots of key and/or limiting devices, tabulated data, rating, and/or settings selected. The study shall present an Engineering balance between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.

c. Separate plots shall be provided for each mode, "normal," and, "standby," operation. Maximum fault values shall be shown in each case. Both power sources shown in one plot will not be accepted.

d. Existing protective device settings in key locations shall be reviewed to ensure selectivity under the new conditions. Recommended changes shall be

indicated in the report. The Contractor shall be made aware of the required changes immediately.

e. Generator short circuit decrement curves and thermal limit curves shall be included.

f. Required settings for breakers and relays shall be maximized to provide the most effective protection possible whether the system is fed from the normal or emergency source.

g. Tabulations indicating recommended set points for all protective devices shall be provided. This shall include the normal as well as the emergency source.

h. Flash Arc study shall include representation of the calculation methods and tabulations, and a one-line drawing of all identifying equipment included in this study. The complete study shall be turned over to the Owner as per 01420. as part of the study, the Contractor shall affix permanent adhesive non-fading labeling indicating the equipment ID number and required information as required by NFPA 70E.

4. Motor Current-Time Characteristic Curves:

a. A complete independent set of current-time characteristic curves for all 480 volt motor drives indicating coordination between the protective relays and the thermal characteristics of the motor shall be provided.

b. The Contractor shall obtain from the motor supplier, the necessary information to perform the study. Certified curves for, "Safe time vs. current at 100 percent voltage," and "Accelerating time vs. current at 100 percent voltage," shall become part of the final report.

5. Motor Starting Study:

a. A motor starting study for all large electric drives to determine voltage dip or power inrush limitations at selected locations due to starting of motors shall be provided. This applies to both the normal and the emergency mode.

6. General Information for Time-Current Curves Presentation:

a. The coordination plots shall include complete titles, representative one-line diagrams, legends, associated power company's relay or system characteristics, significant motor starting characteristics, complete parameters for power, and substation transformers, and complete operating bands for low-voltage circuit breaker trip devices.

b. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pickup settings required.

c. The short-time region shall indicate the medium voltage relay instantaneous elements, the magnetizing in-rush, and ANSI withstand transformer parameters, the low-voltage circuit breaker instantaneous trip devices, fuse manufacturing to tolerance bands, and significant symmetrical and asymmetrical fault currents.

d. Each primary protective device required for a delta-to-wye connected transformer shall be selected so that the characteristic or operating band is within the transformer parameters; which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults.

e. Low-voltage power circuit breakers shall be separated from each other and the associated primary protective device, where feasible, by a 16 percent current margin for coordination and protection in the event of secondary line-to-line faults.

f. Protective relays shall be separated, where feasible, by a 0.3 second time margin when the maximum three-phase fault flows, to assure proper selectivity.

H. CONDUIT DRAWINGS

1. In addition to the manufacturer's equipment shop drawings, the CONTRACTOR shall submit for approval, electrical installation working drawings for all buildings and structures containing the following:

a. Concealed and buried conduit layouts shown on floor plans drawn at not less than 1/4-inch = 1-foot-0-inch scale. The layouts shall include locations of process equipment, motor control centers, transformers, panelboards, control panels and equipment, motors, switches, motor starters, large junction or pull boxes, instruments, and any other electrical devices connected to concealed or buried conduits.

b. Plans shall be drawn on high quality reproducible, double sided mylar, size 36-inch x 24-inch, and shall be presented in a neat, professional manner.

c. Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.

I. OPERATION AND MAINTENANCE DATA

1. Submit complete operations and maintenance data for all equipment furnished under this Division in accordance with Section 01340 manuals shall be prepared specifically for this installation and shall include all required cuts, Drawings, equipment lists, descriptions, complete part lists, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

J. WARRANTY

1. Provide a warranty for all the electrical equipment in accordance with the requirements of other sections, but in no case less than three (3) years from date of substantial completion.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

A. INSTALLATION

1. Electrical systems shall be complete and operable for the intended purpose in accordance with applicable codes at the time of acceptance.

2. The Contractor shall coordinate all activities with the construction manager and the Owner.

END OF SECTION

SECTION 16100 RACEWAYS, BOXES, AND CABINETS

PART 1 - GENERAL

A. SUBMITTALS

1. Provide submittals for all electrical equipment enclosures.

B. REFERENCES

1. Comply with NFPA 70 "National Electrical Code" for components and installation.

2. Comply with NECA "Standard of Installation."

C. LISTING AND LABELING

1. Provide products specified in this Section that are UL listed and labeled.

PART 2 - PRODUCTS

A. CONDUIT

1. Liquid Tight Flexible Metal Conduit: Flexible steel conduit with PVC jacket.

2. PVC Conduit and Tubing Fittings: NEMA TC 3; Schedule 80, match to conduit or conduit/tubing type and material.

3. PVC Conduit and Tubing Fittings: NEMA TC 3; Schedule 40, match to conduit or conduit/tubing type and material.

4. Aluminum Rigid Conduit.

B. BOXES

1. Outlet and Device Boxes: Use 1 of the following:

a. Nonmetallic Boxes: NEMA OS2.

2. PWI and Junction Boxes: Use 1 of the following:

a. Small Boxes: NEMA OS 1, stainless steel.

b. Cast Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

3. Hinged Cover Enclosures: Stainless steel enclosure with continuous hinge cover and flush latch. The enclosure shall be provided with stainless panel insert for mounting equipment. Outdoor enclosures shall be 316 NEMA 4X Stainless Steel.

PART 3 - EXECUTION

A. INSTALLATION

1. Seal all outdoor raceways using duct seal.

2. Use the following wiring methods:

a. Exposed: Rigid Aluminum

b. Underground: PVC Schedule 40 Concrete encased, except elbows shall be rigid aluminum.

c. Schedule 80 PVC conduit shall be used where shown on the Drawings and in chemical rooms and chlorine storage areas or areas designated "CORROSIVE" on the Drawings.

d. Instrumentation (shielded cable): Aluminum or PVC (dependent on location). Provide #10 ground wire in all conduits containing shielded conductors.

e. Connection to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquid tight flexible metal conduit.

f. Boxes and Enclosures:

(1) 316 NEMA 4X stainless steel. All hardware shall be stainless steel.

3. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.

4. Install raceways level and square and at proper elevations. Provide adequate headroom.

5. Complete raceway installation before starting conductor installation.

6. Use temporary closures to prevent foreign matter from entering raceway.

7. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

8. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated keep the legs of a bend in the same plane and the straight legs of offsets parallel.

9. Raceways Embedded in Slabs: Install in middle third of the slab thickness where practical, and leave at least 2-inch (25 mm) concrete cover.

    a. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

    b. Space raceways laterally to prevent voids in the concrete.

    c. Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.

10. Install underground raceways:

    a. At least 18" below grade.
    b. At least 24" below driveways and roads.
    c. All buried ductbanks to be concrete encased 3000 psi color red concrete.

11. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.

    a. Run parallel or banked raceways together, on common supports where practical.

    b. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.

12. Join raceways with fittings designed and approved for the purpose and make joints tight.

    a. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

    b. Use insulating bushings to protect conductors.

13. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.

14. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

15. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb (90kg) tensile strength. Leave not less than 12 inches (300 mm) of slack at each end of the pull wire.

16. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling, threaded inside for plugs, and set flush with the finished floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.

17. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid tight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.

18. Install hinged cover enclosures and cabinets plumb. Support at each corner.

19. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer.

Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

20. Conduits passing from heated to unheated spaces, and at all exterior spaces, refrigerated spaces, cold air plenums, etc, shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.

END OF SECTION

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SECTION 16108 MISCELLANEOUS EQUIPMENT

PART 1 – GENERAL

A. Scope of Work.

1. Furnish and install all miscellaneous equipment as hereinafter specified and as shown on the Drawings.

B. Submittals.

1. Submit to the ENGINEER, in accordance with Division 0, detailed catalog information or drawings with sufficient detail to determine compliance with the specifications including describing electrical and physical characteristics of all equipment specified.

C. Reference Standards.

1. Equipment enclosures shall have NEMA rating suitable for the location in which they are installed, as specified in Section 16050.

PART 2 – PRODUCTS

A. MATERIALS.

1. CONTROL STATIONS AND INDICATORS:

a. Control stations shall be heavy duty type, with full size (30.5 mm) NEMA 4x or 7 operators, indicators, etc.

b. Indicators shall be full voltage and push to test type. Indicators located indoors shall be LED type and indicators located outdoors shall be incandescent lamp type.

c. NEMA 4x enclosures shall be 316 stainless steel.

d. NEMA 7 enclosures shall be cast aluminum.

e. Each station shall be provided with a plastic nameplate, affixed to the enclosure without screws, identifying the equipment served, voltage, and circuit designation.

f. Starters shall be as manufactured by the EATON, Square D Co., or approved equal.

2. WIREWAY:

a. NEMA 1 wireway shall be gasketed painted steel with stainless steel cover.

b. NEMA 4X wireway shall be 316 Stainless Steel with gasketed clamped covers

c. NEMA 1 wireway shall be Square-Duct as manufactured by the Square D Co,; NEMA 4X shall be Bulletin F-22 as manufactured by the Hoffman Engineering Co. or equal.

3. MANUAL TRANSFER SWITCH:

a. Manual transfer switches shall be heavy duty, load-break, quick-make, quick-break, visible blades, 3 or 4 pole, 600 Volt, double throw, with direct manual operation, full cover interlock, interlock defet and shall be UL listed under UL 1008. Switch ratings shall be as shown on the drawings. Enclosure type shall be NEMA 1, unless otherwise noted on the drawings or as required by Section 16050. All current carrying parts shall be copper.

b. NEMA 4x enclosures shall be 316 stainless steel.

c. NEMA 7 enclosures shall be cast aluminum.

d. Each swicth shall be provided with a plastic nameplate, affixed to the enclosure without screws, identifying the equipment served, voltage, and circuit designation.

e. Starters shall be as manufactured by the EATON, Square D Co., or approved equal.

4. CONTROL RELAYS:

a. Control relays shall be heavy duty machine type, with 10 amp, 300 Volt convertible contacts. Number of contacts and coil voltage shall be as shown on the drawings. General use relays shall be Square D Co., Class 8501 Type X, similar by Cuttler Hammer, Allen Bradley or Siemens. Latching relays shall be Square D Co., Class 8501 Type X, similar by Cutler Hammer, Allen-Bradley or Siemens.

b. Time delay relays shall be pneumatic, 600 Volt, 20 Amp contacts with calibrated knob operated adjustment and numerical time dial. On delay and off delay types and timing ranges shall be as shown on the drawings or as required for proper operation of the actual equipment furnished. Relays shall be Agastat Model 7012 or 7022 or equal.

5. DETECTALE POLYETHYLENE WARNING TAPE:

a. Warning tape shall be 5 mil red polyethylene film, 6 inch minimum width. Tape shall be capable of being detected by either conductive or inductive location techniques.

b. Warning tape shall be Mutual Industries Part No. 17774 or equal.

6. TERMINAL BLOCKS:

a. Terminal blocks shall be 600 Volt, channel mounted, with tubular screw and pressure plate.

b. Terminal blocks shall be Bulletin 1492-CA1 as manufactured by the Allen-Bradley Co. or equal.

7. JIC BOXES FOR GF RECEPTACLES:

a. JIC boxes shall be 6-inches x 6-inches x 4-inches aluminum continuous hinge clamp cover boxes, Hoffman Catalog No. A-606 CHAL with type L23 stainless steel fast operating JIC clamp or equal.

b. Install 1-1/2 inch bushings in the bottom of box for cord and plug to pass through.

8. CORROSION INHIBITORS:

a. All equipment enclosures, terminal boxes, etc., located in a NEMA 4X rated area (where shown on the drawings) that contain electrical or electronic equipment or terminal strips shall be furnished with an internally mounted, chemically treated corrosion inhibitor pad.

b. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co., or 3M or equal.

9. EQUIPMENT MOUNTING STANDS:

a. Mounting stands shall be custom fabricated from ¼ inch 316 stainless steel plate and 3-inch stainless steel channel, unless otherwise shown on the drawings.

b. All hardware shall be 316 stainless steel.

10. TERMINAL CABINETS:

a. Interiors shall be so designed that control relays and terminal blocks can be replaced or added without disturbing adjacent units. Each cabinet shall be furnished a minimum of 50 spare terminals.

b. All interiors shall be completely factory assembled with control realys, terminal blocks, insulating barriers, etc. All 120 Volt AC and DC terminal blocks shall be isolated from each other by insulating barriers or separate enclosures.

c. All wiring within the cabinets shall be grouped together in harnesses and secured to the structure.

d. All shielded cables shall terminate in separate cabinets. A third terminal shall be provided for each twisted pair and the shield for each connected thereto, unless otherwise noted on manufacturer’s shop drawings.

e. Terminal blocks shall be tubular screw type with pressure plates and shall be rated 600 Volts. Terminal blocks shall be Allen Bradley or equal.

f. Boxes shall be made of 14 gauge galvanized steel and shall be of sufficient size to provide a minimum of 4 inches of wiring space on all sides and between adjacent terminal blocks. A minimum 2-inch spare shall be provided between control relays. A minimum of four mounting studs shall be furnished without knockouts. Holes for raceways shall be drilled on the job.

g. A single or double hinged door shall cover the front of each terminal cabinet. Doors shall have a neoprene gasket, vault type handle, three-point catch and lock. Two keys shall be supplied for each lock. All locks shall be keyed alike. A terminal block schedule shall be provided with each terminal point numbered and identified (Typewritten) as to function.

h. All exterior and interior steel surfaces of the cabinets shall be properly cleaned and finished with ANSI 61 grey over a rust inhibiting phosphatized coating conforming to ANSI A55.1. The finish paint shall be of a type to which field applied paint will adhere.

i. Cabinets in wet, damp, corrosive and all outdoor locations shall be NEMA 4X 316 Stainless Steel.

j. Cabinets shall be Hoffman Engineering Co, with latch kit hardware or be an equal product.

11. INTRINSICALLY SAFE RELAYS:

a. Intrinsically safe relays should be solid state type with 5 amp output contacts, suitable for use on a 120 Volt, 60 Hz power and shall be FM approved for pilot devices in Class 1, Division 1, Group D hazardous atmosphere.

b. Intrinsically safe relays shall be Gems Solid State Safe-Pak as manufactured by Gems Sensors or equal.

12. BREAK-GLASS EMERGENCY STATION:

a. Break-Glass Emergency Station shall be of the break glass design with a weatherproof cast metal outer case finished in fire red and have an attached chain hung “Hammer”. A glass panel shall be mounted in front of the push button operator. Switch contacts shall be 1-open, 1-closed, rated 10 amps, 600 Volts.

13. LIGHTING CONTACTOR:

    a. Lighting contactor shall be electrically operated, mechanically held type mounted in a NEMA 1 enclosure (except where noted otherwise on the drawings) with number of poles as noted on the drawings. Operating coils shall be rated for 120 Volts unless otherwise noted on the drawings. Provide a “Hand-Off-Auto” switch on cover where shown on the drawings.

14. NEMA 4 Enclosures:

    a. Unless otherwise noted, all NEMA 4 enclosures shall be 316 stainless steel. NEMA 4X push buttons and pilot lights shall be provided in all weatherproof control panels. No painted boxes will be allowed.

15. ELECTRICAL MATTING:

    a. Electrical Matting shall be provided in the electrical room around all electrical gear, including switchgears, MCC, Control Panels and transformers. The rubber matting shall provide a floor covering to prevent shock around high voltage electrical apparatus, fuse boxes, switchgear, control panels, and heavy machinery. It shall meet current ASTM, ANSI (plus IEC Division of ANSI, Tech. Committee-78) specifications for this material. Matting shall be 1/4” thick, Class 2 as manufactured by The Mat King or equal.

PART 3 - EXECUTION (not used)

END OF SECTION

SECTION 16120 WIRES AND CABLES

PART 1 - GENERAL

A. SCOPE OF WORK

1. Furnish, install and test all wire, cable, and appurtenances as shown on the Drawings and as hereinafter specified.

B. SUBMITTALS

1. Samples of proposed wire and cable shall be submitted for approval. Each sample shall have the size, type of insulation, UL listing and voltage stenciled on the jacket.

2. Approved samples will be sent to the project location for comparison by the Resident Engineer with the wire actually installed.

3. Installed, unapproved wire shall be removed and replaced at no additional cost to the Owner.

C. APPLICATIONS

1. Wire for lighting, receptacles, and other circuits not exceeding 150 volts to ground shall be NEC type XHHW. Below grade and underground the wire shall be type XHHW.

2. Wire for circuits over 150 volts to ground shall be NEC type XHHW for sizes 4/0 AWG and smaller, and shall be NEC type RHW for sizes 250 MCM (kcmil) and larger.

3. Wire for all VFD output power cable shall be type XLPE RHH/RHW-2. See section 2.05 of this specification for additional requirements.

4. Single conductor wire for control, indication and metering shall be type MTW No. 14 AWG, 19 strand or type XHHW No. 14 AWG stranded.

5. Multi-conductor control cable shall be No. 14 AWG, 19 strand.

6. Wire for process instrumentation or shielded control cable shall be No. 16 AWG, shielded and stranded.

D. MINIMUM SIZES

1. Except for control and signal leads, no conductor smaller than No. 12 AWG shall be used.

PART 2 - PRODUCTS

A. MATERIALS

1. All wires and cables shall be of annealed, 98 percent conductivity, soft drawn stranded copper conductors.

B. 600 VOLT WIRE AND CABLE

1. Type RHW and XHHW shall be cross-linked polyethylene (XLP); as manufactured by the Southwire Co., Collyer Insulated Wire Co., Rome Cable or approved equal.

2. Type THWN shall be as manufactured by the Southwire Co., Collyer Insulated Wire Co., Rome Cable or approved equal.

3. Variable Frequency Drive **(VFD) Output Power Cable:**

a. Section applies to power cables routed between the output of VFD’s and motor terminals.

b. Cable shall be rated for 2000 volts and shall meet the requirements below:

(1) Conductors shall be stranded Class B bare copper.
(2) All wire shall be brought to the job in unbroken packages and shall bear the data of manufacturing; not older than 12 months.
(3) Type of wire shall be XLPE RHH/RHW-2 rated 90 degrees C suitable for wet locations.
(4) Provide overall 5 millimeter metallic shield (copper tape shield) overlapped 50%.
(5) No wire smaller than No. 12 gauge shall be used unless specifically indicated.
(6) Cable construction shall consist of three insulated current-carrying phase conductors and three bare ground conductors, symmetrically placed between the phase conductors, and twisted beneath a continuous overall PVC polymeric jacket.

c. Each ground conductor size (circular mil area) shall be one-third (1/3) of the NEC required size (circular mil area) for a single ground conductor. If one third of the required circular mil area does not correspond to a standard size (circular mil area) of construction, the next largest size of standard construction shall be used. All conductors shall be megger tested after installation and insulation must be in compliance with the Insulated Power Cable Engineers Association Minimum Values of Insulation Resistance.

d. Manufacturers:

(1) General Cable
(2) Southwire
(3) Approved Equal.

C. INSTRUMENTATION AND CONTROL CABLE

1. Process instrumentation wire shall be twisted pair, 600V, cross-linked polyethylene insulated, aluminum tape shielded, polyvinyl chloride jacketed, type "XLP" as manufactured by the American Insulated Wire Co., Eaton Corp. "Polyset," or approved equal. Multi-conductor cables shall be supplied with individually shielded twisted pairs.

2. Multi-conductor control cable shall be stranded, 600V, cross-linked polyethylene insulated with PVC jacket, type "XLP" as manufactured by the American Insulated Wire Co., Eaton Corp. "Polyset," or approved equal.

D. Communication Wire

1. Ethernet cable shall be designed for use with a high-speed (100 Mbps/Gbps) Ethernet communications network. The twisted pair cable shall have nominal impedance of 100 ohms at 1 Mhz and a maximum attenuation of 10 dB per 1000 feet at 1 Mhz. The twisted pair cable shall be plenum rated and shall have a minimum of four 24 AWG solid copper conductor pairs. All RJ-45 terminations on the twisted pair cable shall be done as specified by the manufacturer. Terminations shall provide strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable. Cable and connections shall meet or exceed Category 6 ratings and upon completion of the network installation, the system shall be tested to Category 6 standards. Category 6 cable shall be as manufactured by Belden, or

equal.

2. Profibus PA cable shall be 300 V, 1 pair 18 AWG, stranded tinned copper, 100% foil shield, color blue and orange, 100 ohms at 31.25 kHz, PVC jacket, Belden Type 3076F or equal.

3. Profibus DP cable shall be 300 V, 1 pair 22 AWG, stranded tinned copper, 100% foil shield, color red and green, 150 ohms, PVC jacket, Belden Type 3079E or equal.

4. DeviceNet cable shall be Class 1 (600V), 2 pair, 16 AWG, stranded tinned copper, 100% individually foil shielded, ODVA (Open DeviceNet Vendor Association)Cable V, Belden Type 7896A or equal.

E. TERMINATIONS AND SPLICES

1. Power Conductors: Terminations shall be die type or set screw type pressure connectors as specified. Splices (where allowed) shall be die type compression connector and waterproof with heat shrink boot or epoxy filling.

2. Control Conductors: Termination on saddle-type terminals shall be wired directly with a maximum of two conductors per termination. Termination on screw type terminals shall be made with a maximum of two spade connectors. Splices (where allowed) shall be made with insulated compression type connectors. Heat shrink boots shall be utilized for all outdoor splices.

3. Instrumentation Signal Conductors (including graphic panel, alarm, low and high level signals): Terminations permitted shall be typical of control conductors. Splices are allowed at instrumentation terminal boxes only.

4. Except where otherwise approved by the Engineer no splices will be allowed in manholes, handholes or other below grade located boxes.

5. Splices shall not be made in push button control stations, control devices (i.e., pressure switches, flow switches, etc.), conduit bodies, etc.

PART 3 – EXECUTION

A. INSTALLATION

1. All conductors shall be carefully handled to avoid kinks or damage to insulation.

2. Lubrications shall be used to facilitate wire pulling. Lubricants shall be U.L. listed for use with the insulation specified.

3. Shielded instrumentation wire shall be installed from terminal to terminal with no splicing at any intermediate point.

4. Shielded instrumentation wire shall be installed in rigid steel conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from control cables in manholes.

5. Shielding on instrumentation wire shall be grounded at one end only, as directed by supplier of the instrumentation equipment.

6. Wire and cable connections to terminals and taps shall be made with compression connectors. Connections of insulated conductors shall be insulated and covered. All connections shall be made using materials and installation methods in accordance with instructions and recommendations of the manufacturer of the particular item of wire and cable. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

7. All wire and cable shall be continuous and without splices between points of connection to equipment terminals, except a splice will be permitted by the Engineer if the length required between the points of connection exceeds the greatest standard shipping length available from the manufacturer specified or approved by the Engineer as the manufacturer of the particular item of wire and cable.

8. Steel fish tapes and/or steel pulling cables shall not be used in PVC conduit runs.

9. All control and instrumentation circuits and wiring shall be clearly and permanently numbered and labeled

at each end so as to identify the location of the opposite end and the function of the circuit. Individual wires in a multi-wire circuit shall be identified with wire numbers. Labeling shall be in place prior to turnover of any equipment, system or sub-system to Owner.

B. TESTS

1. Main service, generator and motor feeders 600-volt wire insulation shall be tested with a meg-ohmmeter after installation. Tests shall be made at not less than 1,000 VDC.

2. All service conductors shall be tested as in paragraph A above. These tests shall be witnessed by the Engineer. A written report shall be submitted to the engineer for review.

END OF SECTION

SECTION 16150 MOTORS

PART 1 – GENERAL

A. Scope of Work

1. Furnish and install the motors as hereinafter specified and as called for in other sections of these Specifications.

B. Qualifications

1. Motor shall be sufficient size for the duty to be performed and shall not exceed their full-rated load when the driven equipment is operating at specified capacity. Unless otherwise noted, motors driving pumps shall not be overloaded at any head or discharge condition of the pump.

C. Submittals

1. The motor manufacturer shall submit to the Engineer certified dimension prints showing nameplate data and outline dimensions within three weeks of the date they receive the order.

2. Guarantee: All equipment furnished and installed under this Section shall be guaranteed against defects of workmanship, materials and improper installation for a period of one year from date of acceptance. All such equipment or parts proven defective, due to the above noted causes, shall be replaced in the machines by the Contractor at no expense to the Owner.

3. Provide equipment warranty in accordance with Section 01750: Warranties and Bonds.

PART 2 – PRODUCTS

A. Rating

1. Unless otherwise noted, all motors shall be of the low voltage type. All motors 1/2 through 100 horsepower shall be rated 230/460 volt, 3 phase, 60 Hertz A.C.; motors 125 horsepower through 500 horsepower shall be

rated 460 volt, 3-phase, 60 Hertz, and motors below 1/2 horsepower shall be rated 115/230 volt, 1 phase, 60 Hertz A.C.

B. Three Phase Induction Motors

1. Motors 20 HP and larger shall have a 120-volt space heater for moisture control.

2. Unless specifically noted in other sections of these Specifications, all motors shall have a minimum as indicated in the table below. All motors shall be "premium efficiency" type.

TABLE 1

Motor HP	Min. Eff.	Max. dba	Motor HP	Min. Eff.	Max. dba
1-2	84.0%	74	25-30	92.0%	92
3-5	86.5%	79	40-50	93.0%	97
7.5-10	90.2%	84	60-75	94.0%	100
15-20	91.0%	89	100	94.1%	102

3. Motors operating with variable frequency drives shall state that they are suitable for their intended applications. Motor nameplate shall read "Inverter Duty Rated".

4. Motors larger than 100 Hp and operating with a VFD shall have imbedded a winding temperature switch.

5. Motors 300 Hp and larger shall have vibration protection.

C. Construction

1. General:

a. All dripproof and weather protected Type I motors shall have epoxy encapsulated windings. Totally enclosed motors shall not be encapsulated. Motors not readily available with encapsulated windings may be standard type. Motors exposed to the

outside atmosphere shall be totally enclosed fan cooled (TEFC) unless otherwise specified.

b. Squirrel-cage rotors shall be made from high-grade steel laminations adequately fastened together and to the shaft, or shall be cast aluminum or bar-type construction with brazed end rings.

2. Low Voltage, Three Phase Motors:

a. Motors shall be of the squirrel-cage or wound rotor induction type as noted. Horizontal, vertical solid shaft, vertical hollow shaft, normal thrust and high thrust types shall be furnished as specified herein. All motors shall be built in accordance with current NEMA, IEEE, ANSI and AFBMA standards where applicable. Motors shall be of the type and quality described by these Specifications, fully capable of performing in accordance with manufacturer's nameplate rating, and free from defective material and workmanship.

b. Motors shall have normal or high starting torque (as required), low starting current (not to exceed 600 percent full load current), and low slip.

c. Motors shall be totally enclosed fan-cooled construction with 1.15 service factor unless otherwise noted. Indoor motors shall be WPI unless otherwise noted.

d. Motors shall be suitable for operation in moist air with hydrogen sulphide gas present.

e. The output shaft shall be suitable for direct connection or belt drive as required.

f. Motors shall have a Class B nonhygroscopic insulation system. Class F insulation may be used but shall be limited to Class B temperature rise.

g. All motors shall have a final coating of chemical resistant corrosion and fungus protective epoxy fortified enamel finish sprayed over red primer over all interior and exterior surfaces. Stator bore and rotor of all motors shall be epoxy coated.

h. All fittings, bolts, nuts, and screws shall be 316 stainless steel. Bolts and nuts shall have hex heads.

i. All machine surfaces shall be coated with rust inhibiter for easy disassembly.

j. Conduit boxes shall be gasketed. Lead wires between motor frame and conduit box shall be gasketed.

k. Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.

l. Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T and larger. Enclosures will have stainless steel screen and motors shall be protected for corrosion, fungus and insects.

m. Low voltage, three phase motors shall be manufactured by General Electric, U.S. Motors, Westinghouse or approved equal.

n. Fractional Horsepower:

(1) Fractional horsepower motors shall be rigid, welded-steel, designed to maintain accurate alignment of motor components and provide adequate protection. End shields shall be reinforced, lightweight die-cast aluminum. Windings shall be of varnish-insulated wire with slot insulation of polyester film, baked-on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses and other hazards.

(2) Motor shaft shall be made from high-grade, cold-rolled shaft steel with drive-shaft extensions carefully machined to standard NEMA dimensions for the particular drive connection.

(3) For light to moderate loading, bearings shall be quiet all-angle sleeve type with large oil reservoir that prevents leakage and permits motor operation in any position.

(4) For heavy loading, bearings shall be carefully selected precision ball bearings with extra quality, long-life grease, and large reservoir providing 10 years' normal operation without relubrication.

o. Integral Horsepower:

(1) Motor frames and end shields shall be cast iron or heavy fabricated steel of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.

(2) Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibrations.

(3) The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be gound and polished.

(4) Rotors shall be made from high-grade steel laminations adequately fastened together, and to the shaft. Rotor squirrel-cage windings may be cast-aluminum or bar-type construction with brazed end rings.

(5) Motors shall be equipped with vacuum-degassed antifriction bearings made to AFBMA Standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent lubrication, but facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight, running fits

or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of lubricant out of the bearing cavity.

(6) Bearings of high thrust motors will be locked for momentary upthrust of 30% downthrust. All bearings shall have a minimum B10 life rating of 100,000 hours in accordance with AFBMA life and thrust values.

(7) Vertical hollow-shaft motors will have nonreverse ratchets to prevent backspin.

3. Low Voltage, Single Phase Motors:

(1) Single phase motors shall be split-phase and capacitor-start induction types rated for continuous horsepower at the rpm called for on the Drawings. Motors shall be rated 115/230 volts, 60 Hertz, single phase, open dripproof, or totally enclosed fan cooled as called for on the Drawings, with temperature rise in accordance with NEMA Standards for Class B insulation.

(2) Totally enclosed fan cooled motors shall be designed for severe-duty.

(3) Motors shall have corrosion and fungus protective finish on internal and external surfaces. All fittings shall have a corrosion protective plating.

(4) Mechanical characteristics shall be the same as specified for polyphase fractional horsepower motors.

PART 3 – EXECUTION

A. Installation

1. Motor Connections: All motors shall be connected to the conduit system by means of a short section 18-inch minimum of flexible conduit unless otherwise indicated. For all motor connections, the Contractor shall install a grounding conductor in the conduit and terminate at

the motor control center with an approved grounding clamp.

B. Tests and Checks

1. The following tests shall be performed on all motors after installation but before putting motors into service.

a. The Contractor shall megger each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the Engineer and shall not energize the motor. The following table gives minimum acceptable insulation resistance in megohms at various temperatures and for various voltages with readings being taken after one minute of megger test run.

TABLE 2

Degree Winding Temperature		**Voltage**			
°F	**°C**	**115V**	**230V**	**460V**	**4,160V**
37	3.9	60	108	210	1,700
50	10	32	60	120	1,000
68	20	13	26	50	460
86	30	5.6	11	21	195
104	45	2.4	4.5	8.8	84
122	50	1	2	3.7	35
140	60	.5	.85	1.6	15

b. The Contractor shall check all motors for correct clearances and alignment and for correct lubrication, and shall lubricate if required in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections if necessary.

2. The following tests shall apply to the medium voltage motors:

   a. See Paragraph 2.03 B.2 for test requirements.

   b. All motors shall be given the standard short commercial test prior to shipment. This shall consist of no load current, check current balance, winding resistance, air gap measurement, high potential tests, and bearing inspection. Six (6) copies of the certified short commercial test shall be mailed to the Engineer prior to shipment.

END OF SECTION

SECTION 16160 PANELBOARDS

PART 1 - GENERAL

A. SCOPE OF WORK

1. Furnish all labor materials, equipment and incidentals required and install all panelboards as hereinafter specified and as shown on the Drawings.

PART 2 - PRODUCTS

A. RATING

1. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.

2. Panelboards installed indoors shall be NEMA 1 type enclosure unless otherwise noted. Panelboards to be stainless steel.

3. Panelboards installed outdoors shall be NEMA 4X SS type enclosure unless otherwise noted.

B. STANDARDS

1. Panelboards shall be in accordance with the Underwriter Laboratories, Inc. "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code.

C. CONSTRUCTION (NEMA 1)

1. Interiors:

a. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the antiturn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.

b. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed

without machining, drilling or tapping.

c. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

d. A nameplate shall be provided listing panel type, number of circuit breakers and ratings.

2. Buses:

a. Bus bars for the mains shall be of copper. Full size neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper.

b. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

c. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

d. Buses for 120/208V light panels shall be rated 10,000 amperes RMS symmetrical.

3. Boxes:

a. Recessed boxes shall be made from galvanized code gauge steel without multiple knockouts. Surface mounted boxes shall be painted to match the trim. Boxes shall be of sufficient size to provide a minimum gutter space of 4 inches on all sides.

b. Surface mounted boxes shall have an internal and external finish as hereinafter specified in paragraph D4.

c. At least 4 interior mounting studs shall be provided.

d. All conduit entrances shall be field punched.

4. Trim:

a. Hinged doors covering all circuit breaker handles shall be included in all panel trims.

b. Doors shall have semi flush type cylinder lock and catch, except that doors over 48-in in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.

c. The trims shall be fabricated from code gauge sheet steel.

d. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.

e. Trims for flush panels shall overlap the box by at least 3/4-inch all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

5. Manufacturer:

a. 120/240V, single phase, 3-wire, and 120/208V 3-phase, 4-wire panelboards shall be as manufactured by Square D, Eaton Cutler-Hammer or Siemens.

b. 480V, 3-phase, 3-wire panelboards shall be as manufactured by Square D, Eaton Cutler-Hammer or Siemens.

D. CONSTRUCTION (NEMA 4X SS)

1. Interiors:

a. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the antiturn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.

b. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units

and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.

c. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

d. A nameplate shall be provided listing panel type, number of circuit breakers and ratings.

2. Buses:

a. Bus bars for the mains shall be of copper. Full size neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper.

b. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

c. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

d. Buses for 120/208V light panels shall be rated 10,000 amperes RMS symmetrical.

3. Boxes:

a. Recessed boxes shall be made from galvanized code gauge steel without multiple knockouts. Surface mounted boxes shall be painted to match the trim. Boxes shall be of sufficient size to provide a minimum gutter space of 4 inches on all sides.

b. Surface mounted boxes shall have an internal and external finish as hereinafter specified in paragraph D4.

c. At least 4 interior mounting studs shall be provided.

d. All conduit entrances shall be field punched.

4. Trim:

   a. Hinged doors covering all circuit breaker handles shall be included in all panel trims.

   b. Doors shall have semi flush type cylinder lock and catch, except that doors over 48-in in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.

   c. The trims shall be fabricated from code gauge sheet steel.

   d. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.

   e. Trims for flush panels shall overlap the box by at least 3/4-inch all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

5. Manufacturer:

   a. 120/240V, single phase, 3-wire, and 120/208V 3-phase, 4-wire panelboards shall be as manufactured by Square D, Eaton Cutler-Hammer or Siemens.

   b. 480V, 3-phase, 3-wire panelboards shall be as manufactured by Square D, Eaton Cutler-Hammer or Siemens.

E. CIRCUIT BREAKERS

1. Panelboards shall be equipped with circuit breakers as shown on the Drawings.

2. Circuit breakers shall be molded case, bolt-in type.

3. Circuit breakers used in 120/240 and 120/208V panelboards shall have an interrupting capacity of not less than 10,000 - amperes, RMS symmetrical.

4. GFCI (ground fault circuit interrupter) shall be provided for circuits where indicated on the Drawings. GFCI units shall be 1 pole, 120 volt, molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be U.L. listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time), and an interrupting capacity of 10,000 amperes RMS.

PART 3 - EXECUTION

A. INSTALLATION

1. Boxes for surface mounted panelboards shall be mounted so there is at least 1/2-inch air space between the box and the wall.

2. Unless otherwise noted on the Drawings, top of cabinets shall be mounted 6-feet 0-inch above the floor, properly aligned and adequately supported independently of the connecting raceways.

3. All wiring in panelboards shall be neatly formed, grouped, laced, and identified to provide a neat and orderly appearance. A typewritten directory card identifying all circuits shall be placed in the cardholder inside the front cover.

END OF SECTION

SECTION 16195 ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

A. WORK INCLUDED

1. Nameplates and tape labels.

2. Wire and cable markers.

3. Color coding.

B. SCOPE

1. Provide engraved nameplates for the following equipment as indicated on the drawings:

   a. Label all compartments.
   b. Label all outdoor junction boxes.
   c. Label control system panels.

2. All wires shall be marked and color-coded.

3. All control wiring shall have wire numbers on each end.

4. All exposed conduits to be painted to match color of back wall.

PART 2 - PRODUCTS

A. MATERIALS

1. Nameplates: Engraved three-layer laminated plastic, black letters on a white background.

2. Wire and Cable Markers: Pre-printed self-sticking type.

3. Color Coding Tape: Vinyl plastic insulating tape, colors as specified in part 3.

PART 3 - EXECUTION

A. INSTALLATION

1. Degrease and clean surfaces to receive nameplates and tape labels.

2. Install nameplates and tape labels parallel to equipment lines.

3. Secure nameplates to equipment fronts using screws, rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations.

B. WIRE IDENTIFICATION

1. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.

2. Any color coding schemes used in existing work shall be maintained in new work.

3. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

240/120 Volts, Single-Phase, 3-Wire	**120/208 Volts, 3-Phase, 4-Wire**	**Phase**	**480/277 Volts, 3-Phase, 4-Wire**
Black	Black	A	Brown
Red	Red	B	Orange
	Blue	C	Yellow
White	White	Neutral	White
Green	Green	Ground	Green

C. NAMEPLATE ENGRAVING

1. Provide nameplates to identify all electrical distribution and control equipment and loads served. Letter Height: 1/8 inch for individual switches and loads served for distribution and control equipment identification.

2. Panelboards, Switchboards and Motor Control Centers: 1/4 inch; identify equipment designation. 1/8 inch; identify voltage rating and source.

3. Individual Circuit Breakers, Switches, and Motor Starters in Panelboards, Switchboards, and Motor Control Centers: 1/8 inch; identify circuit and load served, including location.

4. Individual Circuit Breakers, Enclosed Switches, and Motor Starters: 1/8 inch; identify load served.

END OF SECTION

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SECTION 16370 VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

A. SCOPE OF WORK

1. Furnish all labor, materials, equipment and incidentals required to furnish and install variable frequency drives as shown on the Drawings and as specified herein.

2. These specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and field testing, of all materials, equipment and appurtenances for the variable frequency drives herein specified.

B. DESCRIPTION OF SYSTEM

1. All VFDs furnished for this project shall be the responsibility of the Contractor. The CONTRACTOR shall be responsible for complete system operation and all required coordination with all disciplines.

2. The variable frequency drives will operate motors as specified in Division 11 and Division 16. The drives furnished herein under shall be totally compatible and adequately sized with the Motors to be supplied.

3. VFDs shall be free standing.

4. VFDs shall be sized to serve 115% of motor full load amps at 480 volts, 3-phase.

5. All variable frequency drive systems shall be 18 pulse minimum.

C. QUALIFICATIONS

1. Variable speed drives shall be sized to operate the ampacity shown on the electrical drawings. To assure unit responsibility, all equipment specified in this section of the specifications shall be furnished and coordinated by the CONTRACTOR. The CONTRACTOR shall be responsible for coordinating the sizing of all VFDs.

2. The drives covered by these Specifications are intended to be equipment of proven ability as manufactured by reputable manufacturers having long experience in the production of identical units. The equipment furnished shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

3. The variable frequency control shall operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10% total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds, or when other variable frequency drives are operated from the same bus.

   Individual or simultaneous operation of the variable frequency drives shall not add more than 5% total harmonic voltage distortion to the normal bus, nor more than 10% while operating from standby generator (if applicable) per IEEE 519, latest edition. The load side of the utility transformer shall be the point of common coupling (PCC). The short circuit current at point of common coupling under utility operation is approximately 50,000 symmetrical amperes at 277/480 volts. A harmonic (voltage and current) analysis must be submitted by the variable frequency drive manufacturer with shop drawings. This must include all calculations, simply a statement of compliance is not acceptable. Voltage and current harmonics compliance per IEEE519 shall be verified by the variable frequency drive manufacturer with field measurements of the harmonic distortion difference at the point of common coupling with and without variable frequency drives operating. See testing requirements.

4. The variable frequency drive manufacturer shall maintain and staff engineering service and repair shops through the United States, including the State of Florida, trained to do start up service, emergency service calls, repair work, service contracts and training of customer personnel.

5. The variable frequency drives shall be manufactured by Square D, Eaton Cutler-Hammer, Allen Bradley or Danfoss.

6. Provide Ethernet module for each VFD for monitoring of parameters.

D. SUBMITTALS

1. Copies of all materials required to establish compliance with the specifications shall be submitted. Submittals shall include at least the following:

   a. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

   b. Descriptive literature, bulletins and/or catalogs of the equipment.

   c. Data on the characteristics and performance of the variable frequency drives. Data shall include certification that the variable frequency drives are warranted for use with the motors specified in Division 11 and Division 16.

   d. Complete drawings shall be furnished for approval before proceeding with manufacture and shall consists of master wiring diagrams, elementary or control schematics including coordination with other electrical control devices operating in conjunction with the variable frequency drive, and suitable outline drawings with sufficient details for locating conduit stub-ups and field wiring. Generic schematics not specific to this project shall not be acceptable.

   e. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, packing, etc. on the list. List bearings by the bearing manufacturer's numbers only.

E. OPERATING INSTRUCTIONS (See Section 01300: Operating and Maintenance Data)

F. TOOLS AND SPARE PARTS

1. One (1) set of all special tools required for normal operation and maintenance shall be provided. If no special tools are required then a statement to this effect shall be provided.

2. The Contractor shall supply the following spares:

   (1) One (1) spare VFD rated for 124-amps minimum.

(2) One can of touch up paint for the enclosures.

G. PRODUCT HANDLING

1. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

2. All equipment and spare parts must be properly protected against any damage during a prolonged period at the site.

3. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

4. Each box or package shall be properly marked to show its net weight in addition to its contents.

H. START-UP AND WARRANTY

1. A factory-authorized service technician shall perform start-up on each drive. ("Start up" shall not include installation or termination of either power or control wiring.) Start-up costs provided with the bid shall include time and travel for the estimated number of visits required, but shall not be less than at least one half-day with travel. Additional labor or return trips to the site shall be billed at the VFD supplier’s published straight-time rates. The rates shall be submitted with the VFD shop drawings. Upon completion, a start-up service report shall be provided.

2. All equipment supplied under this Section shall be warranted by the equipment manufacturers for a period of five (5) years, parts and labor from date of substantial completion. The Owner shall not be responsible for any warranty costs including travel, labor, parts, or other costs for a full 5 years from the date of manufacture of the Drive. The warranty shall cover all Drive failures including lightning strikes. The cost of the warranty shall be included in the bid.

PART 2 - PRODUCTS

A. GENERAL

1. The CONTRACTOR shall furnish complete variable frequency drive systems for installation by the Contractor. The CONTRACTOR is responsible for the start up of all VFD drives furnished on this project.

2. The Contractor shall be responsible for the erection and installation of all equipment defined in this section of the contract documents.

3. The variable frequency drive shall be comply with the latest applicable standards of ANSI, NEMA, IEEE, and the National Electrical Code.

4. Variable frequency drive shall operate as specified on standby generators or normal power sources.

5. The CONTRACTOR shall provide a listing of all programmable parameters that are different from the factory default values. For each indicate:

   a. The factory default and meaning
   b. The revised value and meaning

6. The CONTRACTOR shall provide a copy of PC compatible remote programming/ diagnostic software and any required cables to the supplier of the control system. Refer to Division 13. The software shall be able to communicate to the VFDs via an ethernet network connection.

B. CONSTRUCTION

1. Each variable frequency drive shall consist of a 460V, 3-phase rectifier, DC link and variable frequency inverter with features, functions and options as specified. The inverter shall be voltage source design using pulse width modulation (PWM) techniques.

2. The variable frequency drives shall be rated for continuously operating at 1.15 times the full load current of the motor. The variable frequency drives shall be designed to provide continuous speed adjustment of three-phase motors. The variable frequency output voltage shall provide constant

volts-per-Hertz excitation to the motor terminals up to 60 Hertz.

3. Inverters shall be capable of converting incoming three phase, 460V (+10 to -10%) and 60 Hertz (+/-2) Hertz power to DC bus levels. The DC voltage shall be inverted to an variable frequency output.

4. Controllers shall be rated for an ambient temperature of $0^{o}C$ to $40^{o}C$ and humidity of 0 to 95% non-condensing.

5. VFDs shall have complete front accessibility. All VFD openings shall be filtered.

6. The following standard basic control features shall be provided on the inverter:

   a. Start, Stop, "Power On" indicating light and speed control potentiometer. Terminations for remote mounted operator control devices shall be furnished.

   b. Unidirectional operation, coast to rest upon stop.

   c. Variable linear independent timed acceleration.

   d. Variable torque performance from 4 to 60 Hertz.

   e. Frequency stability of 2% for 24 hours with voltage regulation of +2% of maximum rated output voltage.

   f. LCD status indication for Power On, Run, Inverter Enable, Overcurrent, Overvoltage, Overtemperature, Low Supply, and Phase Loss.

   g. 115V AC control power for operator devices.

   h. Phase insensitive to input power.

   i. Automatic restart upon return of power following a utility outage. Drive shall require manual reset after three (3) attempts in a 60 second period.

7. The following protective features shall be provided on the drive:

a. Input AC circuit breaker with an interlocked, pad lockable handle mechanism and AC input line current limiting fuses for fault current protection of AC to DC converter section and circuit breaker. Minimum short circuit rating of 65,000 AIC shall be provided.

b. Electronic overcurrent trip for instantaneous overload protection.

c. Undervoltage and phase loss protection of output.

d. Over-frequency protection.

e. Over-temperature protection.

f. Surge protection from input AC line transients.

g. Electrical isolation between the power and logic circuits, as well as between the 115V AC control power and the static digital sequencing.

h. Drive to be capable of withstanding output terminal line short or open circuits without component failure.

i. di/dt and dv/dt protection for converter semiconductors.

j. Units shall have an English language (no codes) alphanumeric diagnostic display. LED indication of over frequency, instantaneous overcurrent, DC over voltage, AC undervoltage/loss-of-phase, emergency stop, overload, over temperature, inverter pole trip and standby modes shall be provided and door mounted. Additional door mounted status indicating LEDs for self-diagnostic including run, phase loss, micro-processor fault, as well as board mounted LEDs including one for each inverter pole gating signal, each inverter pole status and each logic level VDC used. A comprehensive microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions is also approved.

8. The following standard independent adjustments shall be provided on the inverter:

a. Minimum speed (12 to 54 HZ).
b. Maximum speed (40 to 60 HZ).
c. Acceleration time 6 to 60 Sec. (minimum).
d. Deceleration time 6 to 60 Sec. (minimum).
e. Volts per Hertz.
f. Stability adjustment, if required.
g. Voltage boost (100 to 600 percent of nominal V/HZ ratio at 1 HZ tapering to 100 percent at 20 HZ).

9. The following shall be furnished with each controller:

a. Isolated process instrument speed input signal of 4-20 mA DC.

b. Isolated process instrument speed output signal 4-20 mA DC.

c. Relay output auxiliary contacts as shown on the drawings or as required herein, in Division

d. Door-mounted output load ammeter, voltmeter, and speed output indicating meters.

e. Built-in self diagnostics.

f. Relay output auxiliary contacts as shown on the drawings.

g. Local/Off/Remote and Start/Stop selector switches.

h. Input line reactors.

i. Input filter if required for IEEE519 compliance.

j. All openings in the VFD shall be filtered.

k. Supply an Ethernet connection to access operating parameters and data, power, temperature, voltages and currents to be polled by IFIX.

10. The Variable Frequency Drive shall allow Ethernet communications.

a. 1. The embedded web server shall contain web-pages that provide the ability to configure, control, monitor and diagnose the AC drives via Internet Explorer. No additional software shall be required.

b. The embedded web-pages must be secured by use of a customizable User Name and Password.

11. The Ethernet Communications Card shall support the following services via the standard ethernet Port 502:

a. TCP/Modbus Client, with support for periodic I/O Scanning

b. HTTP Server for drive configuration, control, and monitoring.

c. ICMP client to support certain IP services such as the "ping" command.

d. BOOTP client to assign an IP Address via an address server.

e. FTP Server for modifying, deleting or creating embedded web pages

PART 3 - EXECUTION

A. INSTALLATION

1. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Field wiring shall be in accordance with manufacturer's recommendations. Anchor bolts shall be stainless steel and set in accordance with the manufacturer's recommendations. VFD motor leads shall be in rigid conduit. Each VFD shall have its own rigid conduit for its motor leads. Motor leads shall not be mixed with any other wiring. See VFD manufacturer’s instruction manuals for detailed directions on installation of the VFD’s and the installation of the motor leads.

B. SHOP PAINTING

1. Prior to shop painting, all surfaces shall be thoroughly cleaned, dry, and free from all mill/scale, rust, grease, dirt, and other foreign matter.

2. Drives shall be shop painted.

C. TESTING

1. Tests and Check

   a. The drive manufacturer shall test the drive controller with a motor load prior to shipment. The motor shall have equal or greater full load current than the specified motor.

   b. A certified copy of all tests and checks performed in the field, complete with meter readings and recordings, where applicable, shall be submitted to the Owner.

2. The SYSTEM SUPPLIER shall provide the services of a competent and experienced equipment manufacturer's factory field engineer to supervise start-up and provide training to the Owner's personnel. The factory field engineer shall be available for one (1) - eight (8) hour day to inspect the installed equipment and supervise the start-up demonstration and testing as specified in Section 01664: Start-up, and additional testing and training as specified herein. The factory field engineer shall be available for two (2) additional eight (8) hour days (a total of three (3) - eight (8) hour days) to provide factory and on-site training to the Owner's personnel as specified herein. Training of the Owner's personnel will only be considered valid for approval by the Engineer if it takes place after the successful start-up and demonstration test.

D. TRAINING

1. The training and instruction shall be directly related to the System being supplied. The cost of training programs to be conducted with Owner's personnel shall be included in the Contract price. The training and instruction, insofar as practicable, shall be directly related to the System being supplied. The Supplier shall provide $3,000.00 worth of factory training. Classes to be selected by the Owner.

2. The Supplier shall provide classroom training detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
3. The Supplier shall make use of teaching aids, manuals, slide/video presentations, etc. After the training

services, such materials shall be delivered to Owner.

4. The training program shall represent a comprehensive program covering all aspects of the variable frequency drive and maintenance of the system.

5. All training schedules shall be coordinated with, and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

6. Factory Training: Factory training shall be conducted before the System is commissioned, and subsequent to final manual submittals. Two days of factory training shall be provided and consist of schooling and hands on experience for two people covering the following:

   a. Theory of Operation
   b. Use of Software
   c. Troubleshooting

7. On-site Training: On-site (field) training shall be conducted at the Owner's Plant Site and shall provide detailed hands-on instruction to Owner's personnel covering: system debugging, program modification, trouble-shooting, maintenance procedures, calibration procedures, and system operation. On-site training for general plant staff shall be conducted over a period of one day.

E. SPARE PARTS

1. Contractor to include a $5000.00 Allowance for the Owner to select spare parts from the manufacturers list of recommended spare parts. List to include all recommended spare parts with pricing.

END OF SECTION

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SECTION 16410 UNIT SUBSTATIONS

PART 1 - GENERAL

A. Scope of Work

1. Furnish, install and modify two (2) outdoor unit substations as hereinafter specified and as shown on the Drawings.

2. Incoming primary switch is to remain.

3. The unit substations shall be front aligned and arranged as indicated on the Drawings.

4. The primary switch operating handle and the transformer nameplate shall be the front of the unit substation.

5. All exposed current carrying parts shall be tin plated copper. All cable terminations shall be insulated.

6. The unit substations shall not exceed the physical size shown on the Drawings.

7. The outdoor enclosure, including the transformer and secondary compartments, shall be phosphate cleaned to remove oxide film and painted with electrostatic dry power polyester base paint to 4 mils thick. The enclosures shall be rated NEMA, Type 3R. Unit substations paint color shall be ANSI-61 or ANSI-49 light grey.

8. Substation shall be provided with pulling eyes, jacking facilities and lifting lugs on each shipping section to set the substation in place.

B. Related Work

1. Equipment pads are existing.

2. Power System Study is specified in Section 16010. The preliminary short circuit study shall be approved by the Engineer before the substation submittal will be reviewed.

C. Submittals

1. Submit to the Engineer, in accordance with Section 01300, the following:

a. Copy of this specification confirming compliance with each paragraph.

b. Construction Details

(1) Complete construction details shall be furnished for approval before manufacture. Details shall include front, plan and sectional views of the substation, incoming line equipment, transformer, secondary distribution, elementary and wiring schematic diagrams.

c. Manufacturer’s warranty.

2. Each bidder shall also submit to the Engineer for his approval a complete listing of all full-size transformers of his manufacture within the category covered by these specifications that have been short-circuit tested. This list shall designate complete ratings and shall also point out whether these tests were performed on developmental units or on customer units. In the case of units tested for or by the ultimate customer, indication shall be given on each unit as to whether the test was successful or unsuccessful and, if tested more than once, each subsequent test shall be so listed and appropriate comments given as to design changes made, if any. Shop drawing submittals shall clearly show proof that the transformers are in compliance with "Distribution and Power Transformer Short-Circuit Test Code in ANSI C57.12.91".

D. Reference Standards

1. American National Standards Institute (ANSI)

2. Institute of Electrical and Electronics Engineers (IEEE)

3. National Electrical Manufacturers Association (NEMA)

4. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

E. Maintenance

1. Provide the following spare parts in the quantities specified:

a. For each primary switch, provide three (3) spare primary fuses.

b. Three dozen each of cover bolts, cage nuts and door fasteners.

c. One quart of touch-up paint.

d. Two (2) replacement lens caps.

e. Two (2) pilot lamps of each size and voltage.

f. Two (2) control power fuses of each size.

2. Spare parts shall be boxed or packaged for long term storage and clearly identified on the exterior of the package. Identify each item with manufacturer's name, description and part number.

F. Qualifications

1. The unit substation shall be the product of a manufacturer who shall also be the manufacturer of the primary switch and secondary distribution equipment. Manufacturer shall take complete responsibility for transformers purchased from third parties.

2. Each unit substation shall consist of a primary switch, a transformer, and secondary power distribution section combined as an integral unit.

3. The unit substations shall be Eaton/Cutler-Hammer, Schneider Electric/Square D Company or Siemens.

G. Warranty

1. All equipment supplied under this Section shall be warranted by the Contractor and the equipment manufacturers for a period of five (5) years.

2. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the machine(s) and the unit(s) restored to service at no additional cost to the Owner.

3. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

PART 2 - PRODUCTS

A. Transformer Section

1. The transformer shall be liquid filled with biodegradable food grade oil, dual rated 55°/65°C rise over 40°C ambient at full load continuous operation. See electrical drawings for primary and secondary configurations.

2. The primary winding shall be rated for 12,470 volts, 110 kV BIL, with four approximately 2-1/2 percent rated KVA taps, two above and two below rated primary voltage. Taps shall be accessible from a terminal board from front of unit. The secondary shall be rated (480Y/277V), 3-phase, 4 wire with the mid-point (wye) connection insulated for grounding. Each low voltage connection shall be provided with a flexible section for minimizing transmission of noise to switchgear. Impedance shall be 5.75 percent minimum on the self-cooled KVA base.

3. Transformer accessories shall include sound isolating pads of neoprene rubber under each core/coil mounting point, ground pad, on low-voltage end, provisions for rolling and skidding in any direction, diagrammatic nameplate, thermometer (one in each winding) and high winding temperature alarm switch for a remote alarm and fan operation, fan control and monitoring shall be Life Guard-85 as manufactured by Square D Co. or equal. An indicator shall be provided to display each windings temperature. Fans for forced air cooling shall be provided. Forced air-cooled capacity shall not be less than 115 percent of self-cooled rating at 55°/65°-rise. Fans shall operate on 120-volt power supplied a 480-volt to 120-volt control power transformer located in the secondary section of the substation. A fused disconnecting means shall be provided for the fan power.

4. Buswork for the high-voltage connection shall be bolted to connectors on the face of the coils. Low-voltage buswork shall be assembled and supported by the core clamping structure.

5. Transformer core shall be of grain-oriented silicon steel which has been slit, sheared, and annealed at the transformer manufacturer's plant, to relieve stress and to be burr-free. Boltless core construction shall be employed to provide rigidity and strength, to reduce stress on the laminations and flux concentration in the core. The outer surfaces of the core steel shall be

coated with a moisture-resisting material to prevent atmospheric corrosion.

6. Windings shall be copper and shall closely match the expansion and contraction properties of the insulation system.

7. Enclosures shall be constructed of heavy gauge sheet metal with flanges to mate with incoming and outgoing sections.

8. The following standard factory tests shall be run on each unit manufactured and shall be made in accordance with the latest revision of ANSI Test Code for Transformers, C57.12.91.

   a. Resistance measurements of all windings on the rated voltage connection.

   b. Ratio test on the rated voltage connection and on all panel connections.

   c. Polarity and phase relation tests on the rated voltage connection.

   d. No load loss at rated voltage on the rated voltage connection.

   e. Exciting current at rated voltage on the rated voltage connection.

   f. Impedance and load loss at rated current on the rated voltage connection of each unit.

   g. Applied potential tests.

   h. Induced potential test.

9. Certified test reports shall be furnished (on request) for the above standard test of each unit.

10. Transformer shall have a paint finish same as the low-voltage section.

11. The transformer shall meet the general requirements of ANSI C57.12.01 plus the applicable requirements of ANSI C57.110. Tests shall be per ANSI C57.12.91. Additional transformer construction requirements:

a. Noise Level: The maximum sound level shall not be excessive and shall conform to NEMA Standard TR1.

b. Nameplates: Nameplates, warnings, connection diagrams, etc., shall be in accordance with ANSI C57.12.01.

c. Factory Tests: The routine tests listed in ANSI C57.12.01 shall be conducted on all transformers.

d. Outline Drawings: To include weight, center of gravity, losses at rated load, DC resistance at 25 degrees C. and nameplate data.

12. Accessories:

a. Diagrammatic stainless steel nameplate mounted on the front enclosure panel.

b. Provide engraved, laminated phenolic nameplate (black letters on a white background) attached with stainless steel screws. Nameplate to identify unit substation. Nameplate shall be approximately 2" x 3". (i.e. SUB No. 01).

B. Secondary Termination Cabinet

1. Provide factory supplied secondary termination cabinet for 6-600 kcmil conductors per phase.

PART 3 - EXECUTION

A. Installation

1. The substation shall be mounted on steel channels furnished under this Section, set flush with the concrete pad and level in all directions. Provide galvanized hardware for installation. Grout and caulk all voids beneath the equipment base. The substation shall be bolted to the pad with anchor bolts not less than 1/2-inch galvanized steel, minimum sized and installed in accordance with the manufacturer’s recommendation.

2. Install the equipment in accordance with the manufacturers' instructions.

3. Remove temporary lifting angles, lugs, and shipping braces. Touch-up damaged paint finishes.

4. Make wiring interconnections as required.

5. Caulk seams, cracks, and openings in outdoor enclosures.

B. Field Testing

1. Engage the services of a recognized independent testing firm to inspect and test the installed equipment prior to energization. The testing firm shall provide all material, labor, equipment and technical supervision to perform the tests and inspection. Notify the Engineer at least 2 weeks prior to scheduling any testing.

2. Equipment testing and inspection shall be performed before energizing the unit substation in accordance with NETA Standard ATS and shall include the following.

   a. Visual and mechanical inspection.

   b. Ratio and polarity tests on current and voltage transformers.

   c. Ground resistance test.

   d. Insulation resistance tests (phase-to-phase and phase-to-ground).

   e. Meter calibration

   f. Circuit breaker contact resistance test.

   g. Insulation power factor and resistance test for surge arresters.

   h. Phasing check.

   i. Current injection tests on each circuit.

3. In the event of an equipment fault, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, Engineer, Owner and the equipment manufacturer’s factory service technician. Repair or replace the equipment as directed by the Engineer and Owner prior to placing the equipment back into service.

C. Adjustment

1. The manufacturer shall provide the services of a factory trained service technician for the time period specified in Section 16000. The first trip shall be coordinated with the field testing. The second trip shall include any necessary follow-up or punch list work and technical instruction for the Owner's designated personnel. The manufacturer's service technician shall demonstrate all operational features of the installed equipment.

2. The manufacturers factory service technician shall make the following test and adjustments:

   a. Calibrate and test all circuit breaker trip devices, protective relays and controls per the final version of the Coordination Study specified in Section 16010.

   b. Adjust and lubricate switch and circuit breaker operating mechanisms and contacts.

D. Cleaning

1. Clean the interior and exterior of electrical equipment in accordance with Section 16010.

END OF SECTION

SECTION 16430 480 VOLT SWITCHGEAR

PART 1 - GENERAL

A. Scope Of Work.

1. Furnish and install the 480 Volt switchgear as shown on the Drawings and as specified herein.

B. Related Work.

1. Concrete for equipment pad is specified in Division 3.

2. Power system studies are included in Section 16010. The preliminary short circuit study shall be approved by the Engineer before the switchgear submittal will be reviewed.

3. Surge protective devices are included in Section 16709.

C. Submittals.

1. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data to establish compliance with this Section. Submittals shall include at least the following:

a. Copy of this specification confirming compliance with each paragraph.

b. Equipment shop drawings showing elevation and plan views, conduit entrance spaces, nameplate data, bus arrangement, dimensions, weight, shipping splits and metering layouts. Indicate all options, special features, ratings and deviations from this Section.

c. Point-to-point compartment wiring diagrams for metering, relay, and control circuits. Show wire and terminal numbers.

d. Product data sheets and catalog numbers for circuit breakers, trip devices and protective relays. List all options, trip adjustments and accessories furnished specifically for this project.

e. Itemized bill of materials for metering, protective relays, accessories and control equipment.

f. Manufacturer’s warranty.

g. Instruction and renewal parts books.

h. Itemized list of spare parts furnished specifically for this project, including quantities, description and part numbers.

i. Certified shop test reports.

j. Field test and inspection reports.

D. Reference Standards.

1. Switchgear and components shall be designed, built and tested in accordance with the latest revision of the following standards:

a. UL1558 - UL Standard for Safety Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.

b. NEMA SG.5 - Power Switchgear Assemblies.

c. NEMA SG.3 - Low voltage power circuit breakers.

d. ANSI C37-20.1 and related standards.

e. National Electrical Code (NEC)

2. Solid-state circuitry shall meet or exceed the Transient Overvoltage Withstand Test per NEMA ISCI-109 and the Surge Withstand Capability Tests (SWC) per IEEE Standard 472 (ANSI C37.90A). In addition, where UL Standards exist for components, devices and/or assemblies, such standards shall apply.

3. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

E. Quality Assurance.

1. The equipment furnished under this Section shall be the product of a manufacturer who has produced this

same type of equipment for a period of at least 10 consecutive years.

2. Switchgear shall be designed, assembled and tested by the manufacturer of the circuit breakers used in the switchgear.

3. All sections and devices shall be UL listed and labeled. Service equipment shall be UL labeled as suitable for use as service entrance equipment.

F. Delivery, Storage and Handling.

1. Package the equipment for maximum protection during delivery and storage.

2. Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are permanently weather tight. Furnish, install and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Protect the equipment at all times from exposure to moisture, chemicals, hydrogen sulfide and chlorine gas.

G. Maintenance.

1. Furnish the following maintenance accessories for the switchgear.

a. Two cranks for racking breakers.

b. Overhead breaker traveling lifting device at each switchgear lineup.

c. One portable full function trip device test set and cables for secondary injection testing of trip units.

d. Remote racking and closing device.

2. Provide the following spare parts in the quantities specified:

a. Three dozen each of cover bolts, cage nuts and door fasteners.

b. One quart of touch-up paint.

c. 100 percent replacement of lens caps.

d. 10 pilot lamps of each size and voltage.

e. 10 control power fuses of each size.

3. Spare parts shall be boxed or packaged for long term storage and clearly identified on the exterior of the package. Identify each item with manufacturers name, description and part number.

H. Warranty.

1. All equipment supplied under this Section shall be warranted by the Contractor and the equipment manufacturers for a period of three (3) years from Substantial Completion in accordance with Section 01740.

2. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the machine(s) and the unit(s) restored to service at no additional cost to the Owner.

3. The manufacturer’s warranty period shall run concurrently with the Contractor’s warranty period. No exception to this provision shall be allowed.

I. Extended Warranty (Bid Additive Alternate).

1. If authorized by the Owner, Contractor and equipment manufacturer shall extend the initial warranty period listed in the previous paragraph for a period of two (2) years, bringing the total warranty coverage up to five (5) years.

2. The extended warranty shall include all terms and conditions required to be provided by the Owner to maintain the terms of the warranty.

PART 2 - PRODUCTS

J. Ratings.

1. Service: 480/277 Volt, 3 Phase, 4 Wire, 60 Hz as shown on the Drawings.

2. The switchgear and protective devices shall have a fully rated, short circuit rms symmetrical Amps withstand rating as noted on the drawings. Systems employing series connected ratings shall not be used. Main and feeder devices shall be coordinated for selective tripping using zone selective interlocking.

3. The continuous current rating of the bus shall be equivalent to the frame size of the main circuit protective devices as shown on the Drawings. The bus shall be designed to carry its rated continuous current in the specified ambient temperature without exceeding the temperature rise limits specified in ANSI Standard C37.20.1. Bus bracing shall exceed the specified equipment short circuit rating. Line and load bus connections to feeder devices shall be rated to carry the full continuous current of the device frame.

4. The switchgear, including devices shall be designed for continuous operation at its rated current in a 40 degree C ambient temperature.

K. Construction.

1. General

a. The general arrangement of the Switchgear is shown on the Drawings. Switchgear shall be Magnum DS Type as manufactured by Eaton/Cutler Hammer; or Type PZ-IV by Schneider Electric / Square D Company.

2. Structure

a. Switchgear shall be indoor NEMA 1 gasketed as shown on the Drawings, completely metal enclosed and sectionalized to isolate and minimize the effects of internal short circuit currents. The structure shall consist of a framework of preformed steel channels or angles covered with bolted steel sheets. Each individual breaker/metering cell shall be completely segregated from adjacent compartments and sections by steel barriers at top, bottom, rear and sides.

b. Breaker compartments shall be equipped with shutters to protect against contact with the energized primary disconnects when the breaker is removed from its compartment. Each individual breaker cell, metering and auxiliary compartment shall be provided with a hinged front panel door.

c. Provide side barriers between adjacent vertical structures in cable and bus compartments. The vertical bus shall be so arranged as to have insulating barriers interposed between phases to inhibit phase-to-phase faults. In addition, protective devices shall be completely compartmentalized by the addition of barriers above and below each device to minimize fault communication.

d. Line and/or load terminals of each circuit breaker shall be extended to the rear so that it will be unnecessary to reach across or beyond a line bus to make connections. Removable insulation boots shall be provided to insulate the cable connections after the feeder cables have been installed. Rear cable compartments shall be isolated from the main and riser bus by insulated or grounded steel barriers. Provide cable supports in each vertical section. Cable compartments shall be standard depth with bending space in accordance with the NEC.

e. Provide hinged padlockable covers on the rear of each vertical section. Cover shall utilize 3-point latch system to allow for easy opening when padlock is removed.

f. All live buses shall be phase-isolated in the rear to help prevent accidental contact with buses when making upload terminations. The vertical buses shall be isolated from the main buses with full length glass polyester barriers. The main buses shall be phase-isolated from each other and from the device load/line lugs by means of isolating barriers. Joint bolts in the isolated bus system shall be insulated yet, maintainable without removal of the barriers. Insulation and isolation shall be designed to reduce entrance of foreign objects and contaminants, serving as

a deterrent to fault initiation, yet designed to facilitate inspection and maintenance.

g. The switchgear shall be provided with adequate means for lifting, and shall be capable of being rolled or moved into installation position and bolted directly to the floor without the use of floor sills.

h. Protective devices shall be arranged so they are individually removable and readily interchangeable from the front of the switchgear. Rotary operating handles for all protective devices shall be of the same design and shall be prominently labeled to indicate device ampere ratings, and color coded for device type. ON/OFF and other indication shall be clearly shown by prominent markings and handle position. The protective devices shall be individually mounted with front hinged cover plates and all necessary buses and straps shall be provided.

3. Auxiliary Sections

a. The switchgear shall include an auxiliary cable pull section if required for transition from underground or overhead cable feeds. Provide bus extensions and compression lugs for number and size of incoming cables as shown on the Drawings.

4. Buses

a. Main bus, riser bus, and circuit breaker connections shall be tin plated copper, with bolted connections. All bus bars shall be 98 percent conductivity copper with a current density of 1,000 amperes per square inch. Surfaces shall be tin-plated by the Alstan 70 (or comparable) process to have a uniform appearance, free of blisters. The bus structure shall be mounted on supports of high impact non-tracking insulating material. Bus bars shall be uniformly arranged to provide A-B-C sequence left to right (from front), front to rear and top to bottom.

b. Bus bars shall not be tapered. Bolted connections shall be made with high strength bolts and locking hardware. Individual horizontal and vertical phase bus bars shall be insulated where industry standard 600 Volt clearances cannot be met. Breaker runbacks shall be insulated.

c. Provide a continuous, 1/4-inch by 2-inch (minimum), tin plated copper ground bus extending throughout the entire length of the switchgear, bolted to each vertical section, equipped with lugs for external ground connections, sized for cables shown on the Drawings.

d. All hardware used on conductors shall be zinc or cadmium plated, have a tensile strength of 120 psi.

5. Provide compression type lugs as required to connect size and quantity of cables as shown on the Drawings.

6. Bus extensions from the load side of each feeder breaker into the rear cable compartment shall be the same size as the line side bus taps. Provide neutral bus runbacks for each branch circuit compartment if neutral bus is not accessible without removing barriers. Runbacks shall be tin plated copper.

7. Provide a fully rated, isolated neutral bus for 4-wire systems shown on the Drawings. Bus material and construction shall be similar to the phase bus.

8. Low Voltage Power Circuit Breakers

a. Circuit breakers shall be metal frame construction, low voltage, drawout type, manually or electrically operated with stored energy closing mechanism. Circuit breakers shall be Eaton/Cutler Hammer, “Magnum DS" Type; or Schneider Electric/Square D Company, Type "Masterpact". Circuit breakers shall conform to ANSI standards C37.13 and C37.16 and NEMA SG-3.

b. Where required to meet the specified equipment short circuit rating, breakers shall be equipped with integrally mounted current limiting fuses, coordinated with the trip

devices. Each breaker shall be equipped with an open fuse tripping device and blown fuse indicator.

c. Circuit breakers shall be equipped with a temperature insensitive, adjustable, microprocessor overcurrent trip device with true three phase RMS sensing of sinusoidal and non-sinusoidal currents. Trip units shall be Eaton/Cutler-Hammer, "Digitrip RMS"; or Schneider Electric / Square D Company, "Micrologic".

d. Trip devices shall have as a minimum the following independent trip adjustments and functions:

1) Interchangeable rating plugs.

2) Adjustable long time pick-up.

3) Adjustable long time delay.

4) Adjustable short time pick-up.

5) Adjustable short time delay.

6) Adjustable ground fault pick-up.

7) Adjustable ground fault delay.

8) Trip mode targets for ground fault, overload and short circuit.

9) Adjustable instantaneous that can be set to OFF.

10) Ammeter readout.

e. Manually operated circuit breakers shall be charged by a fixed operating handle. Tripping and closing shall be initiated by pushbutton or levers mounted on the front of the breaker. Racking position indicators shall be provided.

f. Electrically operated circuit breakers shall be charged by an electric motor. Electrically operated breakers shall also be provided with a mechanically operated manual trip pushbutton or lever mounted on the front of the breaker, a

manual charging handle and racking position indicator.

g. Circuit breakers shall be equipped with a shunt trip and provisions for remote closing when automatic control is required.

h. Circuit breakers shall be capable of being racked out without exposing the operator to live parts. Interlocks shall be provided to prevent the following operations:

1) Racking a closed breaker into or out of the CONNECTED position.

2) Closing a circuit breaker until it is fully racked into the TEST or CONNECTED position.

3) Withdrawing a circuit breaker from the cubicle while the closing springs are charged.

4) Insertion of a breaker of incorrect frame size or inadequate interrupting capacity.

i. Provide a mechanical Kirk Key interlocking system to allow the following manual breaker operations:

1) With the bus tie breaker open, opening either main breaker shall release a key to allow manual closing of the tie breaker.

2) With the bus tie breaker closed, the key shall remain captive to prevent parallel operation of the main sources. Opening the tie shall release the key to allow the open main to be restored.

9. Each breaker shall have a secondary control power plug which automatically engages a cell mounted mating receptacle in the CONNECTED position and disengages as the circuit breaker is racked out to the TEST/DISCONNECT position. Provide a means to manually engage the control power plug in the TEST/DISCONNECT position.

10. Breaker contacts on the removable element (TOC) auxiliary switch shall be wired to terminal blocks. Provide 6 normally open and 6 normally closed spare auxiliary contacts in addition to the auxiliary contacts required for breaker operation. Normally closed auxiliary contacts shall break before the normally open auxiliary contacts make.

11. Circuit breakers shall be equipped with mechanism operated (MOC) auxiliary switch contacts for remote status indication. Provide 6 spare "a" and 6 spare "b" contacts wired to terminal blocks.

12. Circuit breaker frame sizes and trip ratings shall be as shown on the Drawings.

13. Cells for future breakers shall be fully equipped with drawout carriage, racking mechanism, primary and secondary contacts, and current transformers. Unless otherwise shown on the Drawings, future breakers shall be for up to 1600 Amp ratings.

14. Circuit breakers shall have additional auxiliary contacts for the controls and interlocks as required and as shown on the Drawings. The circuit breakers shall be provided with a key interlock and bell alarm switches. The following but not limited to shall be provided, in addition to the trip devices; power supply, trip coil, close coil, interpole phase barriers with manual trip button and position indicator. The trip button shall also permit mechanical simulation of overcurrent tripping for test purposes.

15. Provisions shall be provided for padlocking of the breaker in the open and/or withdrawn position.

16. Fused breakers shall be equipped with open fuse lockout device and indicator to protect against single phasing and prevent breaker from reclosing until fuse is replaced and lockout is reset. Fused breakers shall be coordinated with the trip devices so that faults within the rating of the circuit breaker shall be interrupting by the breaker in order to avoid nuisance tripping of the fuses.

17. Secondary Wiring and Control Devices

a. Wiring: 600 Volt, stranded tinned copper, type SIS, flameproof switchboard wire, minimum size No. 14 AWG for control, No. 12 AWG for power and instrument transformer secondaries. Wiring shall be grouped together with harnesses or in ducts and shall be secured to the structure. Pull out type fuse holders shall be used for control circuits.

b. Identification and termination: All wiring shall be numbered at each end with type-written heat shrinkable markers. Terminal blocks shall be rated 20 amps minimum, 600 volt, screw type with white marking area. Current transformer secondaries shall be wired to shorting type terminal blocks.

c. Instrument and control switches: 600 Volt switchboard rotary type, rated 20 Amps continuous, with black molded phenolic escutcheon plates, white characters, General Electric Type SB-1 or equal.

1) Circuit breaker control switches shall be of the momentary contact, spring return type having mechanical target or flag (target position shall not prohibit operation in any cases) and a black, fixed, pistol grip handle.

2) Ammeter and voltmeter switches shall be maintained contact, non-spring return type with black, fixed, knurled handle.

d. Indicator lights: Provide green, red and amber pilot lights for each circuit breaker OPEN, CLOSED and TRIP indication. Indicators shall be full size, LED type.

18. Control and Metering Transformers

a. Potential transformers: Two-winding, encapsulated type with primary and secondary fuses. Voltage ratings shall be as required for the application. Thermal rating and metering accuracy per ANSI standards.

b. Current transformers: Toroidal type suitable for mounting on breaker stabs. Continuous

thermal current rating, relaying and metering accuracy shall conform to ANSI standards.

c. Control power transformers: Two-winding dry type with primary fuses, secondary circuit breaker, NEMA sized for the application.

19. Instrumentation and Metering

a. All trip units shall have amp readout.

b. Power circuit monitors shall be provided on the circuit breakers as indicated in the single line diagrams. The circuit breaker monitor shall have the system display and shall be capable of monitoring up to 16 remotes on a standard RS-485 communications link, 10,000 feet (maximum). The power circuit monitors shall be per Section 16191 with all features.

20. Uninterruptible Power Supply (UPS) shall be provided for operating all Power Monitors within the switchgear. UPS shall be provided with overcurrent protection.

21. Monitoring and Control Functions

a. Provide four self-powered digital status inputs to monitor the following points:

1) Circuit breaker OPEN status

2) Circuit breaker CLOSED status

3) Circuit breaker TRIPPED status

4) Circuit breaker OUT OF SERVICE (withdrawn) status

b. Provide one auxiliary analog input rated 1.0 VAC/VDC nominal full scale input which can be used to measure an external variable such as transformer temperature, air temperature, or battery voltage.

c. Provide one auxiliary analog output (selectable 0-20ma or 4-20ma) proportional to any measured parameter.

d. Provide three Form C dry contact control relay outputs rated 277 VAC or 30 VDC at 10 Amp maximum load current, that can each function as:

1) Setpoint relays that operate as a function of any measured parameter for demand, power factor, or load control. Seventeen programmable setpoints shall each have programmable operate and release limits and time delays on operate and release. Relays shall provide selectable pulse mode or latch mode operation.

2) Remote control relays operated by commands via the communications port.

3) Breaker trip relay (over/under volt, volt unbalance, phase reversal, current unbalance, over/under frequency).

4) KWH or KVARH pulse output relay

5) Alarm relays

e. Operational Features

1) Provide the following operating features:

2) True RMS measurements.

3) Connect directly to PT's and CT's for systems over 600 volts.

4) Provision for a fourth current input for measurement of ground or neutral current.

5) 300 amp, one second surge protection on all four current inputs.

6) 3-field, 20 character, high visibility 0.4-in character height vacuum-fluorescent display with a programmable time out feature.

22. Communication

a. Provide interfacing hardware, software, etc., as required to connect power circuit monitor(s) outputs and all breaker status to plant SCADA

system via Ethernet Cat 6 cable using Modbus TCP/IP communications protocol. The manufacturer shall be responsible for complete coordination and compatibility with the plant computer system specified under Division 13 and the switchgear. Proof of coordination with Division 13 shall be included with the switchgear submittals.

23. Lightning and Surge Protection

    a. Provide Surge Protective Devices in accordance with Section 16709.

24. Marking and Identification

    a. Provide nameplates on each breaker cell door and for each control or indicating device. Nameplates shall be engraved as specified on the Drawing or as directed, using lettering approximately 3/8-in high for unit identification nameplates and 1/4-in high elsewhere. The nameplates shall be black and white laminated phenolic material. The engraving shall extend through the black exterior lamination to the white core. Nameplates shall be screw fastened.

    b. Provide permanent master nameplate for switchgear designation, manufacturer's name, model number, order number and voltage, current and interrupting ratings.

    c. Provide warning signs marked "DANGER - 480 VOLTS KEEP OUT" on each rear compartment door. Signs shall be adhesive backed mylar, OSHA approved.

    d. Identify each phase of bus runouts in cable compartments

    e. Label hoist with maximum allowable weight.

L. Surface Preparation And Shop Coatings.

1. All non-current carrying metal parts of the switchgear assembly shall be cleaned of all weld spatter and other foreign material and given a hot iron-phosphate chemical treatment. A zinc rich, heat

cured, epoxy primer shall be applied to inhibit rust.

2. Indoor equipment shall be painted with one finish coat of manufacturer’s standard air dried enamel. Color shall be light grey ANSI 61 or ANSI 49.

3. Outdoor equipment shall be painted with two finish coats of polyurethane or epoxy enamel, 1 to 2 mil thickness. Exterior color shall be light grey ANSI 61 or ANSI 49.

4. Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion. Printed circuit boards shall be coated with a protective conformal epoxy. All device contacts shall be gold or silver plated.

M. Shop Testing.

1. Perform manufacturers standard production testing and inspection in accordance with ANSI standards. If requested by the Engineer, the manufacturer shall submit certified copies of test results to indicate proof of compliance with ANSI C37.50 and C37.51.

PART 3 - EXECUTION

N. Installation.

1. The equipment shall be leveled and anchored directly to a concrete equipment pad or finished floor as shown on the Drawings. Provide hardware and metal shims for installation. Grout and caulk all voids beneath the equipment base. Anchor bolts shall be 5/8-in galvanized steel, minimum sized and installed in accordance with the manufacturer’s recommendation.

2. Install the equipment in accordance with the manufacturers' instructions.

3. Remove temporary lifting angles, lugs, and shipping braces. Touch-up damaged paint finishes.

4. Make wiring interconnections between shipping splits.

5. Install bus splice plates and torque the connections.

6. Caulk seams, cracks, and openings in outdoor enclosures.

O. Field Testing.

1. Engage the services of a recognized independent testing firm to inspect and test the installed equipment prior to energization. The testing firm shall provide all material, labor, equipment and technical supervision to perform the tests and inspection. Notify the Engineer at least 2 weeks prior to scheduling any testing.

2. Equipment testing and inspection shall be performed before energizing the switchgear in accordance with NETA Standard ATS and shall include the following.

a. Visual and mechanical inspection.

b. Ratio and polarity tests on current and voltage transformers.

c. Ground resistance test.

d. Insulation resistance tests (phase-to-phase and phase-to-ground).

e. Meter calibration

f. Circuit breaker contact resistance test.

g. Insulation power factor and resistance test for surge arresters.

h. Phasing check.

i. Primary current injection tests on each circuit breaker.

3. In the event of an equipment fault, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, Engineer, Owner and the equipment manufacturer’s factory service technician. Repair or replace the equipment as directed by the Engineer and Owner prior to placing the equipment back into service.

P. Adjustment.

1. The switchgear manufacturer shall provide the services of a factory trained service technician for the time period specified in Section 16000. The first trip shall be coordinated with the field testing. The second trip shall include any necessary follow-up or punch list work and technical instruction for the Owner's designated personnel. The manufacturer's service technician shall demonstrate all operational features of the installed switchgear.

2. The switchgear manufacturers factory service technician shall make the following test and adjustments:

   a. Calibrate and test all circuit breaker trip devices, protective relays and controls per the final version of the Coordination Study specified in Section 16000.

   b. Adjust and lubricate circuit breaker operating mechanisms and contacts.

Q. Cleaning.

1. Clean the interior and exterior of electrical equipment in accordance with Section 16000.

END OF SECTION

SECTION 16440 UNDERGROUND DUCTBANK SYSTEM

PART 1 – GENERAL.

A. Scope of Work.

1. Furnish and install a complete underground system of concrete encased ducts, manholes and handholes all as hereinafter specified and shown on the Drawings.

2. CONTRACTOR shall utilize a ground sensing radar or other acceptable methods, along all proposed ductbank routes, and confirm presence of existing utilities and /or conflicts. Ductbank routing is based on information found in the record drawings provided by OCU and with discussions and coordination with the Plant staff.

3. CONTRACTOR shall coordinate with OWNER representative on all routing and potential conflicts found during the use of the ground sensing radar or other acceptable methods prior to initiating any trenching and/or installation.

B. Definitions.

1. Hand Hole: An access opening, provided in equipment, or in a below the surface enclosure used with underground lines, into which personnel can reach but do not enter, for the purpose of installing, operating or maintaining equipment, cabling or both.

2. Pull Box: An access opening, provided in a below the surface enclosure used with underground lines, into which personnel can reach but do not enter, for the purpose of installing, operating or maintaining equipment, cabling or both.

3. Manhole: An access opening, provided below the surface, precast concrete enclosure used with underground lines, into which personnel can reach and enter, for the purpose of installing, operating or maintaining equipment, cabling or both.

4. Duct: The general term for an electrical conduit or raceway, either metallic or nonmetallic, for use underground, embedded in earth or in concrete.

5. Ductbank: A group of two or more ducts in a continuous run between two points.

C. Related Work.

1. Excavation and backfilling is included in Division 2.

2. All concrete and reinforcing steel shall be included under Division 3.

3. Ground rods and other grounding materials and methods shall be as specified under other Sections of Division 16.

D. Submittals.

1. As specified under other sections shop drawings shall be submitted for approval of all materials, equipment, apparatus, and other items as required by the ENGINEER. Shop drawings shall be submitted for the following equipment:

   a. Ducts, fittings and joining cement
   b. Handholes and pull boxes
   c. Manhole and vault accessories, including covers, rack and insulators.
   d. Warning planks and warning tape
   e. Counterpoise conductors

2. Shop drawings: Submit shop drawings for precast vaults, manholes, pull boxes and equipment pads, showing duct or raceway entry types and sizes, locations and elevations of duct banks and individual ducts, reinforcement details, manhole and vault cover design, step details and grounding details. Include dimensioned detailed locations of cable rack inserts, pulling irons and sumps.

E. Quality Assurance.

1. UL Compliance and Labeling: Comply with requirements of UL standards. Provide duct products and components listed and labeled by UL or Electrical Testing Laboratory, Inc. (ETL).

2. ANSI Compliance: Comply with requirements of ANSI C2, “National Electrical Safety Code”, pertaining to construction and installation of underground conduit systems, vaults, manholes and handholes.

3. Code Compliance: Comply with requirements of the NEC.

4. Prefabricators: Provide products of firms regularly engaged in manufacture of factory fabricated enclosures of types and sizes required, whose products have been in satisfactory use in similar service for not less than three years.

F. Delivery, Storage & Handling.

1. Deliver ducts to site with ends capped. Store non-metallic ducts to prevent bending, warping and deforming.

PART 2 – PRODUCTS.

A. Materials.

1. Concrete Materials

a. Comply with provisions of section 03300 for forming of concrete, section for reinforcement for cast in place concrete.

2. Concrete Encased Ducts and Ductbanks.

a. Concrete encased ducts and ductbanks shall be used for all underground electrical power and communication systems. The top of the ductbank shall be minimum 36 inches below the finished grade. The size of the ductbanks shall be designed in accordance with latest edition of NEC and attached detail drawings. All ductbanks shall be dyed red for safety.

3. Sufficient ducts shall be provided so that after all cables are pulled, no duct has more than 40 percentage of its cross sectional area filled. Spare ducts shall be provided as shown on the drawings.

4. Rigid PVC Utility Duct

a. Material: PVC, Meeting NEMA Standard TC-6.

b. UL Listing: Listed as meeting standards 651 for concrete encasement in outdoor trenches rated for 90 degree Celsius wire and cable.

c. Fitting: UL Listed products of the same manufacturer as the duct. Manufactured fittings shall include 90, 45 and 30 degree long radius ells and sweeps, end bells, plugs, adapters to rigid steel conduit, expansion

fittings and spacers.

d. Joint Cement: As recommended by the manufacturer of duct as suitable for the climate, furnished with instructions to achieve watertight joints.

e. Manufacturer: Carlon, Can-Tex Industries or equal.

5. Hand holes and pull boxes

a. Provide hand holes and pull boxes for pulling, splicing and terminating conductors in types and sizes indicated.

b. Hand Holes: Precast concrete, closed bottom with sump with cast iron grate cover, with traffic rated hot dipped galvanized steel traffic rated covers marked “Electric” Designed to AASHTO H-20 loading.

c. Pull Boxes: Precast concrete, open bottom or closed bottom with sump with hot dipped galvanized steel traffic rated covers, marked “Electric” designed to AASHTO H-20 loading. Provide with pulling irons and cable racks.

d. Cover Hold Downs: Stainless steel, penta head, flush with cover bolts.

e. Sump: Cast in bottom of pull boxes with cover and discharge pipe.

f. Manufacturer: Brooks Products or equal.

6. Manholes

a. Provide manholes for pulling, and terminating conductors in types and sizes indicated.

b. Precast concrete, closed bottom with sump with hot dipped galvanized steel traffic rated covers, designed to AASHTO H-20 loading and marked “Electric” on cover. Provide with pulling irons and cable racks.

c. Cover Hold Downs: Stainless steel, penta head, flush with cover bolts.

d. Sump: Cast in bottom of pull boxes with cover and discharge pipe.

e. Manufacturer: Brooks Products or equal.

f. Grounding Materials. Comply with provisions for ground rods, grounding conductors and counterpoise conductors.

7. ACCESSORIES

a. Cable Racks: Heavy Duty non-metallic cable racking system as specified and indicated in drawings. Manufacturer shall be “Underground Devices, Inc., or approved equal.

b. Sump Covers: Cast-iron, slotted or perforated, hinged.

8. EQUIPMENT PADS

a. Provide steel reinforced, precast concrete equipment pads, sizes and details as indicated. Construct with chamfered edges and ground pigtail.

PART 3 – EXECUTION

A. Installation.

1. Install the following types of ducts and fittings in locations listed, unless otherwise noted in the drawings. Conduit entries into buildings shall comply with the provisions of Section 16100.

B. Duct Layout.

1. Ducts shall be installed to drain away from buildings; ducts between manholes or hand holes shall drain toward the manholes or handholes. Duct slopes shall not be less than 3 inches per 100 feet.

2. Duct banks shall be reinforced as shown on the Drawings.

3. Duct lines shall be laid in trenches on a clean backfill bedding not less than 6 inches thick and well graded.

4. Plastic spacers shall be used to hold ducts in place whether concrete encased or not. Spacers shall provide not less than 2-inch clearance between ducts.

5. The minimum cover for duct lines shall be 36 inches unless otherwise permitted by the ENGINEER.

6. PVC duct terminations at manholes shall be with PVC end bells. Steel conduits shall be terminated with insulated, grounding-type bushings.

7. All ducts shall be rodded and a mandrel drawn through followed by a swab to clean out any obstructions, which may cause cable abrasions. The mandrel shall be 12 inches in length and the diameter 1/2 inch less than the inside diameter of the duct.

8. Spare ducts shall be plugged and sealed watertight at all manholes, buildings and structures.

9. Ducts in use shall be sealed watertight at all manholes, buildings and structures.

10. Pulling-in irons shall be installed opposite all duct entrances to manholes, equal to Cope Cat. No. 311-9.

11. Cable racks shall be cut to length for one, two, three or four vertical tiers of cables. Racks shall be mounted with 1/2 inch by 4 inch SS expansion bolts on manhole walls. Lock clips shall be furnished and installed to secure hooks in position. Cable racks shall be non-metallic type CR 36-B w/Rack arm rail, Underground Devices, Inc or equal

12. Cables shall be trained in manholes and supported on racks and hooks at intervals not greater than 3 feet-0 inches and supports shall be installed on each side of all splices. Furnish inserts on all manhole walls for mounting future racks as well as racks required for present installation. Branch circuit conductors shall not be run in manholes.

13. All risers from underground shall be given a heavy coat of bitumastic paint from a point 1 foot-0-inch below grade to a point not less than 6 inches above grade or surface of slab.

14. All joints shall be made so as to prevent the passage of concrete inside the conduit to form obstructions or cause cable abrasions.

15. Magnetic Warning Tape shall be installed over all duct banks.

16. Manhole covers in streets shall finish flush with finished paving and in other areas shall finish 3 inches above crown of adjacent roadway. Floor elevations of manholes shall be so set that the center line of the lowest conduit entering will be not less than 1-foot above the floor and center line of the highest conduit entering will be not less than 1 foot below the roof slab.

17. Concrete monuments shall be provided at each stubbed conduit location. Monuments shall be as shown on the Drawings and shall be installed in the same manner outlined for manhole covers.

18. A 3/4″-inch by 20-foot copper clad ground rod shall be driven as shown on the drawings at each manhole. All bond wires and galvanized steel conduits, manhole cover frame shall be bonded to the ground rod and duct bank counterpoise system.

19. Conduit runs between manholes and hand holes shall not have more than a total of 270 degrees in bending radius in any one conduit run.

END OF SECTION

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SECTION 16450 GROUNDING SYSTEM

PART 1 - GENERAL

A. Scope of Work

1. Furnish and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as hereinafter specified and shown on the Drawings.

B. Related Work

1. Conduit shall be as specified under Section 16100.

2. Wire shall be as specified under Section 16120.

PART 2 - PRODUCTS

A. Materials

1. Ground rods: Ground rods shall be copperclad steel 3/4-inch x 20 foot. Ground rods shall be Copperweld or be an approved equal product.

PART 3 - EXECUTION

A. General

1. The service entrance equipment ground bus shall be grounded to a 3/4-inch cold water pipe, to the ground grid and to the building steel. The protecting conduits shall be bonded to the grounding conductor at both ends. The Contractor shall not allow the water pipe connections to be painted. If the connections are painted, they shall be disassembled and remade with new fittings.

2. Ground bus in all motor control centers shall be connected to the service entrance equipment ground bus with a No. 3/0 conductor.

3. All steel building columns shall be bonded together and connected to the building ground grid and to the service entrance ground with a No. 1/0 copper conductor. The bond wire for all high service pumps shall be connected to the high service pump casing via Cadweld.

4. Conduits stubbed-up below a motor control center shall be

fitted with insulated grounding bushings and connected to the motor control center ground bus. Boxes mounted below motor control centers shall be bonded to the motor control center ground bus. The grounding wire shall, unless otherwise indicated on the drawings, be sized in accordance with Table 250-122 of the National Electrical Code, except that a minimum No. 12 AWG shall be used.

5. Lighting transformer neutrals shall be grounded to a grounding electrode and the service entrance ground.

6. Grounding electrodes shall be driven as required. Where rock is encountered, grounding plates may be used in lieu of grounding rods.

7. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and similar items shall be grounded.

8. Exposed connections shall be made by means of approved grounding clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A or approved equal. All buried connections shall be made by welding process equal to Cadweld.

9. For reasons of mechanical strength, grounding conductors extending from the facility grounding grid to the ground buses of motor control centers shall be No. 3/0 AWG.

10. The facility grounding grid conductors shall be embedded in backfill material around the structures.

11. All underground conductors shall be laid slack and where exposed to mechanical injury shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard.

12. The Contractor shall exercise care to insure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

B. Tests

1. The Contractor shall test the ground resistance of the system. The Engineer shall be notified forty-eight (48) hours before tests are made to enable the Owner to have designated personnel present. All test equipment shall be provided by the Contractor and approved by the Engineer.

Dry season resistance of the system shall not exceed 5 ohms. If such resistance cannot be obtained with the system as shown, the Contractor shall provide additional grounding as directed by the Engineer, without additional payment. The Contractor shall submit all grounding system test results to the Engineer for review.

END OF SECTION

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SECTION 16476 DISCONNECTS, TRANSFORMERS AND CIRCUIT BREAKERS

PART 1 - GENERAL

A. SCOPE

1. Circuit breakers for panelboards.

2. Molded case circuit breakers for motor control centers.

3. Fusible and Non-Fusible safety switches.

B. SUBMITTALS

1. Submit product data according to the Conditions of the Contract and Division 1 Specification Sections.

C. REFERENCES

1. Comply with NFPA 70 “National Electrical Code" for components and installation.

2. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

a. The Terms "Listed" and "Labeled": As defined in the “National Electrical Code," Article 100.

b. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

A. DISCONNECT SWITCHES

1. Non-Fusible Disconnect Switches

a. Disconnect switches shall be heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle unless otherwise noted. Enclosure type shall be as noted on the drawings. All current carrying parts shall be copper.

b. NEMA 4X enclosures shall be stainless steel.

c. NEMA 7 enclosures shall be cast aluminum.

d. Lugs shall be copper.

e. All exterior hardware shall be stainless steel.

f. Switches shall be as manufactured by Eaton / Cutler Hammer, or Schneider Electric / Square D Company.

2. Fused Disconnect Switches

a. Fused disconnect switches shall be NEMA 4X heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle unless otherwise noted. All current carrying parts shall be copper.

b. Fuses shall be rejection type, 600 Volts, 200,000 A.I.C., dual element, time delay, Bussman Fusetron®, Class RK-5 or equal.

c. NEMA 4X enclosures shall be stainless steel.

d. NEMA 7 enclosures shall be cast aluminum.

e. Lugs shall be copper.

f. All exterior hardware shall be stainless steel.

g. Switches shall be as manufactured by Eaton / Cutler Hammer, Schneider Electric / Square D Company or Siemens.

B. CIRCUIT BREAKERS

1. Molded Case Circuit Breakers: The current interrupting capacity of the breaker shall be equal or greater to 22,000 amps, unless otherwise indicated.

C. TRANSFORMERS

1. Dry Type Lighting Transformers:

a. Transformers shall be dry type, two-winding with KVA and voltage ratings as shown on the Drawings.

b. Four full capacity taps shall be furnished, two

2-1/2% above and two 2-1/2% below rated primary voltage.

c. Transformers shall be built in accordance with ANSI C89 and NEMA ST1-4 with a maximum insulation temperature rise of 115 degrees C.

d. Transformers shall be manufactured by the General Electric Co., or approved equal.

PART 3 - EXECUTION

A. INSTALLATION

1. Install enclosed switches and circuit breakers in locations, as indicated, according to manufacturer's written instructions.

2. Install enclosed switches and circuit breakers level and plumb.

3. Install wiring between enclosed switches and circuit breakers and control/indication devices.

4. Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer’s published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

END OF SECTION

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SECTION 16482 480-VOLT MOTOR CONTROL CENTERS

PART 1 - GENERAL

A. SCOPE OF WORK

1. Furnish, install and test the motor control centers as hereinafter specified and as shown on the Drawings.

B. QUALIFICATIONS

1. The motor control centers shall be the product of a manufacturer who shall also be the manufacturer of all the circuit breakers, fused switches, variable frequency drives and motor starters included in the motor control centers.

2. All units and sections shall be U.L. labeled when possible. Motor control centers containing service entrance equipment shall be U.L. labeled "Suitable For Use As Service Equipment."

3. The motor control centers shall be manufactured by Eaton Cutler-Hammer, Square D Company or Siemens.

C. SUBMITTALS

1. Complete master wiring diagrams and elementary or control schematics, including coordination with other electrical control devices operating in conjunction with the motor control centers and suitable outline drawings shall be furnished for approval before proceeding with manufacture. Due to the complexity of the control functions, it is imperative the above drawings be clear and carefully prepared to facilitate interconnections with other equipment. Standard preprinted sheets or drawings simply marked to indicate applicability to this Contract will not be acceptable.

2. Submittals shall include a bill-of-material listing conductor material and insulation type as well as other hardware and equipment to be furnished.

3. Where it is not explicitly shown and completely obvious from the outline drawings the following items shall be verified in a written statement

accompanying the shop drawings.

a. Type of terminal blocks used and that the removal of plug-in compartments can be performed without disconnecting or removing wires.

b. Silver or tin plating of bus.

c. Insulation and isolation of vertical bus.

d. U.L. approval.

D. RELATED WORK

1. Lighting Panels are included in Section 16160.

2. Dry type lighting transformers are included in Section 16476.

3. Surge Protection Devices (SPD) are included in Section 16709.

PART 2 - PRODUCTS

A. RATING

1. The motor control centers shall be designed for 480 volt, 3 phase, 3 wire 60 Hz service and shall have short-circuit rating of not less than 65,000 amperes RMS, symmetrical.

B. CONSTRUCTION

1. Structure:

a. The motor control centers shall be a standard metal-enclosed, free-standing, deadfront structure, not more than 90-inches in height, and fabricated from formed sheet steel of not less than No. 14 gauge thickness. The enclosure shall be NEMA 4X. The motor control centers shall consist of vertical sections of equal height and 20 inches deep containing individual plug-in compartments. Compartments shall be isolated from each other by separate horizontal steel plates or by steel plates without openings that are a part of the compartment itself.

b. Plug-in compartments shall totally isolate enclosed equipment. All unused openings to the adjacent vertical wiring space shall be plugged. All openings used for wiring shall have insulating grommets.

c. Vertical sections shall be mounted on steel channel sills continuous on four sides, or with steel channel sills on two sides and end cover plates. Each compartment shall be provided with a hinged door of pan construction on the front and a door opening of sufficient size to permit ready removal of any of the equipment in the compartment. Interlocks shall be provided to prevent opening the compartment door when the disconnect device in the compartment is in the closed position. An interlock bypass device shall be furnished. Means of locking the disconnect device in the "Off" position shall be provided. Disconnect device operating mechanism shall not be attached to the compartment door.

d. All sections shall have the same structural features with provisions for the addition of similar sections at either end. Each compartment shall meet NEMA Standards for the control equipment installed and units of similar size shall be interchangeable.

e. Each section shall be provided with a horizontal wiring space which shall line up with a similar space in the adjacent section or sections, with openings between so that wires may be pulled the entire length of the control centers. There shall also be provided in each section a vertical wiring space with separate full height door.

f. The motor control centers shall be designed for against-the-wall mounting. All wiring, bus joints and other mechanical parts requiring tightening or other maintenance shall be accessible from the front or top.

g. The motor control centers shall have engraved laminated nameplates screwed to the doors of each individual compartment and wiring diagrams

pasted inside each door. Compartments containing panel boards shall have a card holder on the inside of the door. Compartments containing motor starters shall each have an overload heater selection table pasted inside the door.

h. The motor control centers shall provide equipment of type, capacity, trip ratings for the loads shown on the Drawings or otherwise specified.

i. Construction shall be NEMA Class II, Type B or C. In so far as possible all devices and components used shall be of one manufacturer. The motor control centers shall be furnished as a completely factory assembled unit where transportation facilities and installation requirements permit.

j. The motor control centers shall be finished with ANSI Z55.1, No. 61 light gray enamel over a rust resistant primer.

k. The insulation level of the complete motor control assembly shall be such that it will meet the field tests required under Paragraph 3.02.

2. Buses:

a. All buses shall be silver on tin-plated copper. A continuous main horizontal bus shall be furnished. Main buses shall be rated as shown on the Drawings.

b. Each vertical section shall have a full height vertical bus rated not less than 300 amperes. Vertical buses shall be insulated and isolated with glass polyester or equivalent continuous insulation. Taped buses will not be acceptable. Unused stab openings shall be plugged. Lower ends of vertical buses shall be insulated.

c. A 1/1-inch x 2-inch ground bus shall be furnished the entire length of the motor control centers.

d. Buses shall be braced for 65,000 amperes RMS, symmetrical, short circuit current.

e. All buses except neutral and ground buses shall be completely isolated by steel plates or insulating material.

f. The buses shall be sized for a maximum current density of 400 amperes per square inch.

3. Wiring:

a. All wiring shall be copper.

b. Compartment wiring shall be to compartment mounted, plug-in terminal blocks that allow compartments to be withdrawn without having to remove wires from fixed terminal blocks.

c. Power wiring shall be black, control wiring shall be red, wiring energized from sources other than the starter control power transformer shall be yellow.

4. Signage:

a. Each motor control center shall be furnished with a sign marked "DANGER - HIGH VOLTAGE." Letters shall be not less than 1-inch high, 1/4-inch stroke. Signs shall be laminated plastic, engraved red letters with a white background.

b. All compartments with voltages from sources outside of the compartment, not disconnected by the motor circuit protector, shall have a sign on the compartment door marked "CAUTION - THIS UNIT CONTAINS A VOLTAGE FROM A SOURCE OUTSIDE OF THIS UNIT." Letters shall be black on a high visibility yellow background. Background shall be laminated plastic approximately 3 inches x 5 inches.

C. COMPONENTS

1. Combination Motor Starters:

a. All motor starters shall be a combination motor circuit protector and contactor, 3-pole, 60-Hz, 600-volt, magnetically operated, of the types shown on the drawings. NEMA sizes shall be as required for the horsepowers shown on the Drawings, but shall be not less than NEMA Size 1.

b. All motor starters shall have a 120-volt operating coil, overload relay in each phase and control power transformer.

c. All motor starters shall have 1-N.O. and 1-N.C. auxiliary contacts. Additional auxiliary contacts shall be furnished where shown on the Drawings or as required by the control scheme.

d. Full voltage, non-reversing starters, NEMA size 4 and smaller shall be of plug-in design with stab-on connectors engaging the vertical buses. Larger units shall be of fixed design.

e. Reduced voltage starters: Solid state, six SCR, full wave type with adjustable current limit and voltage ramp to control starting torque, automatic load sensing circuit to minimize energy consumption, line and load side surge protection and noise suppression and controlled deceleration adjustment to reduce the effects of surges caused by centrifugal pump loads. Provide heat sinks and ventilation to remove heat from the structure. Each starter shall include a motor horsepower rated isolation contactor to positively disconnect the line voltage when the SCR control is off.

f. Contactors: Electrically held, 120 VAC coil operator, suitable for tungsten, ballast, or resistive non-motor loads, with over current protection, control transformer and contact ratings and poles as shown on the Drawings.

g. Overload relays shall be adjustable and manually reset by push button in compartment door. Replaceable individual overload relay heaters of the proper size shall be installed in each phase.

h. Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time-delay fuses.

i. Motor circuit protectors shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters. Motor circuit protectors shall have auxiliary disconnect contacts when used with starters having external control circuits.

2. Circuit Breakers:

a. Circuit breakers shall be thermal-magnetic, molded case, 480 volt, with not less than 65,000 amperes,

RMS interrupting capacity. All circuit breakers with 225 amperes frames and larger shall have interchangeable trips. Circuit breakers shall have auxiliary disconnect contacts when used with starters having external control circuits.

3. Control Stations:

   a. Control stations shall be standard size, heavy-duty, oiltight.

4. Indicating Lights:

   a. Indicating lights shall be standard size, heavy duty, oil tight, low voltage transformer operated.

5. Running Time Meters:

   a. Running time meters shall be 3-1/2-inch square case; non-reset, 99,999.9 hour range; Type 236 as manufactured by the General Electric Co. or equal.

6. Metering:

   a. Power Meter: The MCC shall be equipped with a digital-metering device capable of communication on the network of choice. Meters shall be General Electric Co.’s. Type PQMII Power Quality Meter, or approved equal. The meter shall have Ethernet connectivity. Through the use of communication user shall be able to read/write set-points, read actual values, execute commands and read device status loop-back test.

      The meter shall provide continuous monitoring of all three phases. The meter shall measure current, voltage, real and reactive power, energy use, cost of power, power factor and frequency.

      Power analysis features shall include an event recorder, waveform capture, trace memory, harmonic spectrum display (through the 62nd harmonic with total harmonic distortion) and a data logger function. The meter shall be able to sample harmonic spectrum at 256 samples per cycle. All analysis data shall be non-volatile. The meter shall automatically generate log for alarms, triggers and input/output events. 150 events records with time stamp shall be stored in the meter.

7. Instrument Transformers:

   a. Instrument transformers shall be indoor, 600-volt, butyl-rubber molded, metering class designed in accordance with ANSI and NEMA standards.

8. Surge Protection:

   a. As shown on the drawings.

9. Control Relays:

   a. Control relays shall be heavy-duty, machine tool type with suitably rated convertible contacts. Time delay relays shall be pneumatic, adjustable.

   b. Relays shall be CR2810 and CR2920 as manufactured by General Electric Co., or equal.

10. Nameplates:

   a. Unit nameplates shall be black and white laminated plastic having engraved letters approximately 3/16-inch high extending through the black face into the white layer. Nameplates shall identify equipment controlled or circuit designation as applicable.

D. SPARE PARTS

1. The following spare parts shall be furnished:

   a. One (1) box of power fuses of each size furnished.

   b. One (1) set of starter contacts for each NEMA size installed.

   c. One (1) starter coil for each NEMA size installed.

   d. One (1) box of pilot lights.

   e. One (1) breaker for each size used.

PART 3 - EXECUTION

A. INSTALLATION

1. The motor control center housings shall be bolted to angle iron sills imbedded in the concrete on the two longest sides. The sills shall be the full length of the motor control center housing and shall be installed level in all directions.

2. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported such that circuit terminations are not stressed.

3. The motor control centers shall be maintained in an upright position at all times. Lifting shall be only at the floor sills or the top mounted lifting angle.

4. The motor control centers shall be protected against damage at all times. Any damage to the paint shall be carefully repaired using touch-up paint furnished by motor control centers manufacturer.

B. TESTS AND CHECKS

1. The following minimum tests and checks shall be made after the assembly of the motor control centers, but prior to the termination of any field wiring.

2. Megger terminals and buses after disconnecting devices sensitive to megger voltage.

3. A 1,000 VDC megger shall be used for these tests.

4. The first test shall be made with main circuit breaker closed and all remaining breakers open. A second test shall be made with all circuit breakers closed.

5. The test results shall be recorded and forwarded to the Engineer for his review. Minimum megger readings shall be 100 megohms in both tests.

6. The following shall be done before energizing the motor control centers.

7. Remove all current transformer shunts after completing the secondary circuit.

8. Install overload relay heaters based on actual motor nameplate current. If capacitors are installed between starter and motor, use overload relay heaters based on measured motor current.

9. Check all mechanical interlocks for proper operation.

10. Vacuum clean all interior equipment.

C. WARRANTY

1. Manufacturer shall include a five (5) year warranty, parts and labor, from date of substantial completion.

D. TRAINING

1. Manufacturer shall provide two (2) days of training, 1-day of classroom training and 1-day of field training.

END OF SECTION

SECTION 16500 LIGHTING SYSTEMS

PART 1 – GENERAL

A. SCOPE OF WORK

1. Furnish and install complete lighting systems including panelboards, transformers, lighting fixtures, receptacles, switches, contractors, clocks and all necessary accessories and appurtenances required as hereinafter specified and shown on the Drawings.

B. STANDARDS

1. lighting fixtures shall be in accordance with the National Electrical Code and shall be constructed in accordance with the latest edition of the Underwriters Laboratories "Standards for Safety, Electric Lighting Fixtures." All lighting fixtures shall be Underwriters Laboratories labeled.

C. RELATED WORK

1. Panelboards shall be as specified under Section 16160.

2. Conduit shall be as specified under Section 16100.

3. Wire shall be as specified under Section 16120.

4. Transformers shall be specified under Section 16108.

PART 2 - PRODUCTS

A. MATERIALS

1. Switches:

a. Wall switches shall be of the indicating, toggle action, flush mounting quiet type. All switches shall conform to Federal Specification W-S-896-D.

b. Wall switches shall be of the following types and manufacturer or approved equal.

1) Single pole - Arrow-Hart No. 1991 or Leviton No. 1221-2.

2) Double pole - Arrow-Hart No. 1992 or Leviton No. 1222-2.

3) Three way - Arrow -Hart No. 1993 or Leviton No. 1223-2.

4) Four way - Arrow-Hart No. 1994 or Leviton No. 1224-2.

5) Single pole, key operated - Arrow-Hart No. 1991-L or Leviton No. 1221-2L.

6) Momentary contact, 2 circuit, center off - Arrow-Hart No. 1895 or Leviton No. 1256.

7) Weatherproof cover for Arrow-Hart 2900 series tap action switches - Arrow-Hart Catalog No. 2881-G.

2. Receptacles:

a. Wall receptacles shall be of the following types and manufacturer or approved equal.

1) Single, 20A, 125V, 1P, 3W; Arrow-Hart No. 5361 or Leviton No. 5361.

2) Duplex, 20A, 125V, 2P, 3W; Arrow-Hart No. 5362 or Leviton No. 5362.

3) Corrosion-resistant, duplex, 20A, 125V, 2P, 3W; Arrow-Hart No. 5739-CR or Leviton No. 5362CR and Crouse-Hinds WLRD-1 cover.

4) 60A, 480V, 3P, 2W; weatherproof receptacle shall be Crouse-Hinds Catalog No. ARE6324 with Crouse-Hinds Catalog No. APJ 6385 plug.

5) Ground fault interrupter, duplex, 20A, 125V, 3P, 2W; Arrow-Hart No. GF5362 or Leviton No. 6899.

6) Stainless steel indoor mounting plate for G.F.I. receptacle; Arrow-Hart Catalog No. S-26.

7) Clock hanger, 15A, 125V, 2P, 3W; Arrow-Hart No. 452 or Leviton No. 628.

8) Single, 20A, 250V, 2P, 3W; Arrow-Hart No. 5461 or Leviton No. 5461.

9) Single, 30A, 125V, 2P, 3W; Arrow-Hart No. 5716N; cap: Arrow-Hart No. 5717N or Leviton No. 5371.

10) Clothes dryer, 30A, 125/250V, 3P, 3W; Arrow-Hart No. 9344N. Cap: Arrow-Hart No. 9352AN or Leviton No. 5209 and No. 9382-P.

b. Receptacles (Weatherproof/NEMA 4 Areas/Outside)

1) General Requirements: Receptacles in wet locations shall be installed with a hinged outlet cover/enclosure clearly marked “Suitable for Wet Locations While In Use” and “UL Listed”. There must be a gasket between the enclosure and the mounting surface, and between the hinged cover and mounting plate/base to assure proper seal. Taymac; Specification Grade.

c. Special wiring devices shall be provided as noted of the drawings.

a. Tamper resistant duplex receptacle Leviton No. 5262-SG or approved equal.

2) Wall switch occupancy sensor Leviton No. 6775 or approve equal.

3) Scene select microprocessor dimmer Leviton No. 17765 or approved equal.

4) Surge protective duplex receptacle Leviton No. 5380 or approved equal.

3. Device Plates:

a. Plates for flush mounted devices shall be of the required number of gangs for the application involved and shall be 302 (18-8) high nickel stainless steel of the same manufacturer as the device.

b. Plates for surface mounted device boxes shall be of the same material as the box.

4. Lighting Fixtures:

   a. Lighting fixture types shall be as shown on the "Lighting Fixture Schedule" on the Drawings. See below listing of manufacturers.

5. Lamps:

   a. All lighting fixture lamps shall be LED.

   b. All lamps shall be of one manufacturer and shall be as manufactured by Hubble Lighting, Sesco Lighting, Sylvania Electric Products, Inc., General Electric Company, or Westinghouse Electric Corporation or approved equal.

6. Flexible Fixture Hangers:

   a. Flexible fixture hangers used in nonhazardous areas shall be Type ARB and flexible fixture supports used in hazardous areas shall be Type ECHF as manufactured by the Crouse-Hinds Company or approved equal.

   b. Steel channel, roll formed into U-shape, shall be used to span between building steel for mounting of fixtures where required by fixture location or as indicated on the Drawings. Channel shall be as manufactured by Unistrut Corporation or approved equal.

7. Lighting Contactor:

   a. Lighting contactor shall be of the electrically operated, mechanically held type in NEMA 1 enclosures of the number of poles as called for on the Drawings.

   b. Contactors shall be rated for 30A-600 volt contacts and be similar and equal to Automatic Switch Company bulletin 1255-166 RC.

8. Lighting Control Time Switches:

   a. Time switches for the control of lighting shall have astronomic dials, reserve power and be similar and equal to the following types:

1) Where time switch is indicated for SPST maintained control it shall be similar and equal to Tork Time Controls Catalog No. 7100ZL (120V).

2) Where time switch is indicated for DPST maintained control it shall be similar and equal to Tork Time Controls Catalog No. 7200ZL (120V).

9. Photocell:

a. Tork 2101 or equal.

PART 3 - EXECUTION

A. INSTALLATION

1. Each fixture shall be a completely finished unit with all components, mounting and/or hanging devices necessary, for the proper installation of the particular fixture in its designated location and shall be completely wired ready for connection to the branch circuit wires at the outlet.

2. When fixtures are noted to be installed flush, they shall be complete with the proper accessories for installing in the particular ceiling involved. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.

3. Flexible fixture hangers shall be used for all pendant mounted fixtures.

4. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits shall be supported from the structure.

5. Receptacles in process areas and shops shall be mounted 36 inches above the floor unless otherwise noted on the Drawings.

6. Receptacles in office and other like areas shall be mounted 18 inches above the floor unless otherwise noted on the Drawings.

B. SPARE LAMPS

1. Spare lamps shall be provide for all fixture types supplied. Quantity shall be 15 percent of total used on project.

C. CLEANING UP

1. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Engineer.

END OF SECTION

SECTION 16670 LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

A. Scope of Work

1. A Lightning Protection System shall be provided and installed for all structures greater than five (5) feet above grade level. They system shall be provided and installed in compliance with provisions of Code for Lightning Protection Systems as adopted by the National Fire Protection Association and Lightning Protection Institute. All equipment to that result shall be included whether or not specifically called for herein. Installers shall be LPI (Lightning Protection Institute) certified, master and Journeyman in accordance with LPI standards or of equal qualifications as approved by ENGINEER. A LPI label and a UL Master label for the system shall be required.

2. Material shall comply in weight, size and composition with the requirements of the Lightning Protection Institute and the National Fire Protection Code relating to this type of installation, and shall be LPI labeled.

3. All materials, where available by any one manufacturer, shall be cast. All bolts shall have hexagonal heads, no screw heads will be permitted.

4. Lightning protection cable shall be Class I copper. Grounding counterpoise shall be as shown. Fittings and straps shall be cast copper.

B. Submittals

1. Shop Drawings: Shop drawings shall be submitted before work is done. Drawings shall include full layout of cabling and points, and connections.

2. Product Data: Product Data shall be submitted on all equipment to show compliance with this section of the specifications and shall include manufacturer's written recommendations for installation.

PART 2 - PRODUCTS

A. AIR TERMINALS

1. Air terminals shall be copper as required to match roof conductors, and shall have proper base support for surface on which they are attached, and shall be securely anchored to this surface. Terminals shall project a minimum of 10" above top of object to which attached.

B. CONDUCTORS

1. Roof conductors shall consist of copper complying with the weight and construction requirements of the Code, and shall be coursed to interconnect with air terminals, and in general, provide a two-way minimum path to ground. The angle of any turn shall not exceed 90 degrees, and shall provide an approximately horizontal or downward course. Down conductors shall be copper, concealed within the structure. Radius of bends shall not be less than 8 inches. Roof conductor material shall match and/or be compatible with roof flashing material.

C. FASTENER

1. Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor. Where fasteners are to be mounted in masonry or structural work, they shall be furnished to the Masonry or Structural CONTRACTOR so they may be installed during construction of the project.

D. GROUND CONNECTIONS

1. Ground connections shall be made in accordance with requirements of all applicable codes. Ground rods shall be placed in a minimum of two (2) feet from building foundations. In addition to above artificial grounds, one down conductor of each two-path system shall be connected to water piping system with approved water pipe type strap connector. All ground rods shall be 3/4" diameter, with a minimum length of 20' cadweld type. Each installed ground rod shall be checked for resistance to ground. If a 0 to 5 ohm reading is not obtained, extend 10’ rod lengths and

continue driving rods until the required reading is obtained. No rod can be connected to the bonding cable without the required ohm reading. The system must also be tied into the existing plant system.

PART 3 - EXECUTION

A. INSTALLATION

1. Installation shall be made in an inconspicuous manner with conductors coursed to conceal equipment as much as possible. Down conductors shall be concealed within structure, and shall be run in 1" PVC conduit. All metallic equipment within 6 feet of any lightning conductor shall be bonded to conductor. System shall also be tied to the main service electrical ground.

B. EQUIPMENT

1. Equipment shall be as manufactured by National Lightning Protection, Inc., Lightning Masters Corp., or Heary Bros Lightning Protection.

END OF SECTION

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SECTION 16709 SURGRE PROTECTION DEVICES (SPD)

PART 1 – GENERAL

A. DESCRIPTION

1. The specified unit shall provide effective high energy transient voltage surge suppression, surge current diversion and high frequency noise attenuation in all electrical modes for equipment connected downstream from the facility's meter or load side of the main overcurrent device. The unit shall be connected in parallel with the facility's wiring system.

B. RELATED DOCUMENTS AND APPLICABLE STANDARDS

1. Systems shall be designed, manufactured, tested and installed in accordance with the following applicable documents and standards:

   a. Under Underwriters Laboratories (UL1449 3rd Addition and UL 1283)

   b. ANSI/IEEE (C62.41 and C62.45)

   c. Military Standards (MIL – STD 220A)

   d. National Electric Code (NEC)

   e. Underwriter's Laboratories 248

PART 2 - PRODUCTS

A. APPROVED MANUFACTURER

Current Technologies
Power & Systems Innovations
PO Box 590223
Orlando, FL 32859-0223

Contact: John West Sr.
Phone (407) 380-9200
Phone (800) 260-2259
FAX (407) 380-3911 FAX
E-mail jwest@psihq.com
Internet www.psihq.com

Joslyn, AKA (Total Protection Solutions)
Total Protection Solutions
4366 LB McLeod Road
Orlando, FL 32804

Contact: Bob Levit
Phone 407-841-4405
FAX 407-841-4407
E-mail: bob@treborpowersystems.com
Internet www.treborpowersystems.com

Surge Suppression Inc
Surge Suppression Incorporated
P.O. Box 674
Destin, FL 32540-0674

Contact: Mike Barton
Phone (888) 987-8877
FAX (888) 900-8879
E-mail mbarton@surgesuppression.com

B. DEVICES

1. Surge Protection Devices (SPD's) shall be UL listed at or above the available fault current level at the point of SPD application by UL, Per UL 1449 latest edition.

2. The SPD shall be a parallel design using fast-acting energy protection that will divert and dissipate the surge energy.

3. Units shall have:

   a. Minimum 10 mode operation for all 3 phase Y and high leg Delta configurations and six modes of protection for all 3 phase Delta "no Neutral" configurations.

   b. One nanosecond or less response time for any individual component, and shall be self restoring and fully automatic.

   c. Extended noise filtration with a 10 kHz to 100 MHz range.

   d. LED indication of unit failure to indicate the continuous positive operational status of each protected phase.

   e. System Voltage shall be as indicated on the drawings.

f. The fusing system shall be capable of allowing the rated maximum single impulse surge current to pass through without fuse operation.

g. SPD's shall be installed with leads as shorts as possible (not to exceed 24 inches). SPD's may be mounted internally in Motor Control Centers, switchgear and switchboards. SPD's shall be mounted externally at panelboards and control panels.

h. All SPD panel units shall be guaranteed by the installing contractor and surge suppression manufacturer to be free of defects in materials and workmanship for a period of not less than 10 years from the date of substantial completion of the system to which the suppressor is installed.

i. For each SPD type or size used on this project provide the following submittal data:

1) Complete schematic data for suppressor, indicating part numbers, dimensional drawings and mounting arrangement.

2) Cut sheets which include Peak Surge Current "per mode", Let Through Current, UL tested voltage protection rating (VPR) and maximum Continuous Operating Voltage (MCOV).

3) Copy of Warranty Statement

C. APPLICATIONS

1. Surge Current RATING OF 150 kA PER MODE AT 480 Volt distribution panels.

2. Surge Current RATING OF 150 kA PER MODE AT 480 Volt Motor Control Centers.

3. Surge Current RATING OF 150 kA PER MODE AT 480 Volt branch panels or control panels.

4. Surge Current RATING OF 40 kA PER MODE AT 208 or 240 Volt three phase or single phase branch panels.

D. FILTERING

1. The system shall provide a UL 1283 Listed Electromagnetic Interference Filter capable of attenuating noise levels

produced by electromagnetic interference and radio frequency interference.

E. FUSING

1. Fuse component(s) identification and surge rating. The manufacture shall provide documentation demonstrating the tested surge current rating (8x20µsec) of the fuse. The surge rating of the fuse shall be greater than the combined surge current rating of all downstream connected suppression elements.

2. Fusing: Suppression component(s) identification and surge rating. The manufacturer shall provide documentation identifying the suppression element(s) connected in series with fuse element(s) and provide the suppression elements published 8x20µsec surge current rating. The rating of the suppression element(s) shall be less than the rating of upstream fusing element(s).

3. Fusing: Surge performance. All fusing shall be required to meet the single pulse surge current testing requirements of Section 2.2 above.

4. Fusing: Isolation. The unit shall have each MOV fused and designed to operate only in the event of an MOV failure within the SPD device.

5. Fusing Coordination: Units that can't demonstrate MOV-fuse coordination in 2.4.a and 2.4.d are not acceptable.

6. Fusing: UL Rating. All fusing shall be 200kAIC UL248 Recognized.

F. UL 1449 SUPPRESSED VOLTAGE RATING.

A. The unit shall be UL 1449 3rd Edition Listed and shall be as follows for L-N, L-G, N-G, and L-L, modes, inclusive of the disconnect switch: (Select appropriate product rating from below)

1. 40kA – 80kA rated products/120/208V units: L-N = 400V, L-G=500, N-G=500, and L-L=700

2. 60kA – 80kA rated products/277/480V units: L-N = 900V, L-G=1000, N-G=90, and L-L=1800

3. 100kA – 150kA rated products/120/208V units: L-N = 400V, L-G=500, N-G=500, and L-L=700

4. 100kA – 150kA rated products/277/480V units: L-N = 900V, L-G=1000, N-G=800, and L-L=1500

5. 200kA – 300kA rated products/120/208V units: L-N = 400V, L-G=500, N-G=500, and L-L=700

6. 200kA – 300kA rated products/277/48V units: L-N = 800V, L-G=1000, N-G=800, and L-L=1500

G. IN-FIELD TESTING

1. The unit shall be equipped with a performance data extraction protocol allowing unit performance data, including percent of protection remaining, to be transmitted to an internal, external status analyzer.

H. ENCLOSURE

1. Outside - Units shall be provided in a NEMA type 4X plastic enclosure.
2. Interior – Units shall be provided in NEMA type 1 enclosure.

PART 3 – EXECUTION

A. SYSTEM TESTING

1. Upon completion of installation, a factory-authorized local service representative shall provide product startup testing services. The tests shall include:

a. On-line Testing: Verification that all suppression and filtering paths are operating with 100% protection as well as verification of proper facility neutral-to-ground bond by measuring neutral-to-ground current and voltage.

b. Off-line Testing: Impulse injection to verify the system tolerances as well as verification of proper facility neutral-to-ground bond. To be compared to factory benchmark test parameters supplied with each individual unit.

B. DOCUMENTATION AND REPORTING

1. A copy of the startup test results and the factory benchmark testing results shall be supplied to the engineer and the owner for confirmation of proper system function. This letter shall also clarify that the integrity of all neutral-to-ground bonds were verified

through testing and visual inspection, and that all grounding bonds were observed to be in place.

C. SYSTEM WARRANTY

1. The SPD system manufacturer shall warranty the entire system against defective materials and workmanship for a period of ten (10) years following substantial completion.

END OF SECTION

SECTION 16720 FIRE ALARM SYSTEM

PART 1 GENERAL

A. Scope Of Work

1. The Contractor shall employ the services of a licensed fire alarm protection systems engineering company to design and install the fire alarm protection system and prepare detailed installation drawings and material specifications for the Centrifuge Dewatering Building (Process 650) and the North Electrical Building (Bldg 150)at the Orange County Eastern Water Reclamation Facility, Orlando, Florida, to be signed and sealed by a professional engineer registered in the state where the project is located. These Contract Documents shall be submitted for review in accordance with Section 01300.

2. The fire alarm protection system shall be checked by the local fire authority having jurisdiction (AHJ) during design and upon completion of the installation. The Contractor shall assume full responsibility for the correctness of the installation and make any and all corrections and additions deemed necessary by the fire authority. The Contractor shall pay for all costs of the inspection and any subsequent reinspections as required. Provide additional upgrades to existing site fire alarm systems if required by the AHJ.

3. Design, furnish, install, test and place in operating condition an electronically-operated, double-supervised, closed-circuit fire alarm system. All units of equipment shall be listed by UL for fire alarm signaling use and shall consist of a control unit, manual fire boxes, alarm indicating appliances, automatic smoke and heat detectors, door release appliances, standby battery and charger and supervisory switches, all located as required by the system designer and applicable codes and wired in accordance with the manufacturer's instructions to make a complete and workable system.

4. System designer shall coordinate with the local Fire Department to assure that all local, state, and federal requirements are met.

5. The fire alarm system design shall provide total coverage for all the facilities and shall be in accordance with the applicable local building codes and the Americans with

Disabilities Act (ADA). Where the local codes are silent on an issue, the design shall be in accordance with NFPA 101. The application, installation, performance and maintenance of the fire alarm system and its components shall be in accordance with the NFPA 72.

6. The design and installation of all wiring, cable and equipment shall be in accordance with NFPA 70, and specifically with Article 760, Article 770 and Article 800.

7. Provide all the documentation indicated in NFPA 72, Sections 1-7 and 7-5.2. The documentation and permanent records shall include but not be limited to written statement by the Contractor indicating the system has been installed and tested in accordance with applicable documents; certificate of completion; installation instructions and after successful completion of acceptable test satisfactory to the Authority having jurisdiction; a set of reproducible as-built installation drawings; operation and maintenance manuals and a written sequence of operation.

8. The fire system coverage in the Centrifuge Dewatering Building shall comply with NFPA 820.

9. There are additional fire alarm systems located on the site. These fire alarm systems are located at the Operations and Control Building (Bldg 170), the Maintenance Building (Bldg 175), the Main Electrical / Blower Building (Bldg 185), Clarifier No. 10 Electrical Building (Bldg 190), future Preliminary Treatment Structure (Process 500), future modifications to North Control Building (Bldg 155) and West Electrical Building (Bldg 575). Design shall take this into account when designing for the new fire alarm systems for communication with the Fire Department.

B. Related Work

1. Conduit, boxes, fittings, and supports shall be furnished for all wiring to meet the requirements of the system design and be provided and installed under this Section as specified in Section 16100.

2. Wire shall be furnished to meet the requirements of the system design and be provided and installed under this Section as specified in Section 16120.

3. Fire suppression systems, sprinkler system alarm valves, flow and supervisory switches shall be furnished under Division 15.

C. Submittals

1. Submit, in accordance with Section 01300, the following:

a. Shop drawings for each Fire Alarm Control Panel and its associated detectors, alarms, inputs and outputs. Each set of Fire Alarm Control Panel shop drawings shall include:

1) Manufacturer’s equipment data sheets including sufficient data to indicate compliance with the specifications and component identification tag number, when applicable. Show physical dimensions, mounting and installation details and wiring connections. Indicate all options, special features and deviations from this Section.

2) Bill of material for each fire alarm panel listing all modules by quantity and part number.

3) Listing of every input/output point address for each panel.

4) Standby battery calculations.

5) Internal point-to-point wiring diagram for each panel showing interconnections between modules.

6) External loop interconnection wiring diagram for each initiating and notification circuit, including interlock wiring to HVAC. Loop diagrams shall indicate the origin of the loop at the control panel and include all external devices connected to the loop. Identify external devices by room number or location and type. Show all terminal numbers and color coding for wiring.

7) Fire Department acceptance paperwork.

8) Manufacturer’s warranty.

D. Sequence Of Operation

1. Upon activation of any manual pull station, automatic detector, the system shall:

a. Automatically notify local Fire Department (or other agency as directed by the fire authority) via a dedicated telephone line and transmitting/receiving equipment provided, installed and coordinated by the Contractor. All costs for this work shall be borne by this Contractor.

b. Automatically start the audible and visual alarm indicating appliances throughout the building under alarm (if more than one) as specified herein.

c. The audible alarm appliances shall sound the standard evacuation tone temporal pattern 3 and visual alarms flash until alarm initiating devices have been restored to normal and the reset switch located at the control panel actuated.

2. When any of the building's alarm initiating devices are activated, its building exterior mounted beacons shall operate.

3. The local Fire Department shall be hereinafter referred to as the Fire Department.

4. Communication between the fire alarm control panels and the plant’s main telephone backboard for autodial out to the fire department may be done utilizing the existing fiber loop system, if approved by the AHJ. The main telephone backboard is located in the old generator building 150. Provide additional components as required to make system operational and comply with the Fire Department requirements.

E. Reference Standards

1. National Fire Protection Association (NFPA)

a. NFPA 70 - National Electrical Code.

b. NFPA 72 - National Fire Alarm Code.

c. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.

d. NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

2. Underwriters Laboratories (UL)

3. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

F. Spare Parts

1. Provide five (5) keys for each control panel door.

G. Manufacturers

1. To provide consistency with the preferred fire alarm systems on site, the manufacturer of the fire alarm control panel shall be Edwards Systems Technology, product line EST. References within this specification to other manufacturers are for technical equivalency only.

H. Warranty

1. All equipment supplied under this Section shall be warranted by the Contractor and the equipment manufacturers for a period of three (3) years.

2. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the machine(s) and the unit(s) restored to service at no additional cost to the Owner.

3. The manufacturer’s warranty period shall run concurrently with the Contractor’s warranty period. No exception to this provision shall be allowed.

I. Extended Warranty (Bid Additive Alternate)

1. If authorized by the Owner, Contractor and equipment manufacturer shall extend the initial warranty period listed in the previous paragraph for a period of two (2) years, bringing the total warranty coverage up to five (5) years.

2. The extended warranty shall include all terms and conditions required to be provided by the Owner to maintain the terms of the warranty.

PART 2 PRODUCTS

A. Materials

1. The control panel shall be surface mounted, modular, of dead-front construction with key lock door, using solid-state components to operate the system. Alarm initiating circuits shall meet National Electrical Code (NEC) requirements for limited energy applications and function with up to 100 ohms resistance in the alarm initiating device and its associating wiring. The control unit shall contain an internal audible signal with audible acknowledge switch, system reset switch, lamp test switch, audible silence switch and auxiliary master box disconnect switch. Control unit shall be double-supervised so that a trouble signal shall sound in the event of loss of either operating or supervising power. Two light-emitting diodes (LEDS) shall be installed and shall remain illuminated to indicate both operating and supervisory power are energized. Trouble audible acknowledge switches shall be furnished with its associated LED so that indication of trouble on alarm initiating circuits, alarm indicating circuits and supervisory circuits shall initiate a control panel audible and be silenced independent of each other. The silencing of a trouble condition in any zone shall not prevent the resounding of the control panel audible in the event of a subsequent trouble conditions in other circuits. When trouble conditions are restored to normal, the audible acknowledge switch shall not require restoration to normal.

   a. Each circuit shall be supervised to provide a trouble condition in the event of an open or short in either circuit. A means shall be provided so that alarm indicating appliances may be discontinued before the actuated initiating device has been restored to normal; but shall not prevent the resounding of subsequent alarms received from another zone. A visual indicator shall be provided so that operating personnel can readily determine that the signals have been discontinued.

   b. The initiating device circuits and the notification appliance circuits shall be Class "A". They shall allow the receipt of and notification of alarms even in the event of a single open or a single ground in the circuits.

c. Each of the zones shall have a separate zone trouble and alarm indicator. All field wires connected to alarm initiating devices necessary to activate an alarm shall be electrically supervised and a single open or ground on such wires shall not cause an alarm condition. An open in any alarm initiating circuit shall cause the associated visual trouble indicator to flash and the control panel audible to sound steady, until the audible acknowledge switch is actuated at which time the trouble indicator shall go steady and the control panel silenced. On alarm condition in any alarm initiating circuit, its associated visual alarm indicator shall flash and the control panel audible shall pulsate and the alarm indicating appliances shall sound. When a zone audible acknowledge switch is activated, the indicator shall be lit steady and the control panel audible silenced. The silencing of a trouble or alarm condition in any zone shall not prevent the resounding of the control panel audible in the event of a subsequent alarm or trouble condition in other circuits, or loss of either operating or supervising power. Each alarm initiating circuit shall have associated dry, fused, Form "C" alarm contacts for its associated zone. This contact shall transfer upon alarm condition in its associated zone. Each initiating circuit containing four wire smoke detectors shall incorporate an end of line relay to supervise the smoke detector power circuit.

d. The horn/strobe light units shall be wired on dual circuits to permit silencing of the horns and allow the strobe lights to flash during alarm conditions.

e. Means shall be provided to sound the control panel audible upon a ground fault between any supervised circuit and ground. This ground fault shall also light a visual indicator on the control unit for rapid identification of the trouble cause.

f. All visual indicators on the control panel shall be supervised so that an open or short in any visual indicator shall provide a trouble indication.

g. The batteries used with the fire alarm control panel shall be capable of operating the panel for 60 hours with a 5 minute ring-down at the end of a 60 hour period. The calculation used to determine battery capacity shall be submitted to the Engineer and presented to the Fire Department at the time of

inspection. Control unit shall be Autocall, Type MDK or equal.

2. Manual fire boxes shall be non-coded and shall be semi-flush mounted in finished areas and surface-mounted in unfinished and existing areas. Stations shall be double-action with "LIFT TO BREAK" plastic shield. When operated, fire boxes shall remain mechanically locked until manually reset. Construction shall be of rigid metal with raised lettering and clear plastic shield with lettering "LIFT TO BREAK - PULL LEVER DOWN". Manual fire boxes shall be Autocall, double-action 4051 or equal. Double-action stations requiring external hammer to break glass to gain access to actuating lever shall not be acceptable.

3. Manual fire boxes for "WP" weatherproof applications shall be non-coded, surface mounted type. Stations shall be slide action type with internal glass rod. Construction shall be die-cast aluminum finished in red with raised natural aluminum lettering, gasketed with back box. Stations shall be Autocall, Catalog No. 5 DW or equal. Double-action stations requiring external hammer to break glass to gain access to actuating lever will not be acceptable.

4. Manual fire boxes for Class 1, Division 1, Group D hazardous area applications shall be non-coded surface mounting type. Stations shall be double-action type with a hinged cover which holds a sliding actuator plate in place. Activation of the stations is made by lifting the hinged cover and pulling down on the ring. Stations may be reset after activation without need for replacement parts. Stations shall be Killark, XAD Series or equal. Double-action stations requiring a hammer to break glass to gain access to actuating lever will be acceptable.

5. Automatic ionization type smoke detectors shall be of the dual-chamber, locking type. The dual-chamber shall be highly sensitive to products of combustion and shall allow for compensation for pressure and humidity changes. The detectors shall be equipped with a solid-state regulator to maintain detection sensitivity over a wide range of input voltages. A visual indication of an alarm shall be given by a LED on the detector grille. Automatic ionization type detectors shall be four-wire Autocall, Type 1451-B402B or equal.

6. Automatic photo-electronic type smoke detectors shall operate on the forward light scattering principle using a

pulsed infra-red light emitting diode light source and a photo diode sensor. The detectors shall be of the locking type and have an alarm verification circuit requiring several successive signals exceeding the alarm threshold value prior to transmitting an alarm. A visible LED indicator shall blink to indicate power on and normal operation. On alarm the indicator shall turn on and remain on until the detector is reset. Automatic photo-electronic detector shall be four wire type, Autocall, Model 2451-B402B or equal.

7. Heat Detectors

   a. Heat detectors shall be combination fixed temperature and rate of rise of fixed temperature only. Rate of rise element shall comprise of calibrated, moisture proof, trouble free vented chamber with flexible metal diaphragm to close contact when temperature rise exceeds 15 degrees F per minute. Contact shall be rated 3 Amps, 28 VDC. Fixed temperature element shall comprise nonrestorable fusible alloy element with external heat collector that drops for view when alloy fuses for visual indication of operation. Units shall be enclosed in white low profile dome shell with matching base.

   b. Units shall be color-coded to indicate one of the following types:

      1) 135 degrees F fixed temperature and rate of rise (Autocall 601)

      2) 200 degrees F fixed temperature and rate of rise (Autocall 602)

      3) 135 degrees F fixed temperature only (Autocall 603)

      4) 200 degrees F fixed temperature only (Autocall 604)

   c. Heat detectors for Class 1, Division 1, Group D hazardous areas shall have, in addition to their rated enclosures, electrical features similar to those above.

      1) 136 degrees F fixed temperature and rate of rise (Autocall EPB-501)

2) 190 degrees F fixed temperature and rate of rise (Autocall EPB-502)

3) 136 degrees F fixed temperature only (Autocall EPB-503)

4) 190 degrees F fixed temperature only (Autocall EPB-504)

8. Combination audio-visual horn/strobe light units meeting current ADA requirements and shall be installed on supervised circuits. Visual portion shall flash on alarm condition. Audio-visual units shall be Autocall, Types SM-24D/H or equal.

9. Horn for Class 1, Division 1, Group D hazardous area applications shall have a sound rating of 100 dB at 10-ft and be Federal Signal, 41x.

10. Strobe light for Class 1, Division 1, Group D hazardous area applications shall be for wall mounting, provide 72 high intensity flashes per minute, be furnished with a red polycarbonate lens and be Crouse-Hinds, EVBS101R/024.

11. Remote trouble station shall consist of buzzer and silencing with switch. Autocall, Type SC-3 or equal.

12. Remote zone annunciator shall be of the non-graphic type with red bulls-eye lamps mounted on a stainless steel plate.

13. Door hold and release units for the closing of doors when the threat of fire exists to prevent the spread of fire and smoke shall each consist of two elements: an electromagnetic portion to be wall or floor mounted and an armature section to be mounted on the door. The electromagnetic portion is continuously energized by 120 VAC input power. Wall-to-door mounted assembly shall be Autocall, Model 7392-3 or equal. Floor-to-door mounting assembly shall be Autocall, Model 7392-1 or equal.

14. Beacon alarm lights for building exterior mounting shall be weatherproof construction and have a 750,000 candle power xenon strobe tube and red polycarbonate lens. Beacon alarm lights shall be similar and equal to Federal Signal, Model 371 DST.

15. Master box shall be of the local energy, weatherproof enclosure type for surface mounting. Gamewell, Model M3456.

16. Grounding assembly consisting of ground rod, clamps and all other required hardware shall be provided for master box protection. Gamewell, Model 30118.

17. All components shall be products of one manufacturer where such is obtainable.

PART 3 EXECUTION

A. Installation

1. The system shall be wired with No. 14 XHHW throughout in accordance with the manufacturer's diagrams and requirements. All wires shall be numbered at both ends with typewritten heat shrinkable markers.

2. Upon completion of the installation, the fire alarm system designer and the electrical contractor shall test each and every device including manual station, smoke detector, alarm signals, visual signals, waterflow switches, valves, for proper operation. A certified report shall be submitted to the Engineer indicating date of testing and signatures of the designer's and electrical contractor's personnel that performed the test.

3. Final connections in the system shall be made under the direct supervision of an authorized representative of the manufacturer. Upon completion of the installation and testing indicated above, the manufacturer shall check and test the entire system with a representative of the Fire Department and Engineer present. Submit Fire Department acceptance paperwork to Engineer.

4. Provide the Owner with wiring diagrams including terminal to terminal designations, complete equipment specifications and complete sequence of operation.

B. Cleaning

1. Clean the interior and exterior of electrical equipment in accordance with Section 16000.

END OF SECTION

SECTION 16800 SURVEILLANCE SYSTEM

PART 1 - GENERAL

A. WORK INCLUDED

1. Work includes engineering, furnishing, installing, testing, documenting and placing in operation elements of a surveillance system for the Orange County Eastern Water Reclamation Facility (EWRF).

2. The CONTRACTOR shall furnish all labor, materials, equipment, services and incidentals required to install a video surveillance system as shown on the Contract Drawings and as specified herein.

3. The equipment, as installed, shall fully comply with all Federal, State, and City ordinances.

4. Equipment found to be defective prior to system acceptance shall be replaced and installed at no additional cost to the OWNER.

5. All engineering development required by the CONTRACTOR shall be in accordance with the Conditions of this Contract.

B. RELATED WORK

1. All field and power wiring and fiber optic connections required for the system are furnished and installed under other sections of these specifications.

C. SYSTEM DESCIPTION

1. The system shall comprise the following major elements:

   a. A Surveillance System Network Panel (SSNP) in a NEMA 4X Stainless Steel enclosure wall-mounted in the centrifuge building as shown on the drawings. The panel shall include a mixed media Ethernet switch interconnecting the Cameras with the control system fiber optic network together with any power distribution, protection and conversion equipment necessary for complete operation.

b. Eight (8) Ethernet/IP based fixed cameras within the EWRF Centrifuge Building.

c. A system DVR installed by Section 13300 SYSTEM SUPPLIER within the SCADA Control Panel.

d. System software installed on an existing OWNER specified PC.

D. SUBMITTALS

1. Submit shop drawings in accordance with Division 1. These shop Drawings shall fully demonstrate that the equipment and services to be furnished will comply with the provisions of these specifications and shall provide a true and complete record of the equipment as manufactured and delivered. Submittals shall be bound in separate three-ring binders, with an index and sectional dividers, with all Drawings reduced to a maximum size of 11-in by 17-in for inclusion within the binder.

2. Submit the following Shop Drawings in a single package:

a. Catalog information, descriptive literature, wiring diagrams, and shop drawings on all components, including all miscellaneous electrical and mechanical devices furnished under this section.

b. Complete part numbers for all components, including any options, shall be identified. Provide manufacturer’s data that correlates to the complete part number including all options.

c. Installation details for all field mounted devices to show conformance with the Contract Documents.

d. Incomplete submittals (e.g., catalog cuts with no integrated or coordinated drawing depicting equipment function or operation) will be returned without action.

E. DELIVERY, STORAGE AND HANDLING

1. Shipping Precautions. Special instructions for proper field handling, storage and installation required by the manufacturer for proper protection, shall be

securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in re-sealable plastic bags or other acceptable means of protection.

2. Identification. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

3. Storage. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters including in-line equipment and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR at his/her own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such tests as directed by the Engineer. This shall be at the cost and expense of the CONTRACTOR, or the apparatus shall be replaced by the CONTRACTOR at his/her own expense.

F. FINAL SYSTEM DOCUMENTATION

1. Prior to final acceptance, operating and maintenance manuals covering instruction and maintenance on each type of equipment shall be furnished in accordance with the specification.

2. The instructions shall be bound in three-ring binders with Drawings reduced or folded for inclusion and shall provide at least the following as a minimum.

   a. A comprehensive index.

   b. A complete "As Constructed" set of approved shop Drawings.

   c. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.

   d. Full specifications on each item.

   e. System schematic drawings "As Constructed", illustrating all components and electrical

connections of the components supplied under this Section.

f. Detailed service, maintenance and operation instructions for each item supplied.

g. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

h. Complete parts lists with stock numbers and name, address and telephone number of the local CONTRACTOR.

i. A Compact Disk containing the shop drawing data in PDF format in the binder sleeve.

3. The CONTRACTOR's final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation. Modifications to existing manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.

4. The manuals shall contain all illustrations, detailed drawings, wiring diagrams and instructions necessary for installing, operating and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

G. QUALITY CONTROL

1. The CONTRACTOR shall meet all of the requirements of these specifications, and, unless specifically stated otherwise, no prior acceptance of any subsystem, equipment, or materials has been made.

2. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.

3. All camera equipment furnished by the CONTRACTOR shall be of the same manufacturer.

4. The CONTRACTOR shall provide experienced personnel on-site to coordinate and/or perform installation, termination, and adjustment; on-site testing and startup assistance for the system

5. The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment and accessories proposed under this Contract shall conform to the National Electrical Code and to applicable state and local requirements. UL listing and labeling shall be adhered to under this Contract.

6. Any equipment that does not have a UL, FM CSA, or other approved testing laboratory label shall be furnished with a notarized letter signed by the CONTRACTOR stating that the equipment famished has been manufactured in accordance with the National Electric Code and OSHA requirements.

7. Instrument Society of America (ISA) and National Electrical Manufacturers Association (NEMA) standards shall be used where applicable in the design of the system.

8. Any additional work needed resulting from any deviation from codes or local requirements shall be at no additional cost to the OWNER.

H. WARRANTY AND GUARANTEE

1. In accordance with Division 1, the CONTRACTOR shall furnish to the OWNER a written guarantee commencing with final acceptance, that all equipment and parts thereof, material and/or workmanship for the system are of top quality and free from defects.

2. The CONTRACTOR shall guarantee all equipment whether or not of his own manufacture.

PART 2 - PRODUCTS

A. GENERAL REQUIREMENTS

1. Equipment to be installed in a hazardous area shall meet Class, Group, and Division classification as shown on the Contract Electrical Drawings, or comply with the local or National Electrical Code, whichever is the most stringent requirement.

2. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single MANUFACTURER, insofar as possible, and shall consist of equipment models which are currently in production.

3. The equipment shall be designed to operate satisfactorily between 0 degrees C and 40 degrees C at up to 95 percent Relative Humidity (non condensing).

4. All equipment shall be designed to operate on a 60-Hertz alternating current power source at a normal 120 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

5. All equipment furnished shall be designed and constructed so that in the event of power interruption, or temperatures outside the operational range, the systems specified hereunder shall go through an orderly shutdown with no loss of memory, and resume normal operation without manual resetting when power is restored.

6. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 volts-amperes (VA), unless specifically noted otherwise.

7. Electronic equipment shall utilize printed circuitry suitably coated to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for their purpose, to assure optimum long-term performance and dependability over

ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

B. LIGHTNING/SURGE PROTECTION

1. Surge suppressors and arrestors meeting the requirements of ANSI Standard C-62.41 (latest revision) shall be provided on all instruments as further detailed below.

2. Single phase AC Power. Lightning and surge protectors for AC power supply lines up to 15 Amps service shall meet the following criteria:

   a. Serial protection with replaceable fuse

   b. Failure indicator

   c. Response time of less than five nanoseconds

   d. Capable of withstanding up to 10,000 Amps at IEEE/ANSI C-62.41 8 x 20 microseconds combination wave

   e. Manufacturer/model:

      (1) EDCO HSP121BT

      (2) Approved equal

C. VIDEO SURVEILLANCE HARDWARE

1. All cameras shall be IP addressable, powered by PoE IEEE 802.3 and provided in enclosures.

2. The fixed cameras shall be a high performance 1/3-inch digital CCD camera with built-in motion detection and meeting the following:

   a. Automatic lens type detection

   b. Focal point of lens selected based on the location

   c. Automatic iris lens

   d. Power Supply: 24 VAC

e. Operating temperature up to 122 degrees F

f. Bosch LTC 0495/21 or approved equal

3. The Digital Video Recorder (DVR) shall be fully compatible with all cameras and shall support up to sixteen (16) individual camera inputs. The DVR shall meet the following additional requirements;

a. Up to twenty (20) simultaneous users with one using the playback feature.

b. RS-232 port supporting individual camera control from a remote location

c. 10/100 auto-sensing Ethernet network connection for interface with the control system.

d. Selectable record speeds based on event, time lapse, or both

e. Internal CD-RW and DVD+RW archive devices

f. Dual hard disk drives

g. Power Supply: 120 VAC

h. Operating temperature up to 104 degrees F

i. UTC model TVR-3116-6T or approved equal

4. The system software shall be installed on an OWNER selected PC as a fully integrated application.

5. The system software shall be fully compatible with the Digital Video Recorder specified elsewhere herein.

6. The system software shall incorporate the following features:

a. Support up to 32 PC based workstations

b. Interactive dynamic graphical user interface

c. Database partitioning and multiple server support

d. MS Internet browser capability

e. Fixed camera control

f. The system software shall be UTC Facility Commander or approved equal

7. The Ethernet switch interconnecting the cameras and the plant surveillance system shall have a minimum of twelve (12) 10/100 Base TX ports and four 100 Base FX ports. Provide any power conversion necessary to utilize 120 VAC power source. N-Tron 712FX4 or approved equal.

PART 3 - EXECUTION

A. INSTALLATION

1. Install the equipment in the location indicated on the Drawings and follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instruction, and these Contract Documents, follow ENGINEER's decision, at no additional cost. Keep a copy of manufacturers' instructions on the jobsite available for review at all times.

2. If fittings or bends are required to direct the cable to a specific location, sweep fittings shall be used.

3. Coordinate grounding requirements with Division 16, Electrical.

4. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance. Coordinate work with the OWNER and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the existing plant during construction.

5. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type,

color, consistency, and type of surface of the original finish. Clean and polish the exterior of all panels and enclosures upon the completion of the demonstration tests.

END OF SECTION

TAGLIST

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Orange County Utilities
Eastern Water Reclamation Facility
Centrifuge Dewatering Improvements
Bid Package B
Tag List

Process 610 Phase I-II WAS Booster Pump Station

Proc.		Type		No.	Description	Size or Type	Spec. Sect.	Hp. Req	Voltage	Comments/Notes
610	-	P	-	1	WAS Booster Pump	450 GPM @ 20' TDH	11311	5	460	Phase I-II WAS Booster Pump No. 1
610	-	P	-	2	WAS Booster Pump	450 GPM @ 20' TDH	11311	5	460	Phase I-II WAS Booster Pump No. 2
610	-	V	-	1	6 Plug Valve	6V510	15100	-	-	610-P-1 Inlet Isolation Valve
610	-	V	-	2	6 Plug Valve	6V510	15100	-	-	WAS Booster Pump Suction Manifold Isolation
610	-	V	-	3	6 Check Valve	6V720	15100	-	-	610-P-1 Discharge Check Valve
610	-	V	-	4	6 Plug Valve	6V510	15100	-	-	610-P-1 Discharge Isolation Valve
610	-	V	-	5	6 Plug Valve	6V510	15100	-	-	610-P-2 Inlet Isolation Valve
610	-	V	-	6	6 Check Valve	6V720	15100	-	-	610-P-2 Discharge Check Valve
610	-	V	-	7	6 Plug Valve	6V510	15100	-	-	610-P-2 Discharge Isolation Valve
610	-	V	-	8	1 ARV	1V1225	15108	-	-	610-P-2 Discharge Air Release Valve
610	-	V	-	9	1 ARV	1V1225	15108	-	-	610-P-1 Discharge Air Release Valve
610	-	PI	-	1	Pressure Gauge	Type 4	13437	-	-	610-P-2 Discharge Pressure Gauge
610	-	PI	-	2	Pressure Gauge	Type 4	13437	-	-	610-P-2 Inlet Pressure Gauge
610	-	PI	-	3	Pressure Gauge	Type 4	13437	-	-	610-P-1 Inlet Pressure Gauge
610	-	PI	-	4	Pressure Gauge	Type 4	13437	-	-	610-P-1 Discharge Prssure Gauge

Process 620 WAS Holding Tanks

Proc.		Type		No.	Description	Size or Type	Spec. Sect.	Hp. Req	Voltage	Comments/Notes
620	-	TK	-	1	WAS Holding Tank No. 1	30 ft dia, 12 ft 2 in SWD	-	-	-	existing sludge tank
620	-	TK	-	2	WAS Holding Tank No. 2	30 ft dia, 12 ft 2 in SWD	-	-	-	existing sludge tank
620	-	TM	-	1	Thickener Mechanism	30 ft dia	11336	3/4	460	620-TK-1 sludge thickening mechanism
620	-	TM	-	2	Thickener Mechanism	30 ft dia	11336	3/4	460	620-TK-2 sludge thickening mechanism
620	-	LE/LIT	-	1	Level Element and Transmitter	-	13300	-	120	620-TK-1 level element & transmitter
620	-	LE/LIT	-	2	Level Element and Transmitter	-	13300	-	120	620-TK-2 level element & transmitter
620	-	V	-	1	6 Plug Valve	6V510	15100	-	-	Scum outlet valve at 620-TK-1, provide chainwheel actuator
620	-	V	-	2	6 Plug Valve	6V510	15100	-	-	Scum outlet valve at 620-TK-1, provide chainwheel actuator
620	-	V	-	3	8 Plug Valve	8V510	15100	-	-	620-TK-1 Drain Isolation Valve
620	-	V	-	4	8 Plug Valve	8V510	15100	-	-	620-TK-2 Drain Isolation Valve

Note:
1. This tag list includes only those valves and equipment that have been assigned a process/mechanical tag number. This list is not intended to be a complete list of all valves and items of equipment to be furnished on the project. Please refer to the plans and specifications for other valves and equipment to be furnished on the project.

Orange County Utilities
Eastern Water Reclamation Facility
Centrifuge Dewatering Improvements
Bid Package B
Tag List

Process 630 Biosolids Handling Building

Proc.		Type		No.	Description	Size or Type	Spec. Sect.	Hp. Req	Voltage	Comments/Notes
630	-	GD	-	1	Grinder	-	-	-	-	Biosolids Handling Grinder No. 1 - Existing
630	-	GD	-	2	Grinder	-	-	-	-	Biosolids Handling Grinder No. 2 - Existing
630	-	GD	-	3	Grinder	In-line, 600 gpm	11330	3	460	Biosolids Handling Grinder No. 3
630	-	GD	-	4	Grinder	In-line, 600 gpm	11330	3	460	Biosolids Handling Grinder No. 4
630	-	GD	-	5	Grinder	In-line, 600 gpm	11330	3	460	Biosolids Handling Grinder No. 5
630	-	FE/FIT	-	1	6 Meter	Magnetic Flow Meter	13300	_	120	WAS Flow Meter (630-P-1)
630	-	FE/FIT	-	2	6 Meter	Magnetic Flow Meter	13300	_	120	WAS Flow Meter (630-P-2)
630	-	FE/FIT	-	3	6 Meter	Magnetic Flow Meter	13300	_	120	WAS Flow Meter (630-P-3)
630	-	AE/AIT	-	1	TSS Meter and Transmitter	-	13300	_	120	WAS Feed Pump No. 1 - TSS Meter and Transmitted
630	-	AE/AIT	-	2	TSS Meter and Transmitter	-	13300	_	120	WAS Feed Pump No. 2 - TSS Meter and Transmitted
630	-	AE/AIT	-	3	TSS Meter and Transmitter	-	13300	_	120	WAS Feed Pump No. 3 - TSS Meter and Transmitted
630	-	P	-	1	WAS Feed Pump	_	_	_	_	WAS Feed Pump No. 1 - Existing
630	-	P	-	2	WAS Feed Pump	_	_	_	_	WAS Feed Pump No. 2 - Existing
630	-	P	-	3	WAS Feed Pump	_	_	_	_	WAS Feed Pump No. 3 - Existing
630	-	P	-	4	Recirc Pump	_	_	_	_	Polymer Recirculation Pump No. 1 - Existing
630	-	P	-	5	Recirc Pump	-	-	-	-	Polymer Recirculation Pump No. 2 - Existing
630	-	P	-	6	Polymer Injection Pump	32 gpm	11315	5	460	Polymer Injection Pump No. 1
630	-	P	-	7	Polymer Injection Pump	32 gpm	11315	5	460	Polymer Injection Pump No. 2
630	-	P	-	8	Polymer Injection Pump	32 gpm	11315	5	460	Polymer Injection Pump No. 3
630	-	TK	-	1	Polymer Tank	5,000 GAL	-	-	-	Bulk Polymer Storage Tank No. 1 - Existing
630	-	TK	-	2	Polymer Tank	5,000 GAL	-	-	-	Bulk Polymer Storage Tank No. 2 - Existing
630	-	TK	-	3	Aging Tank	1,000 GAL	-	-	-	Polymer Solution Aging Tank No. 1 - Existing
630	-	TK	-	4	Aging Tank	1,000 GAL	-	-	-	Polymer Solution Aging Tank No. 2 - Existing
630	-	P	-	9	Polymer Dilution Pump	-	-	-	-	Polymer Dilution Pump No. 1 - Existing
630	-	P	-	10	Polymer Dilution Pump	-	-	-	-	Polymer Dilution Pump No. 2 - Existing
630	-	FE/FIT	-	4	1 Meter	Magnetic Flow Meter	13300	_	120	Aged Polymer Solution Flow Meter
630	-	FE/FIT	-	5	1 Meter	-	-	-	-	Aged Polymer Solution Flow Meter - Existing
630	-	FE/FIT	-	6	1 Meter	-	-	-	-	Aged Polymer Solution Flow Meter - Existing
630	-	V	-	1	6 Plug Valve	6V510	15100	-	-	Biosolids Handling Grinder Pump No. 3 (630-GD-3) Bypass
630	-	V	-	2	6 Plug Valve	6V510	15100	-	-	Biosolids Handling Grinder Pump No. 3 (630-GD-3) Downstream Isolation
630	-	V	-	3	6 Plug Valve	6V510	15100	-	-	Biosolids Handling Grinder Pump No. 3 (630-GD-3) Upstream Isolation

Note:
1. This tag list includes only those valves and equipment that have been assigned a process/mechanical tag number. This list is not intended to be a complete list of all valves and items of equipment to be furnished on the project. Please refer to the plans and specifications for other valves and equipment to be furnished on the project.

Orange County Utilities
Eastern Water Reclamation Facility
Centrifuge Dewatering Improvements
Bid Package B
Tag List

Process 630 Biosolids Handling Building Continued…

Proc.		Type		No.	Description	Size or Type	Spec. Sect.	Hp. Req	Voltage	Comments/Notes
630	-	V	-	4	6 Plug Valve	6V510	15100	-	-	Biosolids Handling Grinder Pump No. 4 (630-GD-4) Downstream Isolation
630	-	V	-	5	6 Plug Valve	6V510	15100	-	-	Biosolids Handling Grinder Pump No. 4 (630-GD-4) Upstream Isolation
630	-	V	-	6	6 Plug Valve	6V510	15100	-	-	Biosolids Handling Grinder Pump No. 5 (630-GD-5) Downstream Isolation
630	-	V	-	7	6 Plug Valve	6V510	15100	-	-	Biosolids Handling Grinder Pump No. 5 (630-GD-5) Upstream Isolation
630	-	V	-	8	6 Plug Valve	6V510	15100	-	-	Biosolids Handling Grinder Pump No. 5 (630-GD-5) Bypass
630	-	V	-	9	6 Plug Valve	6V510	15100	-	-	Biosolids Handling Future Centrifuge Feed Line Isolation
630	-	V	-	10	4 Gate Valve	6V180	15100	-	-	1 RW-1 Isolation Valve
630	-	V	-	11	6 Plug Valve	6V510	15100	-	-	Biosolids Handling Grinder Pump No. 4 (630-GD-4) Bypass
630	-	V	-	12	1 ARV	1V1225	15108	-	-	630-P-2 Air Release Valve
630	-	V	-	13	1 ARV	1V1225	15108	-	-	630-GD-5 Air Release Valve
630	-	V	-	14	1 ARV	1V1225	15108	-	-	630-GD-4 Air Release Valve
630	-	V	-	15	1 ARV	1V1225	15108	-	-	630-GD-3 Air Release Valve

Note:
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Orange County Utilities
Eastern Water Reclamation Facility
Centrifuge Dewatering Improvements
Bid Package B
Tag List

Process 650 Centrifuge Dewatering Building

Proc.		Type		No.	Description	Size or Type	Spec. Sect.	Hp. Req	Voltage	Comments/Notes
650	-	CNV	-	1	Screw Conveyor No. 1	2700 lbs/hr @ 18% dry solids	14549	Ref Spec	460	Centrifuge No. 1 Dewatered Biosolids Screw Conveyor
650	-	CNV	-	2	Screw Conveyor No. 2	2700 lbs/hr @ 18% dry solids	14549	Ref Spec	460	Centrifuge No. 2 Dewatered Biosolids Screw Conveyor
650	-	CNV	-	3	Screw Conveyor No. 3	2700 lbs/hr @ 18% dry solids	14549	Ref Spec	460	Centrifuge No. 3 Dewatered Biosolids Screw Conveyor
650	-	CNV	-	4	Future Screw Conveyor No. 4	-	-	-	-	Future Centrifuge No. 4 Dewatered Biosolids Screw Conveyor
650	-	TS	-	1	West Scale	Truck Scale, 50 ton	10881	-	Ref Spec	West Dewatered Biosolids Loading Truck Scale
650	-	TS	-	2	East Scale	Truck Scale, 50 ton	10881	-	Ref Spec	East Dewatered Biosolids Loading Truck Scale
650	-	DG	-	1	Motorized Diverter Gate	Ref Specs	11371&15119	Ref Specs	460	Centrifuge No 1 (650-CF-1) Diverter Gate - Screw Conveyor No. 1 (650-SC-1)
650	-	DG	-	2	Motorized Diverter Gate	Ref Specs	11371&15119	Ref Specs	460	Centrifuge No 2 (650-CF-2) Diverter Gate - Screw Conveyor No. 2 (650-SC-2)
650	-	DG	-	3	Motorized Diverter Gate	Ref Specs	11371&15119	Ref Specs	460	Centrifuge No 3 (650-CF-3) Diverter Gate - Screw Conveyor No. 3 (650-SC-3)
650	-	DG	-	4	Future Motorized Diverter Gate	-	-	-	-	Future Centrifuge No 4 (650-CF-4) Diverter Gate
650	-	B	-	1	Blower	12,200 cfm @ 12-inch W.C.	15857	75	460	North Odor Control Blower
650	-	B	-	2	Blower	12,200 cfm @ 12-inch W.C.	15857	75	460	South Odor Control Blower
650	-	D	-	1	36 Motorized Damper	30 inch	15850	Ref Specs	Ref Spec	650-B-1 Damper
650	-	D	-	2	36 Motorized Damper	30inch	15850	Ref Specs	Ref Spec	650-B-2 Damper
650	-	KG	-	1	Motorized Knife Gate	Ref Specs	14594 &15119	Ref Specs	460	Centrifuge No 1 (650-CF-1) - Screw Conveyor No. 1 (650-SC-1)
650	-	KG	-	2	Motorized Knife Gate	Ref Specs	14594 &15119	Ref Specs	460	Centrifuge No 1 (650-CF-1) - Screw Conveyor No. 1 (650-SC-1)
650	-	KG	-	3	Motorized Knife Gate	Ref Specs	14594 &15119	Ref Specs	460	Centrifuge No 2 (650-CF-2) - Screw Conveyor No. 2 (650-SC-2)
650	-	KG	-	4	Motorized Knife Gate	Ref Specs	14594 &15119	Ref Specs	460	Centrifuge No 2 (650-CF-2) - Screw Conveyor No. 2 (650-SC-2)
650	-	KG	-	5	Motorized Knife Gate	Ref Specs	14594 &15119	Ref Specs	460	Centrifuge No 3 (650-CF-3) - Screw Conveyor No. 3 (650-SC-3)
650	-	KG	-	6	Motorized Knife Gate	Ref Specs	14594 &15119	Ref Specs	460	Centrifuge No 3 (650-CF-3) - Screw Conveyor No. 3 (650-SC-3)
650	-	KG	-	7	Future Motorized Knife Gate	-	-	-	-	Future Centrifuge No 4 (650-CF-4) & Screw Conveyor No. 4 (650-SC-4) Knife Gate
650	-	KG	-	8	Future Motorized Knife Gate	-	-	-	-	Future Centrifuge No 4 (650-CF-4) & Screw Conveyor No. 4 (650-SC-4) Knife Gate
650	-	CF	-	1	Centrifuge No. 1	350 gpm @ 1% dry solids	11371	Ref Spec	460	Centrifuge No 1 (650-CF-1) Diverter Gate - Screw Conveyor No. 1 (650-SC-1)
650	-	CF	-	2	Centrifuge No. 2	350 gpm @ 1% dry solids	11371	Ref Spec	460	Centrifuge No 2 (650-CF-2) Diverter Gate - Screw Conveyor No. 2 (650-SC-2)
650	-	CF	-	3	Centrifuge No. 3	350 gpm @ 1% dry solids	11371	Ref Spec	460	Centrifuge No 3 (650-CF-3) Diverter Gate - Screw Conveyor No. 3 (650-SC-3)
650	-	CF	-	4	Future Centrifuge No. 4	-	-	Ref Spec	460	Future Centrifuge No 4

Note:
1. This tag list includes only those valves and equipment that have been assigned a process/mechanical tag number. This list is not intended to be a complete list of all valves and items of equipment to be furnished on the project. Please refer to the plans and specifications for other valves and equipment to be furnished on the project.

ATTACHMENTS

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Attachment A – Orange County Utilities Standards and Construction Specifications Manual
Appendix D: List of Approved Products
February 11, 2011

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APPENDIX D **LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Air Release	ARV Enclosure	**All ARV above ground enclosures shall be vented with tamper proof locking device**						
		Water Plus Polyethylene Enclosure	131632 H30-B	Blue 44" Tall	131632 H30-P	Pantone 44"	131632 H30-G	Green 44" Tall
			171730 H40-B	Blue 30" Tall	171730 H40-P	Pantone 30"	171730 H40-G	Green 30" Tall
		Hot Box Vent Guard Fiberglass Enclosure	AVG2036 Encl GP3232 Base	Blue 36" Tall	AVG2036 Encl GP3232 Base	Pantone 36" Tall	AVG2036 Encl GP3232 Base	Green 36" Tall
			AVG2041 Encl GP3232 Base	Blue 41" Tall	AVG2041 Encl GP3232 Base	Pantone 41" Tall	AVG2041 Encl GP3232 Base	Green 41" Tall
		Safety-Guard/Hydro Guard	15100 Encl	Blue 34" Tall	15100 Encl	Pantone 34" Tall	15100 Encl	Green 34" Tall
	Air Release Valves	**Air Release Valves shall be Combination Type, 316 SS**						
		ARI	D-040SS	Combination	D-040SS	Combination	D-020 (SS)	Combination
		H-TEC	NA	NA	NA	NA	986 (316SS)	Combination
		Vent-O-Mat	Series RBX DN50	2"	Series RBX DN50	2"	RGX series	
	ARV Vault	**Air Release Valve Frame and Cover**						
		US Foundry	NA	NA	NA	NA	USF 7665-HH-HJ	
Blow Off	Auto Blow Off	**Automatic Blow Off Valve**						
		Hydro Guard	HG-1 Standard Unit	Automatic	NA	NA	NA	NA
	Blow Off Valve	**Blow Off Valve - Fits standard 5-1/4 inch Valve Box**						
		Kupferle Foundry Co	Truflo Series TF #550		Truflo Series TF #550		NA	NA
		Water Plus Corp	The Hydrant Plus Series VB 2000B		The Hydrant Plus Series VB 2000B		NA	NA
Casing Seals / Spacers	Casing End Seals	**Casing End Seals. Annular space between pipe and steel casing shall be brick and mortar with end seals to secure ends.**						
		Advance Products	Model AC and AW		Model AC and AW		Model AC and AW	
		BWM Company	Model WR and PO		Model WR and PO		Model WR and PO	
		Cascade Water Works	Model CCES		Model CCES		Model CCES	
		CCI Pipeline	Model ESW and ESC		Model ESW and ESC		Model ESW and ESC	
		Pipeline Seal & Insulator, Inc (PSI)	Model C and W		Model C and W		Model C and W	
		Power Seal	Model 4810ES		Model 4810ES		Model 4810ES	

APPENDIX D **LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Casing Seals / Spacers	Casing spacer	**Casing spacers shall be a min. 8-inches wide for pipe 12" Dia or less or min. 12-inches wide for pipe 16 or greater , shall have a minimum 14 gauge 304 stainless steel shell/band, minimum 10 gauge 304 reinforced risers; minimum thickness of 0.090 EPDM or PVC interior liners, glass reinforces polymer or ultra high molecular weight polyethylene and 304 stainless bolts, nuts and washers.**						
		Advance Products	SSI8 / SSI12		SSI8 / SSI12		SSI8 / SSI12	
		BWM Company	BWM-SS-8 / SS-12		BWM-SS-8 / SS-12		BWM-SS-8 / SS-12	
		Cascade Water Works	Series CCS 8" / 12"		Series CCS 8" / 12"		Series CCS 8" / 12"	
		CCI Pipeline	Model CCS8 / CSS12		Model CCS8 / CSS12		Model CCS8 / CSS12	
		Pipeline Seal & Insulator, Inc (PSI)	Series S8G-2 / S12G-2		Series S8G-2 / S12G-2		Series S8G-2 / S12G-2	
Coatings	Exterior Coatings for Exposed Metal Assets	**Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 1 Zinc / Urethane / Fluoropolymer application and color code per Section 3119 Coatings & Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.**						
		Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils
			Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils
			Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils
		Tnemec	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils
			Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils
			EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils
			Hydroflon Series 700	2.0 - 3.0 mils	Hydroflon Series 700	2.0 - 3.0 mils	Hydroflon Series 700	2.0 - 3.0 mils
	Exterior Coatings for Exposed Metal Assets	**Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 2 Zinc / Epoxy / Urethane application and color code per Section 3119 Coatings & Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.**						
		Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils
			Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils
			Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils
		Tnemec	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils
			Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils	Typoxy Series 27WB	4.0 -14.0 mils
			Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils
			EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils
		PPG / Ameron	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils
			Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils
			Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Fittings	Fittings	**Ductile Iron Fittings C153 SSB / C110 FLG: (Water & Reclaimed Water fittings shall cement lined or holiday free fusion bonded epoxy lined) (Wastewater fittings interior shall be Protecto 401 and holiday free)**						
		American	30" & up	FBE / Cement	30" & up	FBE / Cement	30" & up	Protecto 401
		Sigma		FBE / Cement		FBE / Cement		Protecto 401
		Star		FBE / Cement		FBE / Cement		Protecto 401
		Tyler Union & Clow		FBE / Cement		FBE / Cement		Protecto 401
Flow	Flow Meter	**Flow Meters With Replaceable Sensors**						
		EMCO	NA	NA	NA	NA	Unimag 4411E	
Hydrants	Hydrants	**Hydrants Shall open left, 1-1/2 Pentagon operating nut, NST hose & pumper thread, rotate 360 degrees, closed drains, epoxy on shoe in & out and 304 SS nuts & bolts below ground.**						
		American Flow Control	B-84-B (6 inch)		NA	NA	NA	NA
		Clow	Medallion 2545		NA	NA	NA	NA
		Mueller	Super Centurion 250		NA	NA	NA	NA
Joint Restraints	Ductile iron pipe MJ Restraints	**Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated Restrain ductile iron pipe to mechanical joint fittings, pipe and appurtenances.**						
		EBAA Iron Inc	Megalug Series 1100		Megalug Series 1100		Megalug Series 1100	
		Ford / Uni-Flange	UFR-1400		UFR-1400		UFR-1400	
		Sigma	OneLok Series SLD/SLDE		OneLok Series SLD/SLDE		OneLok Series SLD/SLDE	
		Smith Blair	Cam Lok Series 111		Cam Lok Series 111		Cam Lok Series 111	
		Star	Star Grip Series 3000		Star Grip Series 3000		Star Grip Series 3000	
		Tyler Union	TufGrip Series TLD		TufGrip Series TLD		TufGrip Series TLD	
	DIP Bell Joint Restraints (4"-12") (New & Existing)	**Bell Joint Restraints for Ductile Iron Pipe (4"-12") (New & Existing) - All restraints split serrated on bell and spigot ends. Pipe 16" and greater shall have restraint gaskets or locking bells. (Wastewater only for restraint of existing DIP FM)**						
		EBAA Iron Inc	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Ford / Uni-Flange	Uni-Flange Series 1390C		Uni-Flange Series 1390C		Uni-Flange Series 1390C	
		Sigma	PV-Lok Series PWP-C		PV-Lok Series PWP-C		PV-Lok Series PWP-C	
		Smith Blair	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
		Star	StarGrip Series 3100S		StarGrip Series 3100S		StarGrip Series 3100S	
		Tyler Union	TufGrip-Series 300C		TufGrip-Series 300C		TufGrip-Series 300C	
	DIP Bell Joint Restraints (16" & Greater)	**Ductile Iron Pipe Bell Joint Restraints for Ductile Iron Pipe (16" & Greater) - All restraints shall have a split back-up ring for the bell and a serrated or wedge action gland for the spigot end. New installation for water & reclaimed water piping 16" and greater shall have restraint gaskets or locking bells.**						
		EBAA Iron Inc	Series 1100HD	Existing Only	Series 1100HD	Existing Only	Series 1100HD	Existing Only
		Sigma	Series SSLDH	Existing Only	Series SSLDH	Existing Only	Series SSLDH	Existing Only
		Star	Series 3100S	Existing Only	Series 3100S	Existing Only	Series 3100S	Existing Only

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Joint Restraints	Ductile iron pipe Bell Joint Restraint Gaskets and Locking Bell (4" & Above)	**Bell Joint Restraint Gaskets and Locking Bell (4" & Above) Stainless Steel locking wedges built into the gasket-rubber. ANSI/AWWA C111/A21.11 Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe. Ductile Iron Bell Joint Restraint for Push-On Pipe- Locking bell joint system that prevents joint separation and allows for joint deflection. Bells shall be painted red to verify restrained gasket.**						
		American	Fast Grip Gasket	Gasket	Fast Grip Gasket	Gasket	NA	NA
			Flex-Ring Joint	Bell Lock	Flex-Ring Joint	Bell Lock	NA	NA
			Lok-Ring Joint	Bell Lock	Lok-Ring Joint	Bell Lock	NA	NA
		Griffin	Talon RJ Gasket	Gasket	Talon RJ Gasket	Gasket	NA	NA
			Snap-Lok	Bell Lock	Snap-Lok	Bell Lock	NA	NA
		McWane Inc. DI Pipe Group	Sure Stop 350 Gasket	Gasket	Sure Stop 350 Gasket	Gasket	NA	NA
			Thrust-Lock	Bell Lock	Thrust-Lock	Bell Lock	NA	NA
			TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
			Super-Lock	Bell Lock	Super-Lock	Bell Lock	NA	NA
		US Pipe	Field Lok 350 Gasket	Gasket	Field Lok 350 Gasket	Gasket	NA	NA
			Field Lok Gasket	Gasket	Field Lok Gasket	Gasket	NA	NA
			TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
			HP Lok Restraint Joint	Bell Lock	HP Lok Restraint Joint	Bell Lock	NA	NA
	SS to DIP Transition Restraint	**SS to DIP Transition Restraint -Flanged stainless steel pipe from Wetwell to Valve box restrained joint transition (epoxy coated, SS hardware) Flg x PE RJ.**						
		EBAA Iron Inc	NA	NA	NA	NA	Megaflange 2100	
		Sigma	NA	NA	NA	NA	SigmaFlange with One Lock SLDE	
		Smith Blair	NA	NA	NA	NA	911 Flange - Lock Restrained FCA	
	PVC Pipe MJ Restraints	**Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated Restrain PVC pipe to mechanical joint fittings, and appurtenances.**						
		EBAA Iron Inc	Mega-lug Series 2000PV		Mega-lug Series 2000PV		Mega-lug Series 2000PV	
			NA	NA	NA	NA	Megalug Series 2200	(42"-48")
		Ford / Uni-Flange	UFR 1500 Series		UFR 1500 Series		UFR 1500 Series	
		Sigma	One Lok Series SLC/SLCE		One Lok Series SLC/SLCE		One Lok Series SLC/SLCE	
		Smith Blair	Cam Lok Series 120		Cam Lok Series 120		Cam Lok Series 120	
		Star	Star Grip Series 4000		Star Grip Series 4000		Star Grip Series 4000	
		Tyler Union	TufGrip Series TLP		TufGrip Series TLP		TufGrip Series TLP	
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	**PVC Bell Joint Restraints: PVC pipe Split Serrated on Bell End and Spigot End. (4" - 12") (New & Existing)**						
		EBAA Iron Inc	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Ford / Uni-Flange	Uni-Flange Series 1390		Uni-Flange Series 1390		Uni-Flange Series 1390	
		Sigma	PV-Lok Series PWP		PV-Lok Series PWP		PV-Lok Series PWP	
		Smith Blair	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
		Star	Series 1100C		Series 1100C		Series 1100C	
		Tyler Union	TufGrip 300C		TufGrip 300C		TufGrip 300C	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Joint Restraints	PVC Bell Joint Restraints (16" & Greater)	**PVC Bell Joint Restraints: (16" & Greater) PVC pipe Split Serrated on Bell End and Spigot End. Water & Reclaimed Water Existing pipe only. Wastewater shall be new and existing pipe.**						
		Ford / Uni-Flange	Series 1390	Existing Only	Series 1390	Existing Only	Series 1390	
		JCM	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	
		Sigma	PV-Lok PWP	Existing Only	PV-Lok PWP	Existing Only	PV-Lok PWP	
		Smith Blair	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	
		Star	Series 1100C	Existing Only	Series 1100C	Existing Only	Series 1100C	
Pipe	PVC C900 DR 18 Bell & Spigot (4" - 12")	**C900 Bell & Spigot PVC Pipe: 4 to 12-inch - AWWA C-900, Minimum DR18 for Water, Reclaimed and Wastewater. DR14 for Fire Lines. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.**						
		Certainteed 4" to 12"	Certa-Lok C900/RJ	Blue	Certa-Lok C900/RJ	Pantone Purple	Certa-Lok C900/RJ	Green
		Diamond Plastics Corp	C-900	Blue	C-900	Pantone Purple	Diamond C900	Green
		Ipex Inc	C-900 Blue Brute	Blue	C-900	Pantone Purple	C900 Blue Brute	Green
		JM Eagle	C-900	Blue	C-900	Pantone Purple	C-900	Green
		National Pipe & Plastics Inc	C-900 Dura- Blue	Blue	C-900	Pantone Purple	C-900 Pipe	Green
		North American Pipe Corp (NAPCO)	C-900	Blue	C-900	Pantone Purple	C-900	Green
		Sanderson Pipe Corp	C-900	Blue	C-900	Pantone Purple	C-900	Green
	PVC C905 DR 18 Bell & Spigot 16" and Larger	**C905 Bell & Spigot PVC Pipe 16" and Larger: AWWA C-905, Minimum DR18 for all Force Mains up to 24". Minimum DR21/DR25 for 30" and greater. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.**						
		Certainteed 16"	NA	NA	NA	NA	Certa-Lok C905/RJ	NA
		Diamond Plastics Corp	NA	NA	NA	NA	Trans-21 DR18	Green
		Ipex Inc	NA	NA	NA	NA	IPEX Centurion	Green
		JM Eagle	NA	NA	NA	NA	C905 Big Blue	Green
		National Pipe & Plastics Inc	NA	NA	NA	NA	C905	Green
		North American Pipe Corp (NAPCO)	NA	NA	NA	NA	C905 Big Blue	Green
	HDPE C906 DR11	**HDPE Pipe DR11 AWWA C906 shall be Ductile Iron Pipe Size, PE 3408/3608/4710 DIPS manufactured in accordance with ASTM F-714 and listed with NSF. Pipe shall be marked in accordance with either AWWA C901,AWWA C906. Compression type connections are not acceptable in new installations. Pipe joints shall be butt fusion or electro-fusion with flange or adapter. All HDPE shall be color coded to the Utility. Color identifications are in accordance with the APWA/ULCC Uniform Color Code. Manufacturers shall be members in good standing with PPI to maintain approval status.**						
		JM Eagle	HDPE	DR11 Blue	HDPE	DR11 Pantone	HDPE	DR11Green
		Performance Pipe(Chevron)	Driscoplex 4000	DR11 Blue	Driscoplex 4000	DR11 Pantone	Driscoplex 4300	DR11 Green
		PolyPipe, Inc.	EHMW Poly Pipe	DR11 Blue	EHMW	DR11 Pantone	EHMW	DR11Green

APPENDIX D **LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pipe	Ductile Iron Pipe	**Ductile iron/Cast iron: (4" to 12" = Class 350, 16" to 24" - Class 250, 30" to 64" = Class 200). Water and Reclaimed water shall be cement lined. Wastewater Piping shall be Protecto 401 and Holiday Free. Exterior coatings as specified. Wastewater DIP piping shall be for pump station piping only. Manufacturers shall be members in good standing with DIPRA to maintain approval status.**						
		American	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		Griffin	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		McWane Inc. DI Pipe Group	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
		US Pipe	Cement Lined	Blue	Cement Lined	Pantone Purple	Protecto 401	Pump Station
Sample	Sample Station	**Sample Stations - Bacteriological Sample Station with built in flush system, all internal piping to be 2", brass and includes lockable green enclosures.**						
		Safety-Guard	SG-BSS-05 pedestal #77	green enclosure	NA	NA	NA	NA
		Water Plus Corp	Model 5000	green	NA	NA	NA	NA
Services	Brass Service Saddles	**Brass Service Saddles for 1" & 2" water & reclaimed water services on 4" through 12" Mains - Service saddles can be hinge or bolt controlled OD saddles to be used on C-900 and existing IPS OD PVC pipe.**						
		Ford	Series S-70, S-90	4"-12"	Series S-70, S-90	4"-12"	NA	NA
		AY McDonald	Model 3891 / 3895,3801 / 3805	4"-12"	Model 3891 / 3895,3801 / 3805	4"-12"	NA	NA
		Mueller	Series S-13000/H-13000	4"-12"	Series S-13000/H-13000	4"-12"	NA	NA
	Service Saddles	**Service Saddles for 1" (CC) & 2" (Iron pipe threads) Water & Reclaimed Water services on mains greater than 12". Service saddles for 2" taps (iron pipe threads) on 4" mains and greater for Waste Water. : Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on C-900 / C905 or DI for all 1-in and -2in taps on pipes over 12in.**						
		Ford	Series FC202	16" & greater	Series FC202	16" & greater	Series FC202	4" & greater
		JCM	Series 406	16" & greater	Series 406	16" & greater	Series 406	4" & greater
		Mueller	DR2S	16" & greater	DR2S	16" & greater	DR2S	4" & greater
		Romac	Series 202NS	16" & greater	Series 202NS	16" & greater	Series 202NS	4" & greater
		Smith Blair	Series 317	16" & greater	Series 317	16" & greater	Series 317	4" & greater
	Service Saddles for HDPE	**Service Saddles for 1" (CC) & 2" (Iron Pipe threads) Water and Reclaimed Water Services: Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on HDPE for all 1-in and -2in taps. Taps to HDPE pipe shall be approved on a case by case basis.**						
		Ford	Series FCP202		Series FCP202		Series FCP202	
		Romac	Series 202N-H		Series 202N-H		Series 202N-H	
		Smith Blair	Series 317-1 for HDPE		Series 317-1 for HDPE		Series 317-1 for HDPE	
	Corporation Stops Ball Type	**Corporation Stops Ball Type (1-inch with AWWA taper C threads only/pack joint outlet for CTS) 2" Corporation Stop Ball Type shall be 2" MIP X FIP threads.**						
		Ford	FB1000, FB1700-7		FB1000, FB1700-7		FB1700-7	2" ARV
		AY McDonald	4701B-22, 3149B2		4701B-22, 3149B2		3149B2	2" ARV
		Mueller	P25008, B-20046		P25008, B-20046		B-20046	2" ARV

APPENDIX D **LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Services	Curb Stops	**Curb Stops - Straight Valves: Ball type compression 2" cts O.D. tubing by 2" FIP**						
		Ford	B41-777W		B41-777W		NA	NA
		AY McDonald	6102W-22		6102W-22		NA	NA
		Mueller	P25172		P25172		NA	NA
	Curb Stops	**Curb Stops - Straight Valves: ball type compression x compression**						
		Ford	B44-444W		B44-444W		NA	NA
		AY McDonald	6100W-22		6100W-22		NA	NA
		Mueller	P25146		P25146		NA	NA
	PE tubing	**Polyethylene tubing: AWWA C901. UV protection (SDR-9) 1-inch and 2-inch only. PE 3408 / PE 4710**						
		Charter Plastics	Blue Ice		Lav Ice		NA	NA
		Endot	Endopure Blue		Endocore Lavender		NA	NA
		JM Eagle	Pure-Core		NA	NA	NA	NA
Tapping Sleeves and Valves	Line Stops	**Line Stops**						
		JCM						
		Romac						
		Smith Blair						
	Tapping Sleeves	**Tapping Sleeves: (Mechanical joint for taps on cast iron, ductile iron, PVC & AC pipe, including size on size) with stainless steel nuts and bolts.**						
		American Flow Control	Series 2800		Series 2800		Series 2800	
			Series 1004		Series 1004		Series 1004	
		Clow	Series F-5205	DIP/PVC	Series F-5205	DIP/PVC	Series F-5205	DIP/PVC
			Series F-5207	A/C Pipe	Series F-5207	A/C Pipe	Series F-5207	A/C Pipe
		JCM	Series 414	FBE	Series 414	FBE	Series 414	FBE
		Mueller	Series H-615	DIP/PVC	Series H-615	DIP/PVC	Series H-615	DIP/PVC
			Series H-619	A/C Pipe	Series H-619	A/C Pipe	Series H-619	A/C Pipe
		Smith Blair	Style 623	FBE	Style 623	FBE	Style 623	FBE
	Tapping Valves: 12" and smaller	**Tapping Valves: 12" and smaller - Tapping Valves shall be furnished with an alignment lip and installed in the vertical position for Water and Reclaim Water. Wastewater shall be installed horizontally and abandoned in the open position. Tapping valves shall be resilient seated only and meet the requirements of AWWA C509 or C515**						
		American Flow Control	Series 2500	Alignment Lip	Series 2500	Alignment Lip	Series 2500	Alignment Lip
		Clow	Series F-6114	Alignment Lip	Series F-6114	Alignment Lip	Series F-6114	Alignment Lip
		Mueller	Series T2360 (4"-12")	Alignment Lip	Series T2360 (4"-12")	Alignment Lip	Series T2360 (4"-12")	Alignment Lip

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Tapping Sleeves and Valves	Tapping Valves: 16" and Larger	**Tapping Valves: 16" and Larger - Tapping valves shall be furnished with an alignment lip and be installed in the vertical position for Water and Reclaimed Water. No tapping valve shall be installed horizontally for Water and Reclaim Water unless approved by the engineer. Tapping Valves 16" and larger AWWA C515 resilient seated only (16" and 24" no gearing required) above 24" shall be installed vertically with a spur gear actuator unless noted by the engineer. All tapping valves above 24" shall be furnished with NPT pipe plugs for flushing the tracks when valves are installed horizontally. Tapping valves for Wastewater shall be installed horizontally and abandoned in open position.**						
		American Flow Control	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port
		Clow	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port
		Mueller	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port
Valves	Butterfly Valve 42" and Above	**Butterfly Valves 42"and above. AWWA C504. Actuators input torques based on 150 psi valve pressure and 16 fps velocity with a maximum input of 80 ft-lb on 2" nuts and shall withstand 250 ft-lbs. Valve seats shall be leak-tight in both directions at 150 psi.**						
		Clow	Style #1450		Style #1450		NA	NA
		Dezurik	BAW		BAW		NA	NA
		Mueller / Pratt	LINSEAL III / Groundhog		LINSEAL III / Groundhog		NA	NA
	Check Valves	**Valves (Check) 4-inch and Larger (8 mil epoxy lined)**						
		American Flow Control	NA		NA		Series 600 or 50 line	
		Clow / M&H / Kennedy	NA		NA		106	
		Mueller	NA		NA		Series 2600	
	Gate Valves 4" - 12"	**Gate Valves 12" and smaller - resilient seated only AWWA C509 or C515. Valve seat shall be leak-tight in both directions at 150 psi.**						
		American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100		NA	NA
		Mueller	Series A-2360		Series A-2360		NA	NA
	Gate Valves (Vertical) 16" and Up	**Gate Valves 16" and larger (Vertical Installation) AWWA C515 resilient seated only (16" and 24" no gearing required) above 24" shall be installed vertically with a gear actuator unless noted by the engineer. Valve seat shall be leak-tight in both directions at 150 psi.**						
		American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100			
		Mueller	Series A-2361		Series A-2361		NA	NA

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Valves	Plug Valves	**Plug Valves - Bi-directional, MJ & Flanged (min. 8mil fusion bonded epoxy with stainless steel bolts), gear operator to be sized for rated pressure of the valve. Valves 4"-20" shall be 80% Full Port and valves 24" and greater shall be minimum of 70% full port. Valve shall be factory tested to minimium 100 PSI in both directions.**						
		Clow	NA	NA	NA	NA	F-5412 FLG	4" & up
			NA	NA	NA	NA	F-5413 MJ	4" & up
		Dezurik	NA	NA	NA	NA	Series PEF or PEC	4"& up
		Millikan / Pratt	NA	NA	NA	NA	Eccentric / Ballcentric	4"& up
		Val-Matic	NA	NA	NA	NA	5600 or 5800 (FLG)	4" & up
			NA	NA	NA	NA	5700 or 5900 (MJ)	4" & up
Valve Boxes	Valve Boxes with Locking Lids (Cast Iron)	**Two piece standard screw type Heavy Duty Valve Boxes with Locking Lids (Cast Iron) and type of service cast in heavy duty traffic lid (H20 loading) ASTM A48**						
		Bingham/Taylor	Series 4905	Box	NA	NA	Series 4905	Box
			4905-X	Extension	NA	NA	4905-X	Extension
			4904-L	Blue Water Locking Lid	NA	NA	4904-L	Green Sewer locking Lid
		Sigma	Series VB 261X-267X	Box	VB-25031LK-VB-2612	Box	Series VB 261X-267X	Box
			VB 6302	Extension	VB-6302	Extension	VB 6302	Extension
			VB 4650W	Blue Water Locking Lid	VB2503LK	Purple Square Locking Lid	VB 4650S	Green Sewer locking Lid
		Star	Series VB-0002	Box	NA	NA	Series VB-0002	Box
			VBEX 12-24S	Extension	NA	NA	VBEX 12-24S	Extension
			VBLIDLOCK	Blue Water Locking Lid	NA	NA	VBLIDLOCK	Green Sewer locking Lid
		Tyler Union	Series 6850	Box	NA	NA	Series 6850	Box
			58, 59, 60	Extension	NA	NA	58, 59, 60	Extension
			Locking Lid	Blue Water Locking Lid	NA	NA	Locking Lid	Green Sewer locking Lid
	Valve Box	**For mains equal to, or greater than, 16" diameter or equal to greater than 6' feet deep**						
		American Flow Control	# 2A - 9A Retrofit Valve Box Insert	Fit inside std valve boxes	NA		2A - 9A Retrofit Valve Box Insert	Green Sewer locking Lid
		Mueller Company	MVB050C thru MVB130C with Extension Stem MVB875 Guide Plate	Blue Water Locking Lid	MVB050CR thru MVB130CR with Extension Stem MVB875 Guide Plate	Purple Square Locking Reclaim Lid	MVB050C thru MVB130C with Extension Stem MVB875 Guide Plate	Green Sewer locking Lid

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Coatings	Anti-Graffiti Paint	**Block Walls-Anti-Graffiti Paint per Section 3119 Coatings & Linings**						
		American Building Restoration Products	NA	NA	NA	NA	Polyshield Graffiti Preventer for Unpainted Masonry Type B	Super Bio Strip or Strip it all
		Tnemec / Chemprobe	NA	NA	NA	NA	626 DUR A PEL	680 Mark A Way
		Professional Products of Kansas, Inc	NA	NA	NA	NA	Professional Water Seal & Anti-Graffitiant (PWS-15 Super Strength)	Professional Phase II Cleaner
	Coatings for Existing Manholes	**Rehabilitation corrosion protection system per Section 3119 Coatings & Linings. Interior coating for force main connections to existing concrete manholes only. New precast structures and existing pump stations shall be lined.**						
		CCI Spectrum, Inc	NA	NA	NA	NA	Spectrashield	min of 500 mils
		Kerneos Aluminate Technologies	NA	NA	NA	NA	Sewpercoat	1" (1000mil)
		Raven Lining System	NA	NA	NA	NA	Raven 155 Primer Raven 405	min 8 mils min 125 mils
		Sauereisen	NA	NA	NA	NA	210 Series Topcoat Glaze 210G	min 125 mils min 20 mils
		Tnemec	NA	NA	NA	NA	Series 434 Topcoat Glaze 435	min 125 mils 15-20 mils
PVC Pipe and fittings	Pipe SDR 35 Gravity Mains	**PVC Pipe for Gravity SDR26/SDR 35 (Green in color) ASTM-D034. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.**						
		Certainteed	NA	NA	NA	NA	Gravity Sewer Pipe	
		Diamond Plastics Corp	NA	NA	NA	NA	Sani-21 SDR-35	
		JM Eagle	NA	NA	NA	NA	Gravity Sewer	
		National Pipe & Plastics, Inc.	NA	NA	NA	NA	Ever-Green Sewer Pipe	
		North American Pipe Corp (NAPCO)	NA	NA	NA	NA	Gravity Sewer	
		Sanderson Pipe Corp	NA	NA	NA	NA	Gravity Sewer	
	Locate Balls	**Locating Marker Systems - Wastewater Locator balls placed at all sanitary sewer cleanouts**						
		3M	NA	NA	NA	NA	3M™ EMS 4" Extended Range 5' Ball Marker 1404-XR	
	Fittings SDR 35	**Fittings, Adapters and Plugs - Gravity PVC ASTM-D3034, Min SDR26/ SDR 35**						
		GPK Products, Inc.	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		Harrington Corporation (HARCO)	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		Multi Fittings Corp.	NA	NA	NA	NA	SDR26/SDR 35 Trench Tough Sewer Fittings	
		JM Eagle	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		Plastic Trends Inc	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	
		TIGRE USA, Inc.	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
PVC Pipe a	Flexible Pipe Connectors	**Flexible Pipe Connectors and Transitions**						
		Fernco	NA	NA	NA	NA	1002, 1051, 1056 Series	
		Indiana Seal	NA	NA	NA	NA	102, 151, 156 Series	
		Mission Rubber	NA	NA	NA	NA	MR02, MR51, MR 56 Series	
Precast Concrete Structures	MH Lids	**Frame and Cover**						
		USF Fabrication Inc.	NA	NA	NA	NA	USF 225-AS	
	Adj Ring	**Top Adjusting Rings - HDPE with heavy duty loading (H-20)**						
		Ladtech, Inc	NA	NA	NA	NA	24R, 24S with Rope Sealant CS2455	
	Hatches	**Wet Well and Valve Vault Access Frames and Covers (Include the term "Confined Space" etched or cast into the cover with recessed lock & hasp. Frames and covers per manufacturers specifications.**						
		Halliday Products	NA	NA	NA	NA	S1R or S2R Series	
		USF Fabrication Inc.	NA	NA	NA	NA	APS or APD Series	
	Precast Concrete Structures	**Precast Manhole and Wetwell Structures ASTM C478. Precast concrete shall be batched with concrete dyed crystalline waterproofing admixture with corrosion protection. Concrete without admixture or without color tint /tracer shall be rejected.**						
		Allied Precast	NA	NA	NA	NA	Dyed Admix	
		Atlantic Concrete Products, Inc.	NA	NA	NA	NA	Dyed Admix	
		Delzotto Products, Inc.	NA	NA	NA	NA	Dyed Admix	
		Dura Stress Underground Inc.	NA	NA	NA	NA	Dyed Admix	
		Hanson Pipe & Product	NA	NA	NA	NA	Dyed Admix	
		Mack Concrete	NA	NA	NA	NA	Dyed Admix	
		Oldcastle Precast	NA	NA	NA	NA	Dyed Admix	
		Standard Precast Inc.	NA	NA	NA	NA	Dyed Admix	
	Concrete Admix	**Crystalline Waterproofing Concrete Admix with color dye shall be added to all concrete structures (precast and cast-in-place) to provide waterproofing and corrosion resistance. Concrete without admixture or without color tint / tracer shall be rejected. % concentration of admix with colored dye added to the mix shall be based on weight of cement.**						
		Kryton International	NA	NA	NA	NA	KIM K-301R (with red dye)	2%
		Xypex Chemical Corp	NA	NA	NA	NA	Xypex Admix C-1000Red (with red dye)	3.0 - 3.5%
	Liners	**Interior Liner for New or existing Precast Manhole and Precast Wetwell Structures per Section 3119 Coatings & Linings**						
		AFE	NA	NA	NA	NA	Fiberglass Liner	
		AGRU Liner	NA	NA	NA	NA	HDPE Liner (Min 2 mm for Manhole / Min 5 mm for Pump Station)	
		Containment Solutions Inc. (Flowtite)	NA	NA	NA	NA	Fiberglass Liner	
		GSE Studliner	NA	NA	NA	NA	HDPE Liner (Min 2 mm for Manhole / Min 5 mm for Pump Station)	
		GU Liner	NA	NA	NA	NA	Reinforced Plastic Liner	
		L & F Manufacturing	NA	NA	NA	NA	Fiberglass Liner	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Precast Concrete Structures	Heat Shrink Seal	**Heat Shrink Seal - Precast structures shall be primed with manufacturer approved primer prior to application of heat shrunk encapsulation.**						
		Canusa-CPS	NA	NA	NA	NA	Wrapid Seal with WrapidSeal Primer (Canusa G Primer)	
		Pipeline Seal & Insulator, Inc (PSI)	NA	NA	NA	NA	Riser Wrap with Polyken 1027 or 1039 primer	
	Jointing Material	**Jointing Material Min. 2" width for all products to ensure squeeze out with manufacturer approved primer.**						
		Henry Company	NA	NA	NA	NA	Ram-Nek	with Primer
		Martin Asphalt Company	NA	NA	NA	NA	Evergrip 990	with Primer
		Trelleborg Pipe Seals	NA	NA	NA	NA	NPC – Bidco C-56	with Primer
	Pipe Seals Gravity	**Resilient Connector Pipe Seals, Manhole - Gravity less than 12-inch and less than 15-ft deep**						
		Atlantic Concrete	NA	NA	NA	NA	A-Lok (cast-in-place)	
		Hail Mary Rubber	NA	NA	NA	NA	Star Seal (cast-in-place)	
		IPS	NA	NA	NA	NA	Wedge Style	
		NPC	NA	NA	NA	NA	Kor-N-Seal Model WS	
		Press seal gasket	NA	NA	NA	NA	PSX Direct Drive	
	Pipe Seals Gravity	**Cast in Place Pipe Seals, Manhole - Gravity Greater Than or Equal to 12-inch and all pipe sizes greater than 15-ft deep**						
		Atlantic Concrete	NA	NA	NA	NA	A-Lok	cast in place
		Hail Mary Rubber	NA	NA	NA	NA	Star Seal	cast in place
	FM Pipe Seals	**Modular Pipe Seals for Wet Well and Valve Box penetrations and all forcemain connections to existing and new precast concrete structures. EPDM Rubber with 316 SS Hardware**						
		CCI Pipeline Systems	NA	NA	NA	NA	Wrap-It Link WL-SS Series	
		Pipeline Seal & Insulator, Inc / Link Seal	NA	NA	NA	NA	Link-Seal S-316 Modular Seal	
		Proco Products, Inc	NA	NA	NA	NA	PenSeal ES-PS Series	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Generator	Gen	**Generator Systems, Fixed Shall be UL 2200 Certified.**						
		Caterpillar	NA	NA	NA	NA	CAT Diesel Generator Set	
		Cummins Power Generation	NA	NA	NA	NA	Diesel Generator Set	
	Fuel Tanks	**Generator Fuel Tanks. Shall be UL2085 certified.**						
		Convault	NA	NA	NA	NA	CVT-3SF or CVT-3FF	
		Phoenix	NA	NA	NA	NA	Envirovault	
	GR	**Generator Receptacle (GR)**						
		Cooper Crouse-Hinds	NA	NA	NA	NA	AR2042 (230V, 200A, 3P, 4W)	With AJA1 Angle Adaptor
		Cooper Crouse-Hinds	NA	NA	NA	NA	AR2042-S22 (460V, 200A, 3P, 4W)	With AJA1 Angle Adaptor
		Pyle National	NA	NA	NA	NA	JRE-4100 (230V, 100A, 3P, 4W)	
	ATS	**Generator Transfer Switch**						
		Russelectric	NA	NA	NA	NA	RMTD Series with model 2000 controller	NEMA 12/3R 316SS Enclosure
Odor Control Units	Biotrickling Filters	**Biotrickling filters**						
		BioAir	NA	NA	NA	NA		
		Biorem	NA	NA	NA	NA	Biosorbens BTF	
		Envirogen	NA	NA	NA	NA	BTF	
		Siemens	NA	NA	NA	NA	Zabocs BTF	
	Carbon Adsorption Units	**Carbon Adsorption Units**						
		Calgon	NA	NA	NA	NA		
		Pure Air Filtration	NA	NA	NA	NA		
		Siemens	NA	NA	NA	NA		
Pressure Gauges	Pressure Gauges	**Pressure Gauges shall have Diaphragm Seals. Oil filled.**						
		Ashcroft	NA	NA	NA	NA	10 1008SL 02L 60# 25 200SS 02T XYTSE	Gauge Diaphragm Seal
		Trerice	NA	NA	NA	NA	D83LFSS4002LA100 - Gauge M51001SSSS - Diaphragm Seal D99100 Fill and Mount Charge	
		Winter Gauges	NA	NA	NA	NA	PFQ770 0-60 PSI D70950 top D70954 Bottom	
Pumps	Pumps	**Submersible Pumps**						
		ABS	NA	NA	NA	NA		
		Flygt	NA	NA	NA	NA		

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pumps	Floats	**Float Regulator (FR) - Duplex and Triplex Pump Stations**						
		Atlantic Scientific	NA	NA	NA	NA		Roto-Float
	Radar	**Radar - Pulse Burst Radar Transmitter. Input 24 VDC and Output 4-20 mA**						
		Magnetrol	NA	NA	NA	NA		R82-520A-011
Pump Station Main Ser	Main Srvc Disconne	**Main Service Disconnect Breaker**						
		Square D	NA	NA	NA	NA		H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)
	Surge Protector Device	**Surge Protector - UL 1449, 3rd Edition listed and labeled, minimum 10 year warranty, NEMA LS-1 and IEEEC62, 41/45 tested with NEMA 4X enclosure, internal fusing, voltage and phase to match service. Rated 80,000 amps per mode for Duplex & Triplex stations and 150,000 Amperes per mode for Master Stations. All devices shall be provided with a NEMA 4X Plastic enclosure which is approved in lieu of stainless steel.**						
		Current Technology (Power & Systems	NA	NA	NA	NA		XN-80, TG-150 or CurrentGuard 150 Plus Series
		Josyln AKA (Total Protection Solutions)	NA	NA	NA	NA		TSS-ST 160 Series, ST 300 Series or JSP-300 Series
		Surge Suppressors, Inc	NA	NA	NA	NA		LSE Series or SHL Series
Sub Panel	Sub Panel	**Sub-Panel Enclosure - NEMA 12/3R Enclosure 316SS, white polyester Powder coated-finish inside and out, With 3 Point Pad lockable Handle, and Door Stop**						
		Hoffman	NA	NA	NA	NA		
		Schaefer	NA	NA	NA	NA		
		Universal enclosure systems	NA	NA	NA	NA		
Pump Station Control Panel	Control Panel	**Control Panel Supplier**						
		ECS	NA	NA	NA	NA		
		Sta-Con Inc	NA	NA	NA	NA		
	Enclosure	**Enclosure - NEMA 12/3R Enclosure 316SS, white polyester Powder coated finish inside and out, With 3 Point Pad lockable Handle, and Door Stop**						
		Hoffman	NA	NA	NA	NA		
		Schaefer	NA	NA	NA	NA		
		Universal enclosure systems	NA	NA	NA	NA		
	Mnts	**Mounting Channel for Enclosures**						
		Unistrut Stainless Steel	NA	NA	NA	NA		1" 5/8 x 1" 5/8 316 SS
	Seal-off	**Explosion-Proof Sealoff**						
		Cooper Crouse-Hinds	NA	NA	NA	NA		EYSR - 2 Inch Min.
	FL	**Flasher (FL)**						
		MPE	NA	NA	NA	NA		025-120-105
		SSAC	NA	NA	NA	NA		FS-126

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pump Station Control Panel	AL	**Alarm Light / With Base and Globe (AL)**						
		American Electric	NA	NA	NA	NA	F32552	
		Red Dot Globe Red Dot Base	NA	NA	NA	NA	VGLR-01 VA-01	
	AH	**Alarm Horn (AH)**						
		Wheelock	NA	NA	NA	NA	3IT-115-R	
	Fuse	**Fuses (F)**						
		Bussmann	NA	NA	NA	NA	FNQ-R or KTK-R	
	HOA	**Hand-Auto-Off Selector (HOA)**						
		Square D	NA	NA	NA	NA	9001-SKS43B	
	HSS	**Horn Silence Button (HSS)**						
		Square D	NA	NA	NA	NA	9001-SKR1RH5	
	Inter-lock	**Mechanical Interlock**						
		Square D	NA	NA	NA	NA	S29354	
	Breakers	**Control Panel Main Circuit Breaker (MCB) With S29450 Circuit Breaker Auxiliary Switch**						
		Square D	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
		Emergency Circuit Breaker (ECB) With S29450 Circuit Breaker Auxiliary Switch						
		Square D	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
		Motor Circuit Breaker (MB)						
		Square D	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
		Control Circuit Breaker/ GFCI Receptacle Breaker/ SCADA Breaker						
		Square D	NA	NA	NA	NA	QOU120	
	MS	**Motor Starter (MS)**						
		Square D	NA	NA	NA	NA	Type S Class 8536	
	OL	**Overload Heater(OL)**						
		Square D	NA	NA	NA	NA	Part number will vary with size needed	
	OR	**Overload Reset**						
		Square D	NA	NA	NA	NA	9066-RA1	
	Transformer	**Control Circuit Transformer (XMFR)**						
		Square D	NA	NA	NA	NA	9070TF75D23	120/24 Volt .075 KVA
		Main Circuit Transformer (MCT)						
		Square D	NA	NA	NA	NA	9070T2000D1	480/120 2KVA
	SPB	**Supplemental Protector Breaker - 3 pole, 1-amp for Phase Monitor**						
		Square D	NA	NA	NA	NA	MG24532	

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pump Station Control Panel	PM	**Phase Monitor (PM)**						
		MPE 240 V.	NA	NA	NA	NA	001-230-118-OVG5	
		MPE 480 V.	NA	NA	NA	NA	002-480-123-OVG5	
	Pump Alternator	**Pump Automatic Alternator (PAA)**						
		Diversified Duplex	NA	NA	NA	NA	ARA-120-ACA	
		Diversified Triplex	NA	NA	NA	NA	ARA-120-AME	
		MPE Duplex	NA	NA	NA	NA	008-120-13SP	
		MPE Triplex	NA	NA	NA	NA	009-120-23P	
		MPE Triplex Socket	NA	NA	NA	NA	SD-12-PC	
	Alt. Test Switch	**Alt. Test Switch**						
		Carling Technologies	NA	NA	NA	NA	6GG5E-78	
		Honeywell	NA	NA	NA	NA	2TL1-50	
	Relay	**Relay**						
		Potter Brumfield 24 Volt	NA	NA	NA	NA	KRPA-11AN-24	
		Potter Brumfield 120 Volt	NA	NA	NA	NA	KRPA-11AN-120	
		Square D 24 Volt	NA	NA	NA	NA	8501KP12P14V14	
		Square D 120Volt	NA	NA	NA	NA	8501KP12P14V20	
	Relay Base	**Relay Base**						
		IEDC 8 Pin Relay Base 600 Volt	NA	NA	NA	NA	SR2P-06	
	Duplex Receptacle / GFCI	**Duplex Receptacle/GFCI (DR) Upgraded to 20 Amp**						
		Hubbell	NA	NA	NA	NA	GFTR20BK	
		Pass & Seymour	NA	NA	NA	NA	2095TRBK	
	ETM	**Elapse Time Meter (ETM)**						
		Reddington	NA	NA	NA	NA	711-0160	
	Grounding	**Grounding System**						
		Marathon	NA	NA	NA	NA	Neutral Isolation Block 1421570	
		Panduit	NA	NA	NA	NA	Ground Lug LAM2A 1/0 - 014 -6Y	
		Square D	NA	NA	NA	NA	Ground Buss PK7GTA	
	TS	**Terminal Strip (TS)**						
		Marathon	NA	NA	NA	NA	Series 200	
		Square D	NA	NA	NA	NA	9080GR6	
	TS	**Terminal Strip End Blocks and End Clamps**						
		Square D	NA	NA	NA	NA	9080GM6B & 9080GH10	

APPENDIX D **LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS** **FEBRUARY 11, 2011**

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Pump Station Control Panel	PL	**Pilot Light (PL) 24 Volt with 1819 Bulb**						
		Dialight	NA	NA	NA	NA	803-1710	
		Lighting Components & Design	NA	NA	NA	NA	Littlelight 930507X	
	RL	**Run Indicator Light (RL) 120 Volt**						
		Dialight	NA	NA	NA	NA	803-1710	
		Lighting Components & Design	NA	NA	NA	NA	Littlelites 930507X With 120MB Bulb	
	MT	**Moisture and Temperature Failure Light (MT) 120 Volt with 120MB Bulb**						
		Dialight	NA	NA	NA	NA	803-1710	
		Lighting Components & Design	NA	NA	NA	NA	Littlelites 930507X	
Sluice	Sluice Gate	**Sluice Gate for Wet Well with Motorized Operator**						
		BNW	NA	NA	NA	NA	Model 77 - 316 SS	
		Fontaine	NA	NA	NA	NA	Model 20 - 316 SS	
VFD	VFD	**Variable Frequency Drives**						
		Square D	NA	NA	NA	NA		

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Attachment B – “Geotechnical Engineering Report, Orange County Eastern Regional Water Reclamation Facility, Centrifuge Building”
Nodarse & Associates – A Terracon Company
March 2013

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Geotechnical Engineering Report

Eastern Regional Water Reclamation Facility (EWRF)
Centrifuge Building
Orlando, Florida

January 9, 2013
Terracon Project No. H1125048

Prepared for:
AECOM
Orlando, Florida

Prepared by:
Nodarse & Associates
A Terracon Company
Winter Park, Florida

January 9, 2013

AECOM
150 N. Orange Avenue, Suite 200
Orlando, FL 32817

Attn: Mr. William D. Marshall, P.E.
P: [407] 513 8233
F: [407] 422 3866
E: bill.marshall@aecom.com

Re: Geotechnical Engineering Report
Eastern Regional Water Reclamaion Facility Centrifuge Building
Orlando, Orange County, Florida
Terracon Project Number: H1125048

Dear Mr. Marshall:

Nodarse & Associates, a Terracon Company (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal number PH1110050 dated October 19, 2011.

This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, pavements, and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Nodarse & Associates, a Terracon Company
Certificate of Authorization Number 8830

Amr M. Sallam, Ph.D., P.E.
Principal
Florida PE-67578

Jay W. Casper, P.E.
Senior Associate

Enclosures
cc: 1 – Client (PDF)
1 – File

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EXECUTIVE SUMMARY

A geotechnical investigation has been performed for the proposed Eastern Regional Water Reclamation Facility (EWRF) Centrifuge Building planned to be constructed on the south side of Alafaya Trail east of Curry Ford Road in Orlando, Orange County, Florida. Two (2) borings, designated TB-1 and TB-2, have been performed to a depth of 25 feet below the existing ground surface within the proposed building area. This report specifically addresses the recommendations for the proposed building and pavements.

Based on the information obtained from our geotechnical exploration, it appears that the site can be developed for the proposed project. The following geotechnical considerations were identified:

- The proposed building may be supported on conventional shallow foundations bearing on compacted native soil or on newly placed engineered fill.
- Assuming proper site preparation as recommended in this report, total and differential settlement should be within tolerable limits.
- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to monitor this portion of the work.
- Based upon soils encountered, traditional pavement sections can be used; however final civil design grades should consider estimated seasonal high groundwater levels.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
EWRF CENTRIFUGE
ORANGE COUNTY, FLORIDA

Terracon Project No. H1125048
January 9, 2013

1.0 INTRODUCTION

A geotechnical engineering report has been prepared for the proposed Eastern Regional Water Reclamation Facility (EWRF) Centrifuge Building which will be located on the south side of Alafaya Trail east of Curry Ford Road in Orlando, Orange County, Florida as shown on the Topographic Vicinity Map included as Exhibit A-1 in Appendix A. Two (2) soil borings, designated TB-1 and TB-2 were performed to a depth of 25 feet below the existing ground surface within the area of the proposed building. Logs of the borings along with a site location plan, geologic map and boring location plans are included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- floor slab design and construction
- pavement design and construction
- foundation design and construction

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	See Appendix A, Exhibit A-3: Boring Location Plan
Building	A new building to house the centrifuge units. The building footprint will be about 50 ft x 90 ft (including the main building as the steel entrance structure), and about 22 to 40 ft high. Two centrifuge units weighing about 5 kips each will be installed on an elevated platform. Tractor trailers will pull in under the platform and collect sludge cake which is dropped from the centrifuges. The building will have two parallel loading bays and each bay will have a truck scale.
Building construction	Structural reinforced concrete frame with metal roof joists. A steel entrance structure will be added adjacent to the main concrete building.

Item	Description
Finished floor elevation	Up to 2 feet of fill is anticipated for the proposed finished floor level of the building.
Maximum loads	Columns: 100 kips to 120 kips (provided by AECOM) Walls: 2.5 kips per linear foot (provided by AECOM) Slab: ~800 psf (according to loads provided by AECOM)
Grading	Fill – fine grading, estimated at up to approximately 1 foot.
Cut and fill slopes	3H:1V (Horizontal to Vertical) max
Pavements	Two lanes for tractor trailers to travel through centrifuge. Most probably the floor slabs of the building will serve as rigid pavement for the tractor trailers.
Stormwater management	Stormwater management is not included in the scope of this report.

2.2 Site Location and Description

Item	Description
Location	The project will be located at the existing Eastern Water Reclamation Facility for Orange County on the south side of Alafaya Trail east of Curry Ford Road in Orlando, Orange County, Florida
Existing improvements	Wastewater reclamation plant site.
Existing topography	The USGS topographic quadrangle map Oviedo SW, Florida depicts the undeveloped topography as nearly level, with native ground surface elevations ranging from about elevation +80 feet to +85 feet referencing the NGVD29.
Surface Water	The USGS topographic quadrangle map Oviedo SW, Florida does not depict any named bodies of water near the site location.

3.0 SUBSURFACE CONDITIONS

3.1 Regional Geology

The Soil Survey of Orange County, Florida, cites T. M. Scott of the Florida Geological Survey who wrote that Orange County is located in the north-central part of peninsular Florida, east and southeast of the crest of the Ocala Uplift, or the Ocala High. Two major, generalized physiographic divisions occur in Orange County. They are the Central Highlands and the Coastal Lowlands. The Central Highlands form the western one-third of the county, and the Coastal Lowlands (which include the project site) form the eastern two thirds.

Orange County is underlain by Upper Eocene limestone units of the Ocala Group. The surface of the limestone generally dips eastward from the outcrop area west of Orange County under an increasing thickness of younger materials. The sedimentary deposits immediately above the Upper Eocene limestone units are of the Hawthorn Group. The highly variable, diverse, lithologic character of the Hawthorn Group includes interbedded and interfingering sand, clayey sand, sandy clay, phosphatic sediment, dolomite, and limestone. .

Unconsolidated sand blankets the county. This sand consists of medium to fine sand and silt and does not contain clay or shell fragments. They are underlain in some areas by a shelly sand and clay, in other areas by the Hawthorn Group, and in a few scattered areas by limestone of the Eocene age. Shell beds of Miocene age through Pleistocene age occur in portions of the eastern part of the county.

3.2 General Potential for Sinkhole Development

The USGS Geological Survey map “Sinkhole Type, Development, and Distribution in Florida” prepared by the USGS in cooperation with state agencies (1985) divides Florida into four areas that have varying potentials for sinkhole development and type as follows:

- Area I. Bare or thinly covered limestone. Sinkholes are few, shallow and broad, and develop gradually. Solution Sinkholes dominate.
- Area II. Cover is 30 to 200 feet thick and consists mainly of in-cohesive and permeable sand. Sinkholes are few, shallow, of small diameter, and develop gradually. Cover-subsidence Sinkholes dominate.
- Area III. Cover is 30 to 200 feet thick and consists mainly of cohesive clayey sediments of low permeability. Sinkholes are most numerous, of varying size, and develop abruptly. Cover-collapse Sinkholes dominate.
- Area IV. Cover is more than 200 feet thick and consists of cohesive sediments interlayered with discontinuous carbonate beds. Sinkholes are very few, but several large diameter deep sinkholes occur. Cover-collapse Sinkholes dominate.

Review of the map listed above indicates the site is located in Area II. Review of the Florida Geological Survey sinkhole database indicates no reported sinkholes within three miles of the project site. It should be noted that according to the published literature and previous experience, the risk for sinkhole potential at the site general area is low. However, it is prudent to state that no special sinkhole explorations and evaluations were performed for each and every components of the project.

3.3 Soil Survey

The Soil Survey of Orange County, Florida as prepared by the United States Department of Agriculture (USDA), Soil Conservation Service (now renamed the Natural Resource Conservation Service - NRCS), identifies the soil type at the subject site as Smyrna fine sand. It should be noted that the Soil Survey is not intended as a substitute for site-specific geotechnical exploration; rather it is a useful tool in planning a project scope in that it provides information on soil types likely to be encountered. Boundaries between adjacent soil types on the Soil Survey maps are approximate (included in Appendix as Exhibit A-2). Descriptions of the mapped soil units are included in Appendix A as Exhibit A-3.

3.4 Typical Profile

Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	13.5	Fine Sand and Fine Sand with Silt (SP)/(SP-SM)	Loose
2	18.5	Fine Sand with Silt (SP-SM)	Medium Dense
3	25	Fine Sand with Silt to Silty Fine Sand (SP-SM)/(SM) (Hardpan)[1]	Dense

1. Hardpan type soils are usually cemented and require additional effort and may need special equipment to excavate, if need be.

Conditions encountered at each boring location and results of laboratory testing are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report. Descriptions of our field exploration are included as Exhibit A-5 in Appendix A. Descriptions of our laboratory testing procedures are included as Exhibit B-1 in Appendix B.

3.5 Groundwater

The boreholes were observed during drilling for the presence and level of groundwater. Groundwater was observed in both of the borings, between depths of 2½ and 4 feet below existing grade. Longer term monitoring in cased holes or piezometers, possibly installed to

greater depths than explored under this project scope, would be required to better define groundwater conditions at the site.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the boring was performed. In addition, perched water can develop within higher permeability soils (sands and sands with silt) overlying less permeable soils (Hardpan). Therefore, groundwater levels during construction or at other times in the future may be higher or lower than the levels indicated on the boring logs.

We estimate that during the normal wet season (typically June through October) with rainfall and recharge at a maximum, groundwater levels will be about 1 to 2 feet below the existing grade. Our estimates of the seasonal groundwater conditions are based on the USDA Soil Survey, available survey data, the encountered soil types, recent weather conditions, and the encountered water levels. The estimated normal seasonal high groundwater tables are included in the following table:

Boring No.	Approximate depth to encountered water table (feet)	Approximate depth to estimated normal seasonal high groundwater table (feet)
TB-1	2.5	1
TB-2	4	2

These seasonal water table estimates do not represent the temporary rise in water table that occurs immediately following a storm event, including adjacent to other stormwater management facilities. This is different from static groundwater levels in wet ponds and/or drainage canals which can affect the design water levels of new, nearby ponds. The seasonal high water table may vary from normal when affected by extreme weather changes, localized or regional flooding, karst activity, future grading, drainage improvements, or other construction that may occur on our around the site following the date of this report.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Borings encountered native sand and sands with silt. These materials are generally suitable for construction of the proposed foundations, floor slabs, and pavements following the recommended Earthwork portions of this report.

We recommend that the exposed subgrade be thoroughly evaluated after stripping of any topsoil and creation of all cut areas, but prior to the start of structural fill operations (if any). We recommend that Terracon be retained to evaluate the satisfactory preparation of the bearing material for the pavements, foundations, and floor slab subgrade soils. Subsurface conditions, as identified by the field and laboratory testing programs, have been reviewed and evaluated with respect to the proposed building plans known to us at this time.

Design and construction recommendations for foundation systems and other earth connected phases of the project are outlined below.

4.2 Earthwork

4.2.1 Site Preparation

Prior to placing any fill, all vegetation, topsoil, possible fill material and any otherwise unsuitable material should be removed from the construction areas. Wet or dry material should either be removed or moisture conditioned and re-compacted. After stripping and grubbing, the subgrade should be proof-rolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with appropriate heavy equipment to obtain a minimum compaction as defined in Section 4.2.3. Unstable soil (pumping) should be removed or moisture conditioned and compacted in place prior to placing fill.

Where fill is placed on existing slopes, we recommend that fill slopes be over filled and then cut back to develop an adequately compacted slope face. Slopes should be provided with appropriate erosion protection.

4.2.2 Material Requirements

Compacted structural fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
General [1]	SP (fines content < 5%)	All locations and elevations
	SP-SM (fines content between 5 and 12%)[2]	All locations and elevations, except strict moisture control will be required during placement, particularly during the rainy season.

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris.
2. If fines contents are greater than 12%, special design and construction procedures may be necessary.

4.2.3 Compaction Requirements-Mass Fill Areas

Item	Description
Fill Lift Thickness	12 inches or less in loose thickness when heavy compaction equipment is used in vibratory mode. Lift thickness should be decreased if static compaction is being used, typically to no more than 8 inches, and the required compaction must still be achieved. 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used.
Minimum Compaction Requirements [1]	95 percent of the material's maximum modified Proctor dry density (ASTM D 1557).
Moisture Content[2]	Within ±2 percent of optimum moisture content as determined by the Modified Proctor test, at the time of placement and compaction.
Minimum Testing Frequency	One field density test per 20,000 square feet or fraction thereof per 1-foot lift.

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

4.2.4 Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. Utility trenches are a common source of water infiltration and migration. All utility trenches that penetrate beneath the building should be backfilled with native soils to avoid creating a preferred flow path through the trenches.

4.2.5 Grading and Drainage

Final surrounding grades should be sloped away from the structure on all sides to prevent ponding of water. Gutters, downspouts, or other appropriate methods that direct water a minimum of 10 feet beyond the footprint of the proposed structures are recommended. Site grades should be set considering the estimated seasonal high groundwater presented in Section 3.4.

4.2.6 Earthwork Construction Considerations

After initial proof rolling and compaction, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should

also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction.

Trees or other vegetation whose root systems have the ability to remove excessive moisture from the subgrade and foundation soils should not be planted next to the structure. Trees and shrubbery should be kept away from the exterior edges of the foundation element a distance at least equal to 1.5 times their expected mature height.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of building floor slabs.

4.3 Foundations

In our opinion, the proposed Eastern Regional Water Reclamation Facility Centrifuge building can be supported by a shallow foundation system bearing on native soil or newly placed fill extending to native soil. Design recommendations for shallow foundations for the proposed structure are presented in the following sections.

4.3.1 Foundation Design Recommendations

Description	Columns	Wall	Slab-on-Grade/Mat
Net allowable bearing pressure [1]	2,500 psf	2,500 psf	Actual contact pressure is about 800 psf
Minimum dimensions	30 inches	24 inches	N/A
Minimum embedment below finished grade [2]	24 inches	18 inches	18 inches
Approximate total settlement [3]	About 1 inch	About 1 inch	About 1 ½ inches

Description	Columns	Wall	Slab-on-Grade/Mat
Estimated differential settlement [3]	<¾ inch between columns	<¾ inch over 40 feet	<¾ inch across the mat

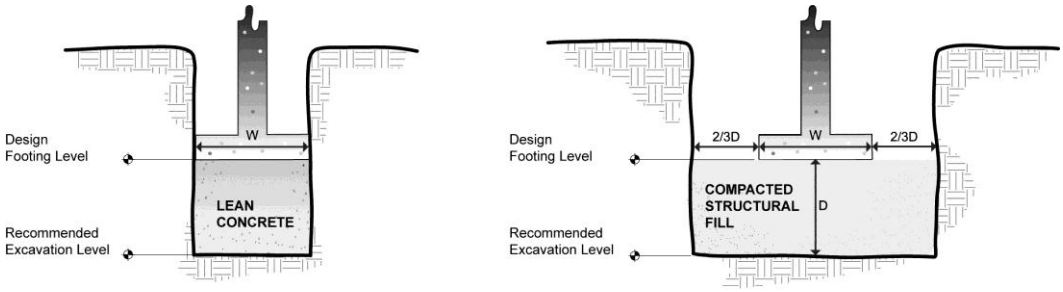
1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable fill or soft soils, if encountered, will be undercut and replaced with engineered fill.
2. For erosion protection and to reduce effects of seasonal moisture variations in subgrade soils.
3. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations.

4.3.2 Foundation Construction Considerations

The base of all foundation excavations should be free of water and loose soil and debris prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed or saturated, the affected soil should be removed or moisture conditioned and re-compacted prior to placing concrete. Place a lean concrete mud-mat over the bearing soils if the excavations must remain open over night or for an extended period of time. It is recommended that the geotechnical engineer be retained to observe and test the soil foundation bearing materials.

If unsuitable bearing soils are encountered in footing excavations, the excavations should be extended deeper to suitable soils and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. The footings could also bear on properly compacted backfill extending down to the suitable soils. Overexcavation for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation with granular material placed in lifts of 6 inches or less in loose thickness and compacted to at least 95 percent of the material's modified effort maximum dry density (ASTM D 1557). The overexcavation and backfill procedures are described in the figures below. Compaction tests should be performed at a frequency of 1 test per footing per 1-foot lift for square footings, and 1 test per 50 lineal feet per 1-foot lift for wall or continuous footings.

The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed or saturated, the affected soil should be removed prior to placing concrete. It is recommended that Terracon be retained to observe and test the soil foundation bearing materials.



NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

4.4 Seismic Considerations

Florida is under the jurisdiction of its own building code as opposed to the International Building Code. The Florida Building Code does not have a requirement or provision for evaluating seismic potential. Florida is generally regarded to be in a zone of low seismic risk. Therefore we do not consider seismic effects to be a concern at this site.

4.5 Floor Slabs

4.5.1 Floor Slab Design Recommendations

Item	Description
Floor slab support	Free draining granular material meeting the general fill specification [1]
Modulus of subgrade reaction	125 pounds per square inch per inch (psi/in) for point loading conditions
Aggregate base course/capillary break [2]	6 inches of free draining granular material
Compaction requirements	95 percent of the materials maximum Modified Proctor dry density
Minimum Testing Frequency	One field density test per 500 square feet or faction thereof.

1. We recommend subgrades be maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become desiccated prior to construction of floor slabs, the affected material should be removed or the materials scarified, moistened, and recompacted. Upon completion of grading operations in the building areas, care should be taken to maintain the recommended subgrade moisture content and density prior to construction of the building floor slabs.
2. The floor slab design should include a capillary break, comprised of free-draining, compacted, granular material, at least 6 inches thick and can be considered as part of the low volume change zone. Free-draining granular material should have less than 5 percent fines (material passing the #200 sieve).

Where appropriate, saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or any cracks that develop should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

The use of a vapor retarder should be considered beneath concrete slabs-on-grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302, ACI 360, and Florida Building Code (FBC) Section 1807 and Appendix E – Chapter 9 B-67 regarding radon for procedures and cautions regarding the use and placement of a vapor retarder. We note that FBC Section 1807 requires a minimum of 6-mil polyethylene, which is typically used in Florida. However, local requirements that might affect what moisture barrier may use should also be consulted.

4.5.2 Floor Slab Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of concrete and corrective action will be required.

We recommend the area underlying the floor slab be rough graded and then thoroughly proofrolled with a loaded tandem axle dump truck prior to final grading. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill. All floor slab subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of concrete.

4.6 Pavements

4.6.1 Subgrade Preparation

Site grading is typically accomplished relatively early in the construction phase. Fills are placed and compacted in a uniform manner. However, as construction proceeds, excavations are made into these areas, rainfall and surface water saturates some areas, heavy traffic from concrete trucks and other delivery vehicles disturbs the subgrade and many surface irregularities are filled in with loose soils to temporarily improve ride comfort. As a result, the pavement subgrades, initially prepared early in the project, should be carefully evaluated as the time for pavement construction approaches.

We recommend the moisture content and density of the top 12 inches of the subgrade be evaluated and the pavement subgrades be proofrolled and tested within two days prior to commencement of actual paving operations. Compaction tests should be performed at a frequency of 1 test per 10,000 square feet or fraction thereof. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and recompacted. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are found should be repaired by removing and replacing the materials with properly compacted fills.

After proofrolling and repairing deep subgrade deficiencies, the entire subgrade should be scarified and prepared as recommended in Section **4.2** of the **Earthwork** section this report to provide a uniform subgrade for pavement construction. Areas that appear severely desiccated following site stripping may require further undercutting and moisture conditioning. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

4.6.2 Design Considerations

Traffic patterns and anticipated loading conditions were not available at the time that this report was prepared. However, we anticipate that traffic loads will be produced primarily by tractor trailer traffic and occasional light car traffic. The thickness of pavements subjected to heavy truck traffic should be determined using expected traffic volumes, vehicle types, and vehicle loads and should be in accordance with local, city or county ordinances.

Pavement thickness can be determined using AASHTO, Asphalt Institute, PCA, and/or other methods if specific wheel loads, axle configurations, frequencies, and desired pavement life are provided. Terracon can provide thickness recommendations for pavements subjected to loads other than personal vehicle and occasional delivery and trash removal truck traffic if this information is provided. However, absent that data, we recommend the following minimum typical sections.

4.6.3 Estimates of Minimum Pavement Thickness

Typical Pavement Section (inches)						
Traffic Area	**Alternative**	**Asphalt Concrete Surface Course**	**Limerock, Soil-Cement or Crushed Concrete Base Course**	**Stabilized Subbase Course[1,2,3]**	**Portland Cement Concrete**	**Free Draining Subgrade**
Car Parking/ drive areas	PCC	--	--	--	5.0	18.0
	AC	1.5	6.0	12.0	--	--

Tractor Trailer and Truck Drive Areas	PCC	--	--	--	8.0	24.0
	AC	3	8.0	12.0	--	--

1. Often referred to as Stabilized Subgrade.
2. Use coarse granular materials such as recycled crushed concrete, shell, or gravel when seasonal high groundwater is within 4 feet of the profile grade. Clay stabilization is acceptable with deeper seasonal high groundwater.
3. Some municipalities do not require stabilized subbase beneath soil-cement base.

4.6.4 Asphalt Concrete Design Recommendations

The following items are applicable to asphalt concrete pavement sections.

- Terracon recommends a minimum separation of 12 inches for this purpose between the bottom of the base course and the seasonal high water table.
- Natural or fill subgrade soils to a depth of 18 inches below the base should be clean, free draining sands with a fines content passing a No. 200 sieve of 7 percent or less.
- Stabilized subgrade soils (also identified as stabilized subbase) should be stabilized to a minimum Limerock Bearing Ratio (LBR; Florida Method of Test Designation FM 5-515) value of 40 if they do not already meet this criterion, or modified/replaced with new compacted fill that meets the minimum LBR value. Although LBR testing has not been performed, our experience with similar soils indicates that the near surficial sands encountered in the soil borings are unlikely to meet this requirement.
- The stabilized subgrade course should be compacted to at least 98 percent of the Modified Proctor maximum dry density (AASHTO T-180 or ASTM D-1557). Any underlying, newly-placed subgrade fill need only be compacted to a minimum of 95 percent of the Modified Proctor maximum dry density. Compaction tests should be performed at a frequency of 1 test per 10,000 square feet or fraction thereof.
- Limerock base courses from an approved FDOT source should have a minimum LBR value of 100, and be compacted to a minimum of 98 percent of the maximum dry density as determined by the Modified Proctor test. Limerock should be placed in uniform lifts not to exceed 6 inches loose thickness. Recycled limerock is not a suitable substitute for virgin limerock for base courses but may be used as a granular stabilizing admixture.
- Soil cement base courses typically experience shrinkage cracking due to hydration curing of the cement. This shrinkage cracking typically propagates through the overlying asphalt course and reflects in the pavement surface. This reflective cracking is not necessarily indicative of a pavement structural failure, though it is sometimes considered to be aesthetically undesirable.
- Soil cement bases should have 7-day design strength of 300 psi. Soil cement base should be compacted to a minimum of 95 percent of the material's maximum dry density as determined by the Modified Proctor Test (AASHTO T-134). Higher design strengths may result in increased cracking.

- Crushed (recycled) concrete base should meet the current FDOT specification 204 for recycled materials.
- Asphalt should be compacted to a minimum of 95 percent of the design mix density. Asphalt surface courses should be Type SP, Type S, or other suitable mix design according to FDOT and local requirements.
- To verify thicknesses, after placement and compaction of the pavement courses, core the wearing surface to evaluate material thickness and composition at a minimum frequency of 5,000 square feet or two locations per day's production.
- Underdrains or strip drains should be considered along all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils. Underdrains will also be required below pavement if the separation between the bottom of the base course and the seasonal high groundwater table is less than 1 foot. Orange County will require soil cement on all of the project roads if underdrains are required for high groundwater conditions.
- All curbing should be full depth. Use of extruded curb sections which lie on top of asphalt surface courses can allow migration of water between the surface and base courses, leading to rippling and pavement deterioration.

4.6.5 Portland Cement Concrete Design Recommendations

The following items are applicable to rigid concrete pavement sections.

- At least 18 inches of free-draining material should be included directly beneath rigid concrete pavement. Fill meeting the requirements presented in Section 4.2 (Earthwork) of this report may be considered free-draining for this purpose. Limerock should not be considered free draining for this purpose.
- The PCC should be a minimum of 4,000 psi at 28 days. PCC pavements are recommended for trash container pads and in any other areas subjected to heavy wheel loads and/or turning traffic.
- The upper 1 foot of rigid pavement subgrade soils should be compacted to at least 98 percent of the Modified Proctor maximum dry density (AASHTO T-180 or ASTM D-1557). Compaction tests should be performed at a frequency of 1 test per 10,000 square feet or fraction thereof.
- Rigid PCC pavements will perform better than ACC in areas where short-radii turning and braking are expected (i.e. entrance/exit aprons) due to better resistance to rutting and shoving. In addition, PCC pavement will perform better in areas subject to large or sustained loads. An adequate number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI and/or AASHTO requirements. Expansion (isolation) joints must be full depth and should only be used to isolate fixed objects abutting or within the paved area.
- Adequate separation should be provided between the bottom of the concrete and the seasonal high water table. Terracon recommends that in no case should less than 1

foot of separation be provided. Based on the encountered conditions and anticipated development, we anticipate this requirement can be readily met.

- Sawcut patterns should generally be square or rectangular but nearly square, and extend to a depth equal to a quarter of the slab thickness. If the bottom of the concrete pavement is separated from the seasonal high water table by at least 1 foot, filter fabric will not be necessary beneath the expansion joints.

4.6.6 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. The subgrade and the pavement surface should have a minimum ¼ inch per foot slope to promote drainage. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the base layer.

4.6.7 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the first priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we

should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

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APPENDIX A
FIELD EXPLORATION

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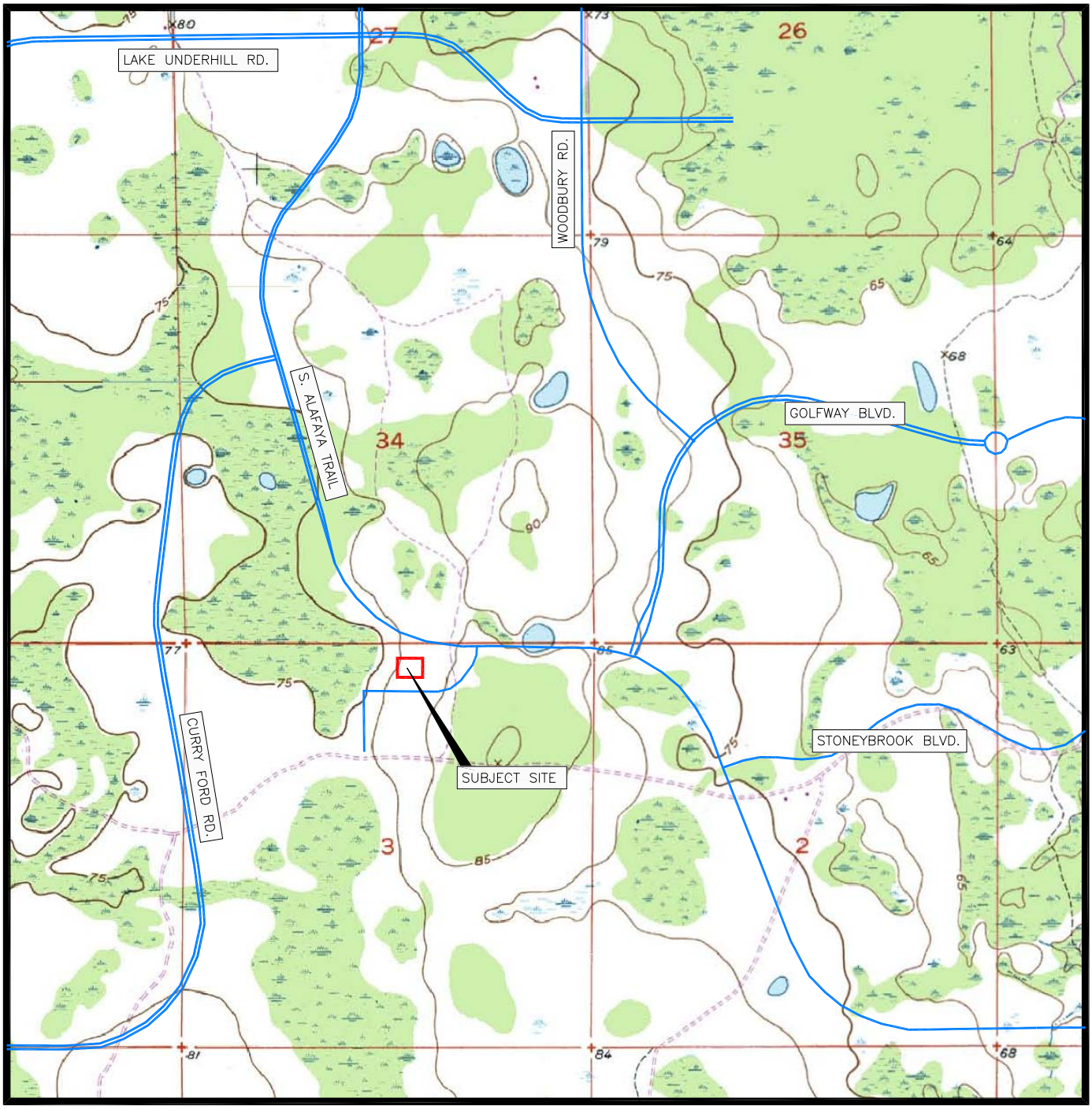

REFERENCE: U.S.G.S. "OVIEDO SW, FLORIDA" QUADRANGLE MAP ISSUED: 1953 REVISED: 1980

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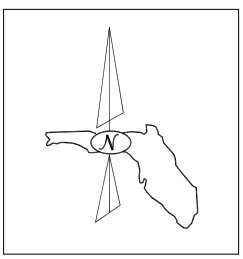
RANGE: 31 EAST
SCALE: 1" = 2000'



U.S.G.S. TOPOGRAPHIC MAP

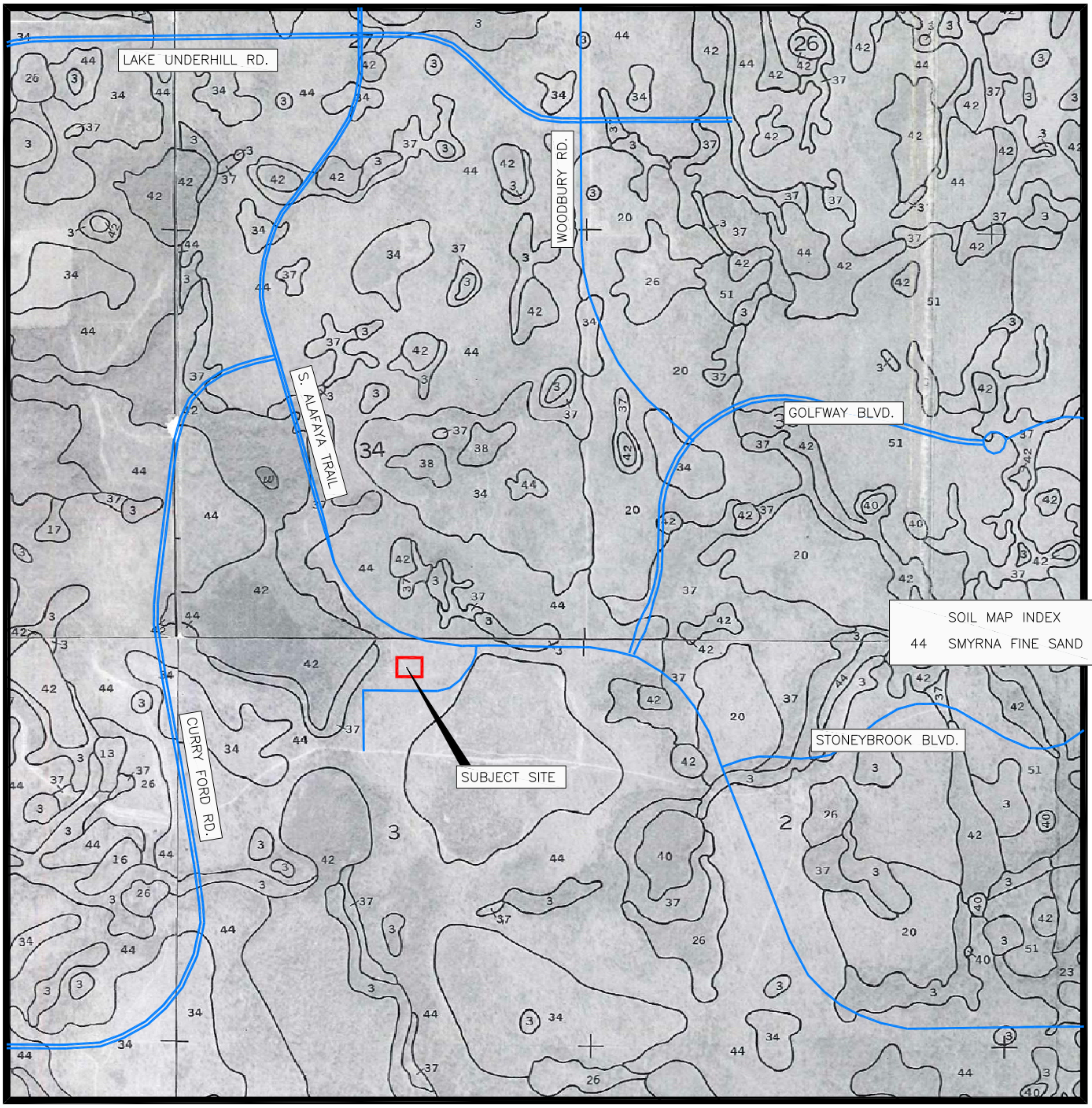
ERWRF CENTRIFUGE

EASTERN REGIONAL WATER RECLAMATION FACILITY

ORANGE COUNTY, FLORIDA

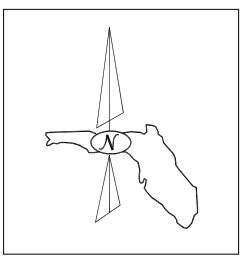
DRAWN: SW	NODARSE A Terracon COMPANY		
CHKD: AMS			
SCALE: NOTED			
DATE: 11-7-12	PROJ. No. H1 12 5048	EXHIBIT: A-1	

Nov07, 2012 - 1:45pm N:\Projects\2012\H1125048\PROJECT DOCUMENTS (Reports-Letters-Drafts to Clients)\cad\USGSmap1.dwg



REFERENCE: U.S.D.A. – S.C.S. SOIL SURVEY FOR ORANGE COUNTY, FLORIDA ISSUED: 1989

SECTION: 3
TOWNSHIP: 23 SOUTH
RANGE: 31 EAST
SCALE: 1" = 2000'



U.S.D.A. SOILS MAP

ERWRF CENTRIFUGE

EASTERN REGIONAL WATER RECLAMATION FACILITY

ORANGE COUNTY, FLORIDA

DRAWN: SW	NODARSE A Terracon COMPANY		
CHKD: AMS			
SCALE: NOTED			
DATE: 11–7–12	PROJ. No. H1 12 5048	EXHIBIT: A–2	

Nov07, 2012–1:44pm N:\Projects\2012\H1125048\PROJECT DOCUMENTS (Reports–Letters–Drafts to Clients)\cad\USDAsoils2.dwg

Soil Survey Descriptions

44 – Smyrna fine sand. This soil type is nearly level and poorly drained. It is typically found on broad flatwoods. In its natural state and during years of normal rainfall, this soil type has a seasonal high water table within 10 inches (0.8 feet) of the surface, receding to a depth of 10 to 40 inches (0.8 to 3.3 feet) for more than six months.

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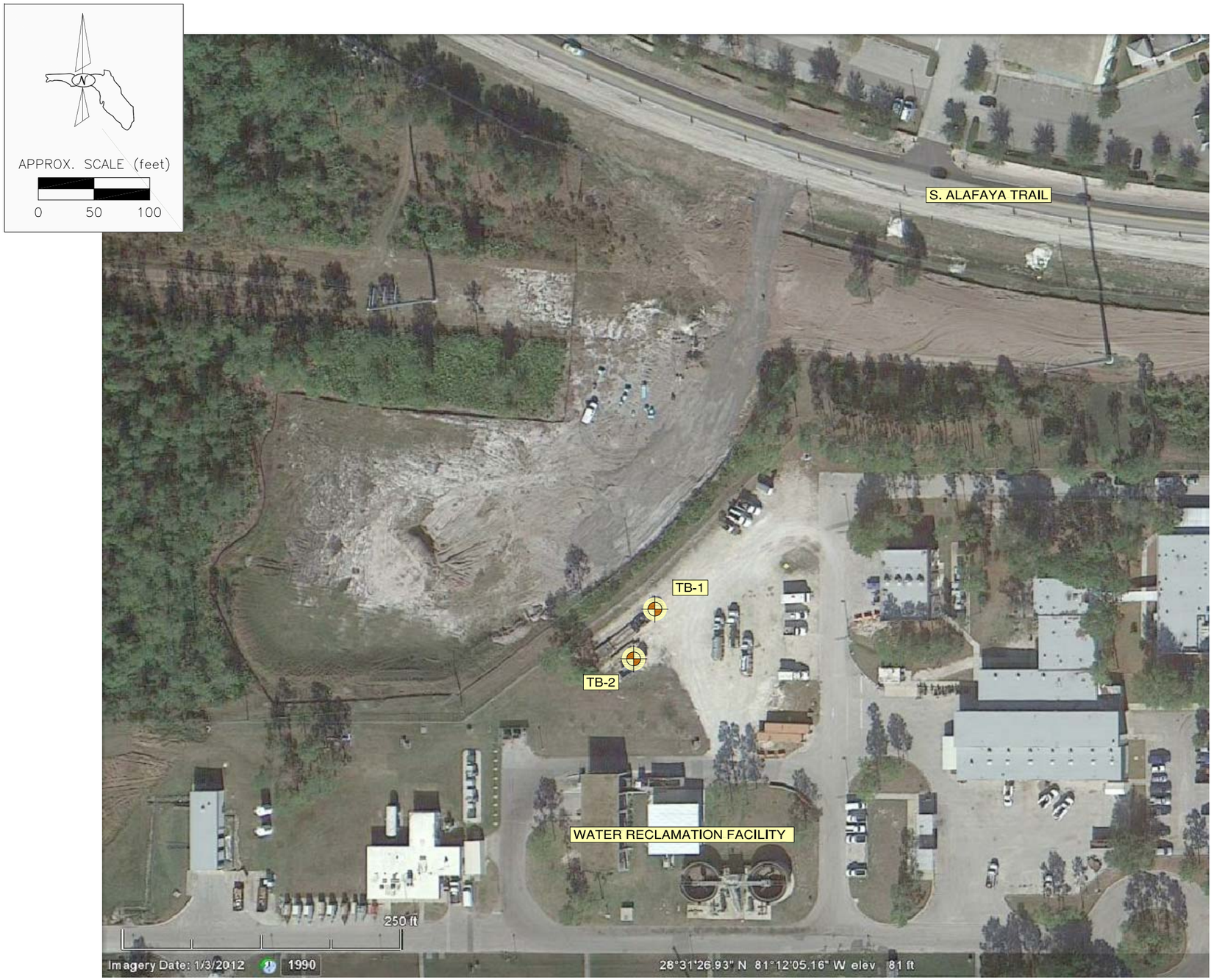

APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

BORING LOCATION PLAN
ERWRF CENTRIFUGE
EASTERN REGIONAL WATER RECLAMATION FACILITY
ORANGE COUNTY, FLORIDA

DRAWN: SW	NODARSE A Terracon COMPANY
CHKD: AMS	
SCALE: NOTED	
DATE: 11-7-12	PROJ. No. H1 12 5048
	EXHIBIT: A-4

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Field Exploration Description

The boring locations were laid out at the project site by Terracon personnel. The locations indicated on the attached diagram are approximate and were measured by pacing distances and estimating right angles, across vegetated/wooded terrain. The locations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The SPT soil borings were drilled with a mud bug mounted, rotary drilling rig equipped with an automatic safety hammer. The boreholes were advanced with a cutting head and stabilized with the use of bentonite (drillers' mud). Soil samples were obtained by the split spoon sampling procedure in general accordance with the Standard Penetration Test (SPT) procedure. In the split spoon sampling procedure, the number of blows required to advance the sampling spoon the last 12 inches of an 18-inch penetration or the middle 12 inches of a 24-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (N). This value is used to estimate the in-situ relative density of cohesionless soils and the consistency of cohesive soils. The sampling depths and penetration distance, plus the standard penetration resistance values, are shown on the boring logs.

Portions of the samples from the borings were sealed in glass jars to reduce moisture loss, and then the jars were taken to our laboratory for further observation and classification. Upon completion, the boreholes were backfilled with the site soil.

Field logs of each boring were prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation of the samples.

BORING LOG NO. TB-1

PROJECT: ERWRF Centrifuge

CLIENT: AECOM
Orlando, Florida

SITE: Alafaya Trail and Curry Ford Road
Orlando, Orange County, Florida

GRAPHIC LOG	LOCATION See Exhibit A-4 DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	PERCENT FINES
	FINE SAND (SP), brown to light brown, loose		▽				
		5			2-2-2-2 N=4		
					2-3-3-4 N=6		
		10			3-4-4-5 N=8		
	13.5						
	FINE SAND WITH SILT (SP-SM), dark brown, medium dense	15			5-6-9 N=15	19	12
	18.5						
	FINE SAND WITH SILT (HARDPAN) (SP-SM), reddish-brown, dense	20			11-14-28 N=42		
	23.5						
	FINE SAND (SP), orange and brown, dense	25			11-15-25 N=40		
	25.0						
	Boring Terminated at 25 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

WATER LEVEL OBSERVATIONS

▽ *Water Initially Observed at 2.5'*

See Exhibit A-5 for description of field procedures

See Appendix B for description of laboratory procedures and additional data, (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

NODARSE
A Terracon COMPANY
1675 Lee Road
Winter Park, Florida

Boring Started: 11/2/2012 | Boring Completed: 11/2/2012

Drill Rig: CME45 | Driller: Doug

Project No.: H1125048 | Exhibit: A-6

BORING LOG NO. TB-2

PROJECT: ERWRF Centrifuge

CLIENT: AECOM
Orlando, Florida

SITE: Alafaya Trail and Curry Ford Road
Orlando, Orange County, Florida

GRAPHIC LOG	LOCATION See Exhibit A-4 DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	PERCENT FINES
	FINE SAND (SP), with gravel, grayish-brown 2.0						
	FINE SAND WITH SILT (SP-SM), reddish-brown 4.0		▽				
	FINE SAND (SP), light brown, loose	5			3-2-3-2 N=5		
					2-3-3-3 N=6	25	5
					3-3-5-6 N=8		
		10					
	13.5						
	FINE SAND WITH SILT (SP-SM), dark brown, medium dense				9-7-8 N=15		
		15					
	18.5						
	FINE SAND WITH SILT (HARDPAN) (SP-SM), reddish-brown, dense				13-12-22 N=34		
		20					
					13-20-23 N=43		
	25.0	25					
	Boring Terminated at 25 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

WATER LEVEL OBSERVATIONS

▽ *Water Initially Observed at 4.0'*

See Exhibit A-5 for description of field procedures

See Appendix B for description of laboratory procedures and additional data, (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

NODARSE
A Terracon COMPANY
1675 Lee Road
Winter Park, Florida

Boring Started: 11/2/2012	Boring Completed: 11/2/2012
Drill Rig: CME45	Driller: Doug
Project No.: H1125048	Exhibit: A-7

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APPENDIX B – LABORATORY TESTING

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Laboratory Testing

During the field exploration, a portion of each recovered sample was sealed in a glass jar and transported to our laboratory for further visual observation and laboratory testing. Selected samples retrieved from the borings were tested for moisture (water) content and fines content (soil passing a US standard #200 sieve. Those results are included in this report and on the respective boring logs. The visual-manual classifications were modified as appropriate based upon the laboratory testing results.

The soil samples were classified in general accordance with the appended General Notes and the Unified Soil Classification System based on the material's texture and plasticity. The estimated group symbol for the Unified Soil Classification System is shown on the boring logs and a brief description of the Unified Soil Classification System is included in Appendix B. The results of our laboratory testing are presented in the Laboratory Test Results section of this report and on the corresponding borings logs.

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APPENDIX C
SUPPORTING DOCUMENTS

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GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING


Auger


Split Spoon


Shelby Tube


Macro Core


Ring Sampler


Rock Core


Grab Sample


No Recovery

WATER LEVEL


Water Initially Encountered


Water Level After a Specified Period of Time


Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K,L,M,N] / Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K,L,M,P] / Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.